



**Sandia
National
Laboratories**

Fiscal Year 2023 Site Sustainability Plan



Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

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Acronyms and Abbreviations

Acronym	Definition
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
B20	biodiesel (20 percent biobased, 80 percent petroleum)
C&D	construction and demolition
CHAMP	Chiller Asset Management Program
COVID-19	Coronavirus Disease 2019
DOE	United States Department of Energy
E85	ethanol-based fuel (85 percent ethanol, 15 percent unleaded)
ECM	energy conservation measure
EISA	Energy Independence and Security Act
EPA	United States Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
ERICA	Energy Resilient Infrastructure and Climate Adaptation
ES&H	Environment, Safety and Health
ESPC	energy savings performance contract
FY	fiscal year
GHG	greenhouse gas
GSA	U.S. General Services Administration
GVWR	gross vehicle weight rating
HERMES	High-Energy Radiation Megavolt Electron Source
HVAC	heating, ventilation, and air conditioning
ISO	International Organization for Standardization
IT	information technology
KAFB	Kirtland Air Force Base
LED	light-emitting diode
LEED	Leadership in Energy and Environmental Design
LLNL	Lawrence Livermore National Laboratory
N/A	not applicable
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NTESS	National Technology & Engineering Solutions of Sandia, LLC
PSEL	Photovoltaic System Evaluation Laboratory
RAMP	Roof Asset Management Program
Sandia	Sandia National Laboratories

Acronym	Definition
SF6	sulfur hexafluoride
SFO	Sandia Field Office
SNL	Sandia National Laboratories
SNL/CA	Sandia National Laboratories, California
SNL/KTF	Sandia National Laboratories, Kauai Test Facility
SNL/NM	Sandia National Laboratories, New Mexico
SNL/TTR	Sandia National Laboratories, Tonopah Test Range
SPHINX	Short Pulse Nano Second X-radiator
SSP	Site Sustainability Plan
U.S.	United States

Units of Measure

Acronym	Definition
°F	degrees Fahrenheit
%	percent
AC	alternating current
Btu	British thermal unit
DC	direct current
ft	foot
gal	gallon
GGE	gasoline gallon equivalent
GSF	gross square feet
kWh	kilowatt-hour
mg	milligram
MMBtu	millions of British thermal units
mt	metric ton
mtCO ₂ e	metric tons of carbon dioxide equivalent
MW	megawatt
MWh	megawatt hour

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Executive Summary

DOE O 436.1, *Departmental Sustainability*, requires each United States Department of Energy (DOE) site to develop and commit to implementing an annual site sustainability plan that identifies that site's contributions toward meeting DOE sustainability goals.

The Sandia National Laboratories site sustainability plan and its associated DOE Sustainability Dashboard data entries encompass Sandia National Laboratories contributions toward meeting the DOE sustainability goals. This site sustainability plan fulfills the contractual requirement for National Technology & Engineering Solutions of Sandia, LLC, the management and operating contractor for Sandia National Laboratories, to deliver an annual sustainability plan to the DOE National Nuclear Security Administration Sandia Field Office.

This site sustainability plan also serves as the deliverable to address the following DOE reporting requirements:

- DOE Annual Energy Report, as required by the National Energy Conservation Policy Act, Energy Policy Act of 2005, and Energy Independence and Security Act of 2007.
- Section 432 of Energy Independence and Security Act 2007, which requires reporting of energy and water conservation measures that are identified in site audits.

This site sustainability plan presents information on site sustainability performance status and projected performance for the following:

- Energy management
- Water management
- Waste management
- Fleet management
- Clean and renewable energy

- Sustainable buildings
- Acquisitions and procurement
- Efficiency and conservation measure investments
- Indirect emissions
- Fugitives and refrigerants
- Electronic stewardship and data centers
- Adaptation and resilience

1.0 Introduction

1.1 Site Information, Description, and Operations

SNL personnel conduct mission activities at four primary locations: Sandia National Laboratories, New Mexico (SNL/NM); SNL/California (SNL/CA); SNL/Tonopah Test Range (SNL/TTR) in Nevada; and SNL/Kauai Test Facility (SNL/KTF) in Hawaii. Mission activities are also conducted at other locations, including Carlsbad, New Mexico, and Amarillo, Texas. Each location has unique energy, water, and transportation fuel resource management challenges. SNL/NM and SNL/CA account for most of the total energy, water, transportation fuel use, and building square footage. Therefore, although the goals and targets of this plan include all locations, sustainability activities focus predominantly on the SNL/NM and SNL/CA locations.

1.1.1 Sandia National Laboratories, New Mexico

SNL/NM is located on Kirtland Air Force Base (KAFB) at the base of the Manzano Mountains, adjacent to Albuquerque, New Mexico. The location has approximately 6.54 million gross square feet (GSF) of existing facilities on 11,325 acres. SNL purchases electricity, natural gas, and water from external utility suppliers through an interagency support agreement with KAFB. The sanitary sewer connects to the City of Albuquerque system. Liquid petroleum gas and fuel oil are purchased independently from KAFB.

1.1.2 Sandia National Laboratories, California

SNL/CA is located 3 miles east of downtown Livermore and 40 miles east of San Francisco, California. The location has approximately 905,363 GSF of existing facilities on 410 acres. It is adjacent to Lawrence Livermore National Laboratory (LLNL), with residential areas to the west, industrial parks to the north, and agricultural lands to the east and south. Electricity, natural gas, sewer, and water are metered and billed by LLNL, which has contracts with outside agencies and municipalities. The sanitary sewer connects to the City of Livermore system after

passing through the LLNL sewer system. SNL/CA maintains a separate Wastewater Discharge permit with the City of Livermore.

1.1.3 Sandia National Laboratories, Tonopah Test Range

The Tonopah Test Range is a full-scale test range and outdoor laboratory located north of Las Vegas, Nevada, on Nellis Air Force Base. A land use permit between the NNSA and the U.S. Air Force is for the nonexclusive use, operation, and occupancy of an approximately 5.5-square-mile portion of the Nevada Test and Training Range at Nellis Air Force Base. The location is used to develop, validate, and certify NNSA-designed weapon systems and components. Electricity, liquid petroleum gas, sewer, and water are metered and billed independently of Nellis Air Force Base.

1.1.4 Sandia National Laboratories, Kauai Test Facility

SNL/KTF is a rocket-launch range at the north end of the Pacific Missile Range Facility on the island of Kauai. The range consists mainly of rocket- and payload-assembly facilities and a launch operations facility. The location has approximately 49,059 GSF of existing facilities on 133 acres.

1.2 Sustainability Definition and Environmental Responsibility

SNL leadership seek to achieve innovative, large-scale institutional transformation toward a sustainable, carbon-neutral environment while increasing mission effectiveness, resource reliability, and resource security. Long-term management aimed at preserving and enhancing the quality of the environment has evolved at SNL sites for more than 50 years. Establishing community environmental partnerships, incorporating sustainable design in new and renovated facilities, increasing energy and water efficiency, and improving environmental restoration are all integral parts of SNL environmental stewardship.

For SNL, sustainability means making balanced environmental, social, and economic decisions about developing, operating, and maintaining its sites to meet the human and mission needs of the present without compromising future generations. NTESS

recognizes that SNL is part of a larger community; the impacts of sustainable development on SNL sites extend beyond the physical boundaries. To that end, SNL is actively engaged in finding and implementing innovative sustainable solutions for its sites and the nation.

1.3 Best Management Practices

The following best management practices will continue to be implemented to achieve SNL goals:

- Use every opportunity to improve resource effectiveness for projects, operations, and activities, and implement sustainable options.
- Pursue non-carbon-emitting renewable energy sources as they become more cost-effective.
- Support research and development efforts by using SNL locations as test beds for new alternative and renewable technologies.
- Learn from and share best management practices with other institutions; incorporate innovative resource management techniques.
- Integrate efficient and sustainable resource strategies into all planning, building location, design, construction, operations, infrastructure, and Environment, Safety, and Health (ES&H) activities.
- Enable and encourage the workforce to reduce resource use and waste generation to meet the corporate goal of Zero Waste by 2025.
- Use the ISO 14001:2015, *Environmental Management Systems*, aspects and impacts evaluation process to facilitate identification of objectives relevant to energy, water, and materials sustainability measures, activities, and actions.

1.4 Mission Change

SNL personnel develop advanced technologies to ensure global peace. This strategic direction will continue to be advanced over the next two to three decades. Given the increasing rapidity of global events, such a long-range view is essential in

order to avoid technological surprises and ensure that the United States is prepared to meet future threats.

For the foreseeable future, the national demands for SNL technologies and services are expected to be high. Since 2009, the workforce has increased by over 5,000 persons to meet national demands.

Effectively managing future demand is critical if SNL is to meet its goals. Should the mission grow or change over the planning period, there is likely to be associated growth in energy and water use. Planning for mission change before it occurs and managing change during program implementation will increase the probability of sustainability success.

2.0 Site Sustainability Performance Status and Projected Performance

Table 2-1 summarizes performance status and projected performance across SNL sites in support of DOE goals.

Table 2-1. Performance status and projected performance

Prior DOE Goal	Current Performance Status	Planned Actions and Contributions	Overall Risk of Nonattainment
Energy Management			
Reduce energy use intensity (Btu per gross square foot) in goal-subject buildings.	<ul style="list-style-type: none"> Investments in ECMs Energy audits Monitoring-based commissioning Implemented asset management programs 	<ul style="list-style-type: none"> Pursue ESPC Continue energy audits Continue monitoring-based commissioning Continue asset management program 	High risk: Financial
EISA Section 432 continuous (4-year cycle) energy and water evaluations.	<ul style="list-style-type: none"> Energy audits All metered and covered facilities benchmarked using Energy Star Portfolio Manager 	<ul style="list-style-type: none"> Continue energy audits Continue to use Energy Star Portfolio Manager to benchmark covered facilities 	Low risk: Audits have secure funding through FY 2023. All required (metered) buildings have been and will continue to be benchmarked.
Meter all individual buildings for electricity, natural gas, steam, and water, where cost-effective and appropriate.	<ul style="list-style-type: none"> Completed metering security plan Tagged meters for maintenance management system entry Replaced meters as funding allowed 	<ul style="list-style-type: none"> Advocate for large-scale metering upgrade 	High risk: Financial. A funding source has not been identified for a large-scale replacement project.
Water Management			
Reduce potable water use intensity (Gal per gross square foot).	In FY 2022, potable water intensity was down 36.2% relative to the 2007 baseline. However, potable water intensity increased by 5.1 % relative to FY 2021.	<ul style="list-style-type: none"> Continue efforts to conserve water 	Low risk
Reduce non-potable freshwater consumption (Gal) for industrial, landscaping, and agricultural.	N/A	N/A	N/A
Waste Management			
Reduce non-hazardous solid waste sent to treatment and disposal facilities.	<ul style="list-style-type: none"> Reduced nonhazardous solid waste sent to the landfill <p>The FY 2022 diversion rate was 64.4%.</p>	<ul style="list-style-type: none"> Continue to pursue recycling and reuse activities 	Low risk

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Prior DOE Goal	Current Performance Status	Planned Actions and Contributions	Overall Risk of Nonattainment
Reduce construction and demolition materials and debris sent to treatment and disposal facilities.	The FY 2022 diversion rate was 33%.	<ul style="list-style-type: none"> Continue to pursue opportunities to increase diversion of construction and demolition waste from the landfill 	Low risk
Fleet Management			
Reduce petroleum consumption.	In FY 2021 the use of petroleum was up by 15.8% relative to the 2005 baseline, but use decreased slightly relative to 2021 (234,669 GGE from 273,557 GGE in 2020).	<ul style="list-style-type: none"> Maintain motor vehicle and electric cart loan pools to reduce the number of vehicles assigned to individual organization 	High risk: management
Increase alternative fuel consumption.	In FY 2021 the use of alternative fuel was down 35.1% relative to the FY 2005 baseline, but use increased slightly relative to FY 2020 (30,335 GGE from 29,789 GGE in 2020).	<ul style="list-style-type: none"> Continue to promote the use of E85 fuel in 2023 	High risk: management
Acquire alternative fuel and electric vehicles.	<ul style="list-style-type: none"> Developed zero-emission vehicle plans for both SNL/NM and SNL/CA <p>In FY 2021, 82% of all vehicle acquisitions were alternative fuel vehicle models.</p>	<ul style="list-style-type: none"> Continue to order alternative fuel vehicle models from GSA when available Request funding to support installation of electric vehicle charging infrastructure through FY 2024 	Medium risk: financial, supply chain, and technical
Clean and Renewable Energy			
Increase consumption of clean and renewable electric energy.	<ul style="list-style-type: none"> Partnered with the SNL research and development community to determine the best renewable energy solutions for SNL 	<ul style="list-style-type: none"> Study specific design solutions and advocate for funding 	Medium risk: financial
Increase consumption of clean and renewable non-electric thermal energy.	<ul style="list-style-type: none"> Partnered with NNSA to work on a new electrical contract. Also working with the SNL research and development community to determine the best renewable energy solutions for SNL 	<ul style="list-style-type: none"> Implement new utility contracts Study specific design solutions and advocate for funding 	Medium risk: financial

Prior DOE Goal	Current Performance Status	Planned Actions and Contributions	Overall Risk of Nonattainment
Sustainable Buildings			
<p>Increase the number of owned buildings that are compliant with the <i>Guiding Principles for Sustainable Buildings</i>.</p>	<ul style="list-style-type: none"> Improved the SNL design manual Designed and constructed three new LEED Gold buildings 	<ul style="list-style-type: none"> Update sustainable design guidelines to incorporate net zero emission requirements 	<p>Medium risk: Bringing existing buildings into compliance is difficult due to challenges with retrofitting or upgrading old systems (technical risk), challenges in enforcing energy and other policies across multiple departments (management risk), and availability of funding to keep up with identified energy conservation measures (financial risk).</p>
Acquisition and Procurement			
<p>Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring all sustainability clauses are included as appropriate.</p>	<ul style="list-style-type: none"> Added sustainable acquisition reporting requirements into the request for information/request for quote process Created rules in Oracle to add the updated 350APR clause into applicable contract categories Completed modifications to the ecomedes tool, conducted user testing and feedback, and launched the tool Provided subcontractors with a user's guide, training, and a video tutorial on the new reporting mechanism 	<ul style="list-style-type: none"> Continue using the ecomedes application and collect reports from all subcontractors that have sustainable acquisition requirements in their contracts with SNL 	<p>Medium risk: management. Need more management support and guidance to increase subcontractor compliance. It would be useful to write and implement a corporate policy pertaining to sustainable acquisition purchasing and reporting requirements.</p>
Efficiency and Conservation Measure Investments			
<p>Implement life cycle cost-effective efficiency and conservation measures with appropriated funds and/or performance contracts.</p>	<ul style="list-style-type: none"> Identified ECMs through energy audits Identifying low- and no-cost ECMs through monitoring-based commissioning Used measurement and verification best practices to quantify energy, cost savings, and payback Used direct and indirect funds to finance ECMs 	<ul style="list-style-type: none"> Pursue ESPC Identify ECMs through energy audits Identify low- and no-cost ECMs through monitoring-based commissioning Use measurement and verification best practices to quantify energy, cost savings, and payback Use direct and indirect funds to finance ECMs 	<p>Medium risk: financial</p>

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Prior DOE Goal	Current Performance Status	Planned Actions and Contributions	Overall Risk of Nonattainment
Electronic Stewardship and Data Centers			
Electronics stewardship from acquisition, operations, to end of life.	<ul style="list-style-type: none"> Managed electronics stewardship with 95.5% for acquisition, 100% for operations, and 100% for end-of-life 	<ul style="list-style-type: none"> Continue to pursue improvements to this goal 	Low risk
Increase energy and water efficiency in high-performance computing and data centers.	<ul style="list-style-type: none"> Measure power usage effectiveness using Nlyte Energy Optimizer Monitor all power distribution and cooling equipment in the data center and in supporting buildings <p>The power usage effectiveness for Building 725E has been significantly reduced from 1.06 to 1.07.</p>	The power usage effectiveness of Building 725E is expected to reduce to 1.05 during FY 2023 due to additional energy-efficient high-performance computing machines. Water usage effectiveness and energy required for energy are not currently implemented. Water usage effectiveness will be implemented in the future; there is a project to install the meters necessary for this calculation. Once the water temperature is high enough for reuse, energy required for energy will be implemented.	Low risk
Adaptation and Resilience			
Implement climate adaptation and resilience measures.	<ul style="list-style-type: none"> Completed a vulnerability assessment and resilience plan 	<ul style="list-style-type: none"> Monitor and identify resilience solutions 	High risk: financial
Multiple Categories			
Reduce Scope 1 & 2 greenhouse gas emissions.	Reduced Scope 1 and Scope 2 GHG emissions relative to FY 2021. This reduction does not include fleet vehicle emissions data.	Continue to improve management of SF6 and facility energy consumption.	High risk: management
Reduce Scope 3 greenhouse gas emissions.	Maintained a telecommute/remote work posture for at least 30% of the workforce. Reduced Scope 3 GHG emissions from commuting by 26% relative to FY 2021. Increased overall Scope 3 greenhouse gas emissions by 6.3% relative to FY 2021.	Continue supporting full-time and part-time telecommuting post COVID-19 as much as is feasible	Medium risk: management

E85 = ethanol-based fuel (85 percent ethanol, 15 percent unleaded)

ECM = energy conservation measure

ESPC = energy savings performance contract

FY = fiscal year

GSA = U.S. Government Services Administration

Guiding Principles = *Guiding Principles for Sustainable Federal Buildings and Associated Instructions*

LEED = Leadership in Engineering and Environmental Design

N/A = not applicable

3.0 Energy Management

Energy management focuses on all energy-related topics, such as energy intensity, EISA Section 432 benchmarking, facility metering, and non-fleet fuel use.

3.1 Energy Usage and Intensity

3.1.1 Performance Status

Energy intensity is measured and reported for goal subject buildings and for total buildings at the SNL/NM, SNL/CA, and SNL/TTR sites as one combined performance measurement. The measurement for total buildings includes all goal subject and excluded buildings.

Historically, energy data for SNL/KTF has not been reported. In fiscal year (FY) 2021, SNL personnel identified energy consumption data for the site; however, baseline energy consumption data is not yet available. Thus the energy consumption data for that site is not reported in the DOE Sustainability Dashboard for this fiscal year. SNL personnel will continue the search for baseline data to ensure complete and accurate records.

In FY 2022, the energy use intensity calculation was updated to consider the square footage of buildings as reported in the official Facilities Information Management System Real Property Database. Therefore, the numbers are different from previous versions of the SSP report. This update is part of an internal data quality improvement effort, and it is necessary so the numbers used for gross square footage are traceable and replicable.

In FY 2022, the goal subject building energy intensity was approximately 135,675 Btu per square foot per year. Goal subject building energy intensity was 5 percent greater in FY 2022 than the FY 2015 baseline, and 3 percent greater than in FY 2021.

In FY 2022, the total building energy intensity was approximately 186,808 Btu per square foot per year. The total building measurement includes both goal subject and

excluded buildings. Total building energy intensity was 5 percent greater in FY 2022 than the FY 2015 and 2 percent greater than in FY 2021.

Figure 3-1 shows total and goal subject building energy intensity for FY 2015 through FY 2022.

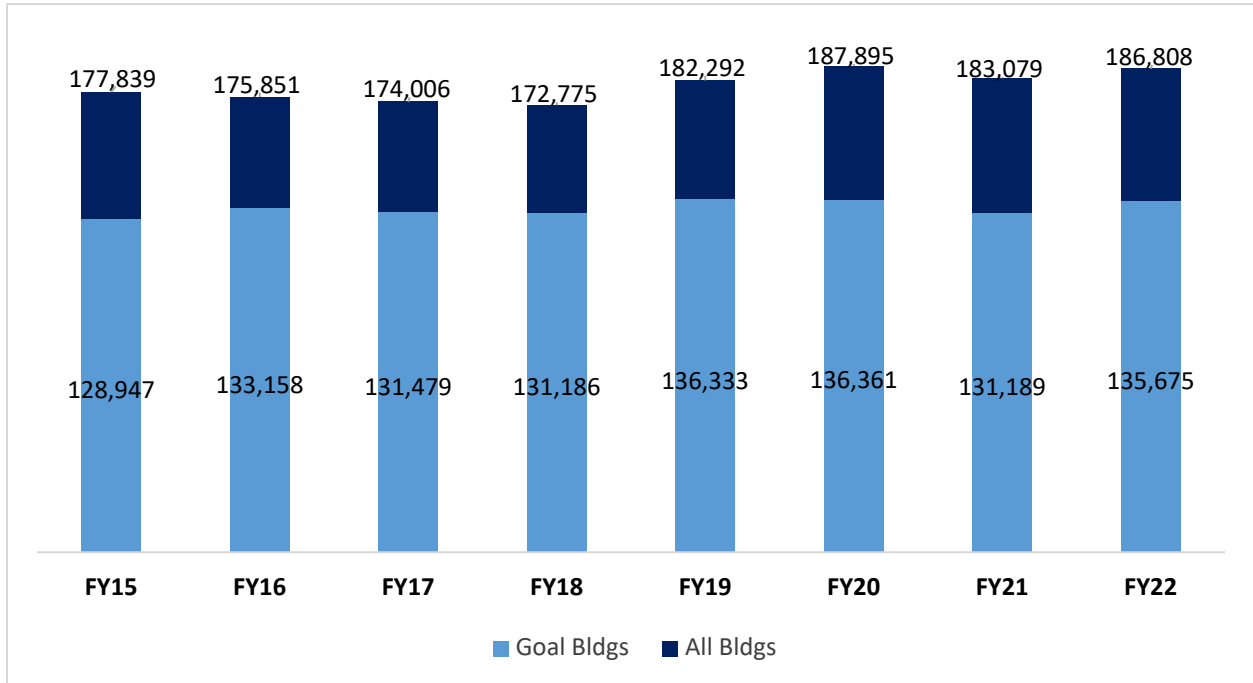


Figure 3-1. Total and goal subject building energy intensity for SNL/NM, SNL/CA, and SNL/TTR (Btu/GSF), FY 2015–FY 2022

Figure 3-2 shows total energy usage for SNL/CA, SNL/NM, and SNL/TTR by site.

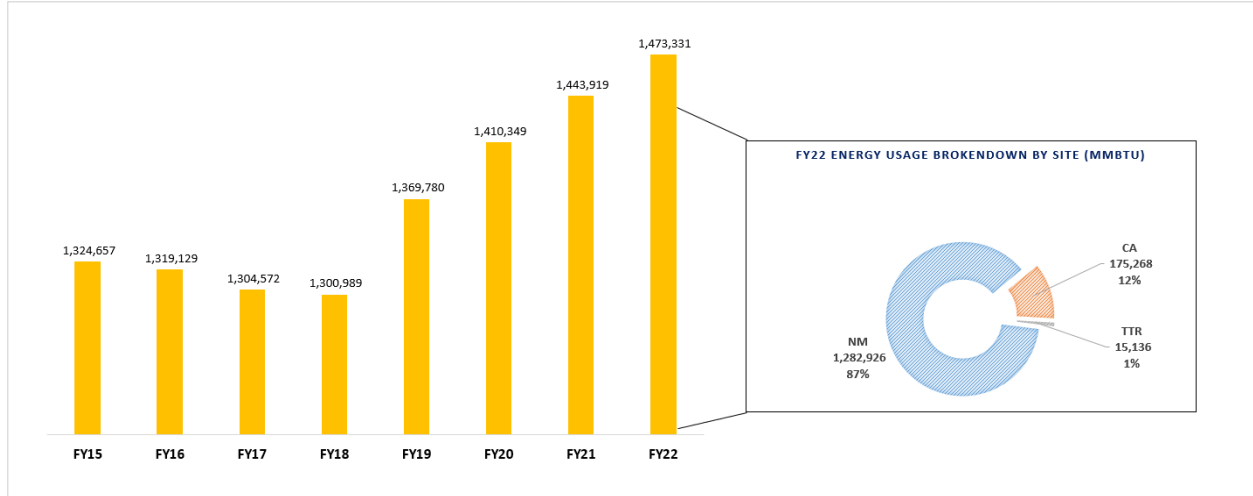


Figure 3-2. Energy usage for SNL/CA, SNL/NM, and SNL/TTR (Btu/GSF), FY2015–FY 2022

The slightly warmer weather in New Mexico (this site accounts for more than 85 percent of the total energy usage across all SNL sites) may be responsible for this increase. The total number of cooling degree days for New Mexico in FY 2022 was 1 percent higher than in FY 2021 (see Figure 3-3), which indicates that more cooling energy (i.e., electricity) was needed to meet building occupants’ thermal comfort required levels.

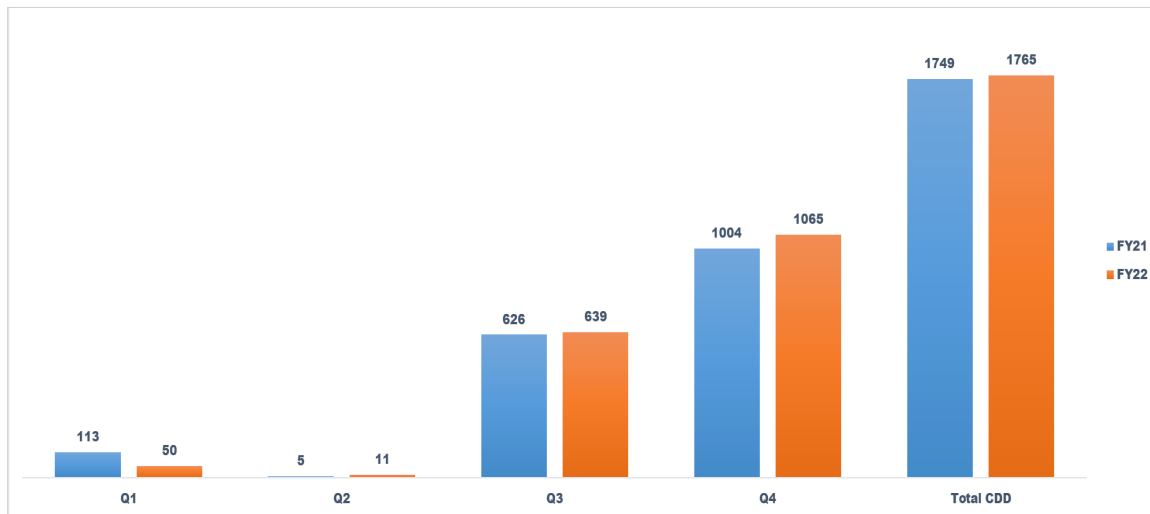


Figure 3-3. Cooling degree days for New Mexico, FY 2021 and FY 2022

SNL personnel continue to pursue initiatives, projects, and actions to increase energy savings in FY 2022 and beyond.

An initiative in FY 2021 for goal subject buildings was to develop Smart Labs pilot projects for one lab building at SNL/NM and a second lab building at SNL/CA. Smart Labs projects use a risk-based approach for managing ventilation air flow rates, improving ventilation effectiveness, increasing safety, and improving energy efficiency in labs. A lab ventilation risk assessment and a demand ventilation assessment were completed for the project at SNL/NM, identifying performance improvement measures. Smart Labs projects have the potential to save a significant amount of energy.

In FY 2022, energy audits identified 126 energy conservation measures (ECMs) for 17 high energy intensity buildings at SNL/NM. If funded, these ECMs have the potential to reduce energy and water usage significantly. In FY 2023, the energy and water savings expected from these ECMs will be estimated to help prioritize projects. In FY 2022, a building energy savings calculation tool was developed to streamline this process and will help quantify energy and cost savings. The tool is currently being piloted at SNL/NM. One hundred and twenty-nine ECMs were identified at SNL/NM facilities. Forty percent of the total ECMs involve building envelope modifications, such as windows, insulation, and roof replacements. Heating, ventilation, and air conditioning (HVAC) upgrades account for 13 percent of the total, while lighting upgrades represent 9 percent of the total identified ECMs. [Figure 3-4](#) show the ECMs type by percentage of the total.

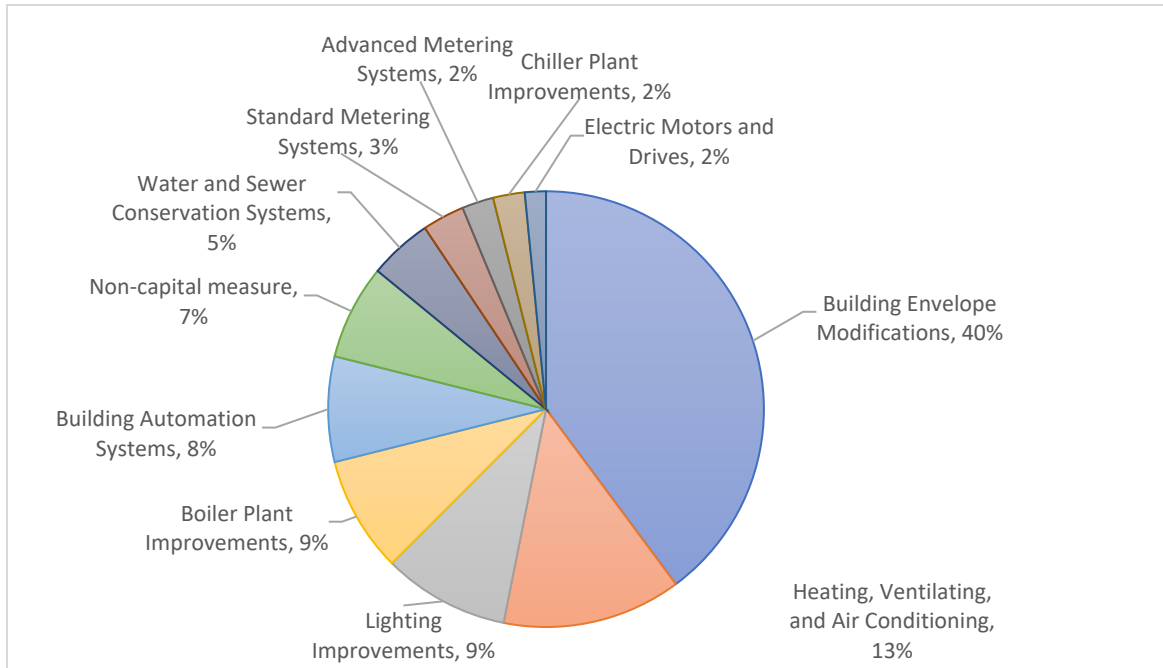


Figure 3-4. SNL/NM energy audits identified by ECM type, FY 2022

At SNL/CA, 29 ECMs were identified. Figure 3-5 shows the ECM types by percentage of the total at SNL/CA. Lighting improvements represent the majority of the ECMs identified at SNL/CA. Fifteen percent of the total ECMs represent low- or no-cost ECMs such as changes in operational set points that can help reduce energy waste.

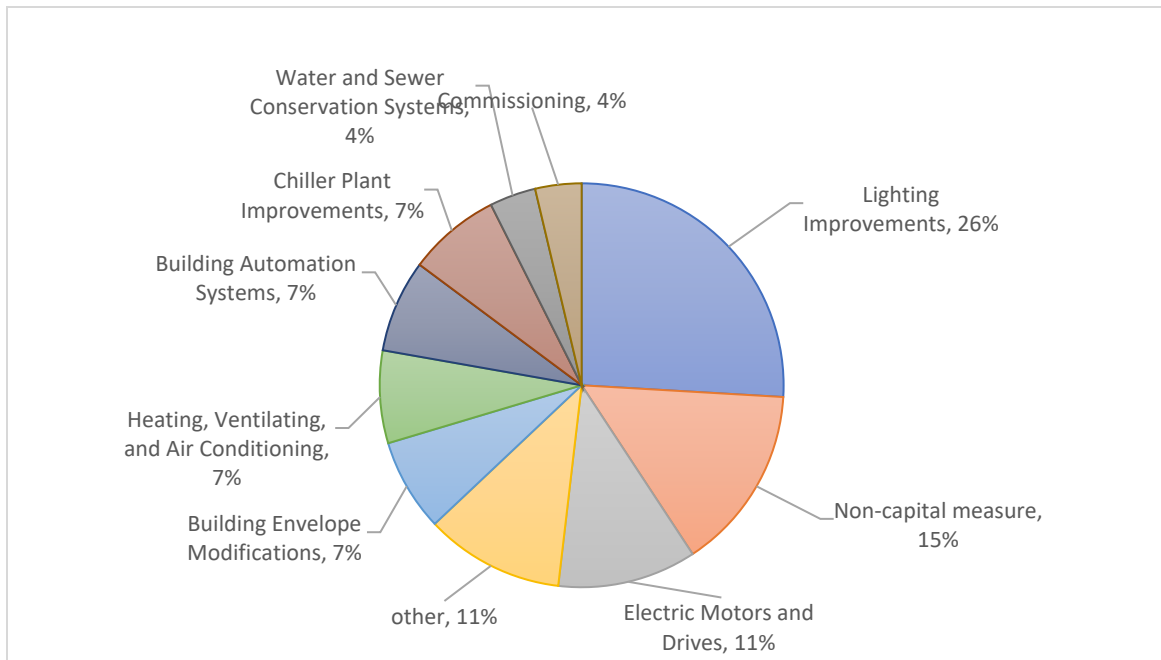


Figure 3-5. SNL/CA energy audits identified by ECM type, FY 2022

NNSA is interested in pursuing an energy savings performance contract (ESPC) at SNL/NM and SNL/CA. The ESPC will help both sites identify and prioritize ECMs. Efforts to select an energy service company have been initiated, and the ESPC is expected to last up to 25 years.

The newest monitoring-based commissioning program helped identify ECMs and energy efficiency opportunities. monitoring based commissioning is a process that uses automated data analytics to monitor the performance of systems continuously over the life of a building and helps identify low- or no-cost ECMs.

The SNL high-performance computing environment uses approximately one-third of total energy. Since 1985, SNL personnel have pioneered, installed, and tested new technologies and computing center designs to remove heat more efficiently. These measures have led to the Building 725 data center being awarded Leadership in Energy and Environmental Design (LEED) Gold status. In FY 2023, SNL is on track to field test a new extreme high-efficiency immersion fluid cooling computing system. This new immersion cooling data center equipment will pair perfectly with the already installed, zero water use, thermosyphon fluid coolers.

3.1.2 Plans and Projected Performance

Sandia’s mission is growing, and the energy used to support that mission is also expected to grow, as shown in [Figure 3-6](#) and [Figure 3-7](#). It will be challenging to achieve the energy intensity reduction goal through FY 2025. The goal to reduce energy intensity 30 percent from an FY 2003 baseline was achieved in FY 2015, in part by implementing many large-energy conservation measures with short payback periods. Going forward, low utility rates and uncertain project funding will impact implementation of future energy conservation measures with longer paybacks. SNL personnel will continue to pursue opportunities such as an ESPC, reinvestment of utility savings, and requests in budget cycles to seek funding to reduce energy intensity. Better procedures for measurement and verification need to be developed in order to quantify energy and cost savings accurately. Using energy data normalization to define energy baselines and savings potential is also necessary to better understand energy performance. All these efforts require securing funding sources and specialized technical staff to tackle different areas in order to improve energy performance.

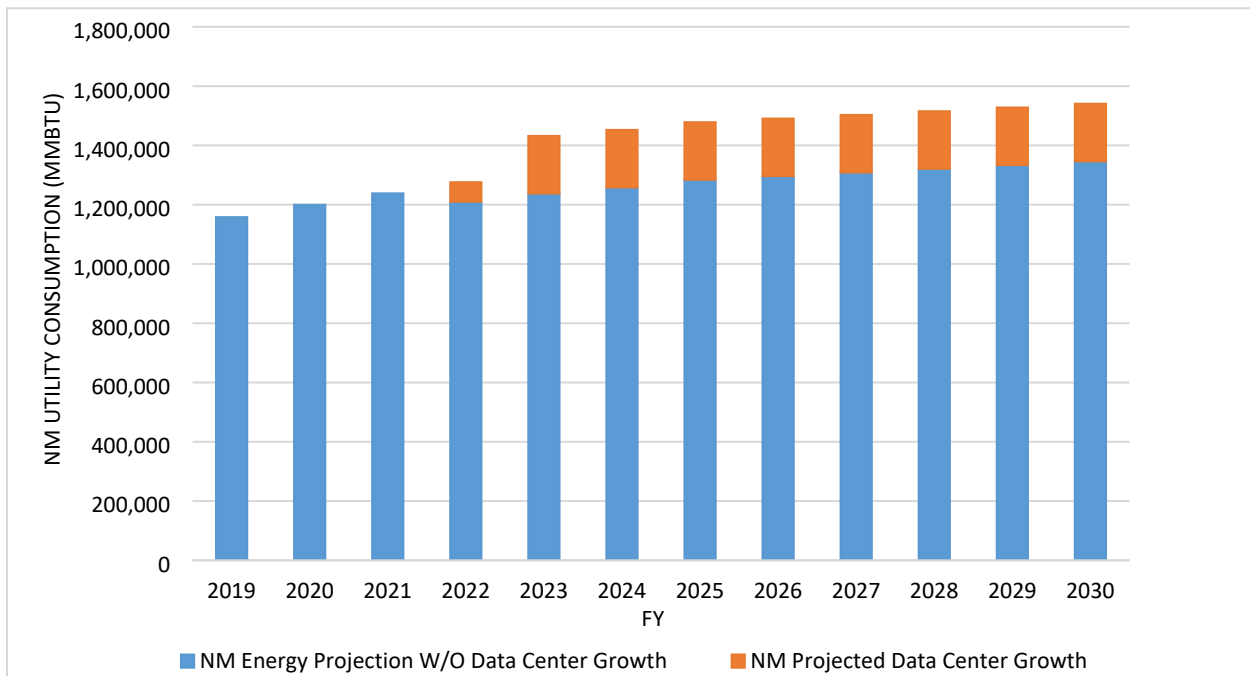


Figure 3-6. Projected energy consumption (all energy sources) for SNL/NM

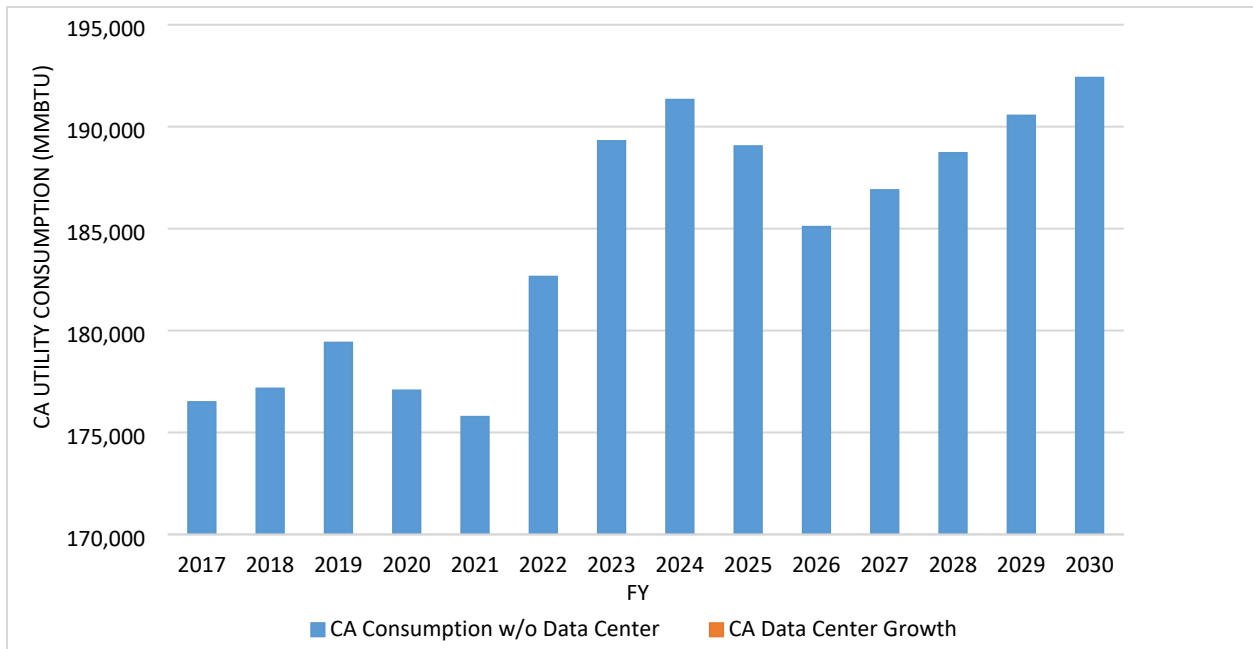


Figure 3-7. Projected energy consumption (all energy sources) for SNL/CA

To address the efficiency of high-performance computing facilities, the energy management team has partnered with experts on computing facilities, building controls, and operations from SNL and the National Renewable Energy Laboratory to continually review building operations and design. This team meets weekly to discuss building performance and potential operational improvements. As this team matures, it will provide recommendations for more efficient computing capabilities.

3.2 Net Zero Emissions

3.2.1 Performance Status

In FY 2023, emission reductions from real property will be achieved through continuous improvements to existing HVAC systems using monitoring-based commissioning, data analysis, and modeling. Emission reductions will also be achieved using ongoing energy audits and implementing energy conservation measures and energy management methods specified by federal directives, such as Executive Order 14057, *Executive Order on Catalyzing Clean Energy Industries and Jobs through Federal Sustainability*, and programs such as the DOE 50001 Ready program.

The approach used to convert the SNL/CA campus to net zero emissions is largely defined by the Net Zero Roadmap developed in FY 2022. This plan includes recommendations, such as electrifying building equipment, implementing on-site renewable energy, energy exchange loops, thermal systems, and other systems efficiency improvements. The plan also includes procurement direction and strategies to achieve resiliency (Table 3-1).

Table 3-1.- Projects for achieving net zero emissions at SNL/CA

Project	Description
Energy Conservation Measures (ECMs) - Existing Facilities	Deploy energy efficiency measures across all existing buildings including lighting upgrades, HVAC control enhancements, and deployment of a smart labs program.
Renewable Energy - PV	17.5MW Ground Mounted Solar Array
Energy Exchange - Phase I	Install a new energy exchange system to provide thermal energy to buildings across campus. Includes a new energy center and distribution.
Energy Exchange - Geothermal	Install a geothermal well field to serve as heat source/sink for the energy exchange.
Energy Exchange - Phase II	Connect new buildings to the energy exchange system. This will consist of branch lines to connect buildings in as needed basis.
Microgrid - Phase I	C964 renewable energy microgrid
Microgrid - Phase II	On site energy generation and storage with implementation of critical load feeders.
Microgrid - Phase III	Full campus critical microgrid with on site generation and long duration energy storage.
Thermal Energy Storage	Install a one-million-gallon thermal energy storage tank which will provide system resilience during a grid outage and also enable load shifting to improve system performance.
Net Zero Education Center	Convert Building C903 into a Net Zero Education Center. This includes interior upfit, new HVAC, relocation of existing servers, enhanced environmental controls, and rooftop Solar PV.
Net Zero Nano Grid	Create a testing hub for analysis of various energy generation, storage, and controls technology. The test hub will create a real-world environment while still protecting campus infrastructure.
Electric Vehicle Charging Stations	Install approximately 88 EV charging stations for employee personal vehicles.
Net Zero Walking Path	Utilize a combination of new signage and enhanced pathways to create a looped walking path for employees and visitors to highlight the key components contributing to achieving Net Zero.

The net zero emissions approach at SNL/NM consists of developing a scope of work for the Sandia Energy Security and Resilience Master Plan. The scope for this planning project targets net zero goals specifically outlined in Executive Order 14057, such as developing a net zero emissions building portfolio by 2045, including a 50 percent emissions reduction by 2032.

At SNL/NM, a net zero emissions pilot project at Building 848 has been funded for FY 2023 through the Energy Resilient Infrastructure and Climate Adaptation (ERICA) funding stream. This project includes an LED lighting upgrade, controls upgrade,

Trombe wall redesign, and solar and battery energy storage. This building site will serve as a living lab for SNL personnel involved in research and development, energy management, and associated areas to evaluate net zero emission and resiliency approaches for both existing and new facilities. Personnel are starting to incorporate net zero emission requirements into new building designs, including the Power Sources Capability Building project.

3.2.2 Plans and Projected Performance

Net zero emission efforts planned for execution in 2023 are as follows:

- At SNL/NM, the Building 848 project will result in net zero energy and emissions associated with activities at Building 848. For future fiscal years, this site will serve as a living lab for personnel to test net zero emission technologies that involve solar and/or battery energy storage.
- At SNL/NM, the scope of work for the net zero emissions (Sandia Energy Security and Resilience) plan will be completed. If funding becomes available, a study will be completed in FY 2024.
- At SNL/CA, execution of the Net Zero Roadmap for meeting net zero emissions energy goals and resiliency will begin. The work recommended in this document will be phased over multiple fiscal years.

At both SNL/CA and SNL/NM, as building systems engineers become educated about electrifying equipment, design standards and practices will be revised to reflect these goals. All sustainability requirements will continue to be met for new buildings, and existing buildings will be brought into compliance ([Table 3-2](#)).

Table 3-2. Net zero emissions approach for new and existing buildings at SNL/CA

<p>In Existing Buildings</p> <p>An energy reduction program for existing buildings consists of different EMs to provide a good balance of performance and cost efficiency, including:</p> <ul style="list-style-type: none"> • Retroactive commissioning (Cx), monitoring, and repair program • Lab improvements such as low-flow fume hoods, unoccupied lab mode, “close the sash” program • Building automation system (BAS) improvements for enhanced monitoring and predictive maintenance • LED lighting and occupancy sensors; daylight harvesting and solar collectors <p>In addition, Sandia CA should bring existing buildings into compliance with the Federal Guiding Principles for Sustainable Buildings, a federal requirement that will also support energy reduction toward net zero goals.</p>	<p>In New Buildings</p> <p>The most cost-effective time to deploy ECMs is during the design and construction planning of a new building. To ensure cost-effective measures are considered and deployed, a net zero design standard should be developed as an overlay to the Sandia National Laboratories SNL/CA Facilities Management Design Standards Manual (2019) (“the Manual”), which refers to the U.S. Green Building Council’s LEED rating system, the Federal Guiding Principles for Sustainable New Construction and Major Renovations, and CalGreen Code.</p> <p>The standard should include passive design strategies such as:</p> <ul style="list-style-type: none"> • Using climate analysis to inform building placement, building massing, and orientation, as well as renewable energy planning and mechanical design approaches • Optimizing daylighting and glazing selection criteria • Improving the building envelope, integrating natural ventilation, and leveraging passive solar design • Using building materials that contribute less to GHG emissions and avoiding concrete and steel.
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3.3 Energy Management Strategies and Procedures

3.3.1 Performance Status

3.3.1.1 ISO 50001 Ready Program

A DOE 50001 Ready program is currently under development at SNL/NM and SNL/CA. This program identifies ways to fill gaps in energy management processes and integrate an energy management system into the SNL culture. The program will be fully implemented by the end of FY 2023. This program will ensure continuous improvement of energy efficiency and energy management processes across SNL/NM and SNL/CA.

3.3.1.2 Building Commissioning

A monitoring-based commissioning program has been implemented. The program’s mission is to ensure that all SNL buildings operate in the way in which they were designed. With the adoption of energy savings measures and modernized equipment, buildings are becoming more efficient, when they work. However, their operational status becomes fragile, when small HVAC components malfunction. To

combat this issue and maximize building efficiency, a monitoring-based commissioning team continually monitors HVAC equipment with dedicated and customizable monitoring software. Rather than allowing buildings to operate inefficiently for months or years, the monitoring-based commissioning team identifies maintenance needs and then schedules work, which usually begins within a few weeks for mechanical issues and as quickly as the same day for control-system issues. So far, the monitoring-based commissioning team’s actions have accumulated carbon dioxide savings of over 600 metric tons since October 2021. Commissioning is required for all new buildings, and a recommissioning statement of work has been developed to bring existing buildings into compliance with the federal *Guiding Principles*.

3.3.1.3 Energy Management Information System

SNL personnel have developed a customized analytics tools using Sky Foundry’s SkySpark tool. SkySpark has become the analytics dashboard for fault diagnostics on metering, renewable energy, and building control systems. This system collects interval data from all the data sources identified in [Figure 3-8](#).



PSEL = Photovoltaic System Evaluation Laboratory

Figure 3-8. SkySpark connections

The SNL SkySpark program communicates with Energy Star’s Portfolio Manager tool. Portfolio Manager is the database that is used for monthly energy benchmarking at SNL/NM and SNL/CA. SkySpark is used to benchmark SNL buildings against the large inventory of buildings in Portfolio Manager. Currently, SkySpark is pulling monthly data from Portfolio Manager back into the metering dashboard so the manually vetted data found in Portfolio Manager can be used to identify issues in automated meter readings. In a future state, when the meter data quality improves, utility meter data will feed directly from SkySpark to Portfolio Manager. This has the potential to reduce data quality issues created by manually transferring data and will also free some of the time spent on manual data scrubbing.

3.3.1.4 Operation and Maintenance

Facility maintenance is managed using Maximo, a centralized maintenance management system. Each building and the assets living in those buildings are on a routine maintenance plan that was developed based on manufacturer recommendations and lessons learned. This maintenance is now also being informed by SkySpark. As the monitoring-based commissioning team completes their sprint efforts in each of the buildings at SNL/NM and SNL/CA, they identify any abnormalities in building function. These abnormalities are referred to as “sparks” in the SkySpark tool. When identified, the monitoring-based commissioning team then works with maintenance personnel to address the issues. As SkySpark develops and Facilities personnel become more comfortable with the tool, the hope is that maintenance will become more proactive and targeted.

All SNL projects require a project charter, which is a formal document that identifies the project’s scope and evaluates each investment based on its potential for deferred maintenance. Builder is the tool used to quantify the deferred maintenance for a project. The scoring criteria used to rank projects and allocate indirect monies for repair, replacement, and restoration all take the impact of deferred maintenance into consideration.

Buildings that require automated control are managed using a Siemens Apogee system. A large upgrade is underway to convert from Siemens Apogee to a Siemens Desigo system. Building controls are managed internally, and standards are developed based on space use needs for temperature setbacks. In many locations, occupancy sensors are tied to the building's ventilation system. These controls have the potential to create great energy savings in buildings, and it was noted during the COVID-19 pandemic that buildings with occupancy-based controls experienced the greatest reduction in energy consumption.

The pandemic also resulted in a shift to off-site work. This led to reconsidering some building leases and some new construction projects at SNL/NM, a site where it is a struggle to find office space for employees. Many vacated office spaces have been converted to touchdown spaces for telecommuters. There are many aging buildings at SNL/NM; if these buildings are not replaced or renovated, they will eventually fail to meet Sandia's mission need. Buildings that have fallen into disrepair or where the cost to renovate is greater than the building's value have been placed on a demolition and disposition list.

3.3.1.5 Cybersecurity Policies

The energy management and facilities control system team worked throughout FY 2022 to develop a security plan for all networked metering and building devices. This plan outlines a system structure and requirements that all facilities devices must adhere to. This will enable the implementation of the metering and facilities control system life cycle asset management plans.

3.3.2 Plans and Projected Future Performance

3.3.2.1 DOE 50001 Ready Program

The next steps for the 50001 Ready program, beyond fiscal year 2023, are to identify additional buildings and building systems that are significant energy uses and then integrate them into the 50001 energy management system process. ISO 50001, *Energy Management*, certification will also be considered after evaluating it alongside other energy goals and efforts.

3.3.2.2 Building Commissioning

New buildings will continue to be commissioned as they are being designed and constructed. As facilities age, recommissioning and monitoring-based commissioning will become more necessary and impactful. The hope is to expand the monitoring-based commissioning team to include a controls expert and a building craftsman; this will enable on-demand fixes to the issues identified by the team.

3.3.2.3 Energy Management Information System

The plan is to expand the SkySpark fault detection system to all buildings once the Facilities Control System is upgraded to Desigo. This will enable the monitoring-based commissioning team to expand their scope. Moving forward, the team's focus will shift to supporting net zero emission goals at SNL/CA. This upgrade will also increase data resolution. As implementation of a potential ESPC moves forward, the energy analytics tool will become critical in supporting the measurement and verification process ([Section 10.4](#)).

3.3.2.4 Operation and Maintenance

The sustainability team hopes to increase their impact on maintenance, repair, and space utilization. The team is working to build relationships with building operations teams and maintenance personnel to showcase the benefits of a monitoring-based commissioning program and a more proactive approach to maintenance. Sustainability team members also want to develop stronger relationships with space planners to impact telecommuting strategies. There is great opportunity in properly assigning permanent and temporarily occupied spaces.

3.3.2.5 Cybersecurity Policies

As more networked devices are required to operate facilities, the energy management team will work with networking and cybersecurity personnel to get these devices evaluated, approved, and added to MAN-004, *Sandia National Laboratories/New Mexico Design Standards Manual* and specifications.

3.4 EISA Section 432 Benchmarking and Evaluations

3.4.1 Performance Status

EISA Section 432 requires DOE to complete energy and water evaluations (audits) on its covered facilities every four years. EISA defines covered facilities as those facilities using at least 75 percent of an organization's total energy use. FY 2021 was the beginning of a new four-year cycle for energy and water audits.

EISA requires benchmarking for energy and water usage. SNL personnel use the U.S. Environmental Protection Agency (EPA) Portfolio Manager system to benchmark monthly data on building energy and water usage. All metered buildings at SNL/CA and SNL/NM are benchmarked using Energy Star Portfolio Manager. Energy data is entered into the system monthly. All covered facilities are also benchmarked using Energy Star Portfolio Manager. In total, energy data (electricity and natural gas) for 243 buildings at SNL/NM and 43 at SNL/CA is tracked monthly using the Energy Star tool.

In FY 2022, the process of collecting and reporting on energy data was streamlined using internal resources and tools. This new reporting process significantly reduced the time spent on collecting data, tracking energy data at the building level, and entering energy data into Energy Star Portfolio Manager.

Every year, approximately 20 building energy audits are conducted. These audits are conducted using in-house resources and subject matter experts. An energy management team hosts energy audit kickoff meetings where energy conservation measures from the previous year's audits are discussed and vetted and the current year's efforts are introduced. SNL buildings are managed using a facilities area management structure. This means each building has a dedicated architect, electrical engineer, mechanical operator, building manager, mechanical engineer, and tradesman. Each of these individuals is responsible for contributing to the energy audit. A discipline-specific checklist is provided to each participant to support their efforts and to ensure that the energy management team collects all

the information needed to compile the final reports. In FY 2022, energy audits identified 155 ECMs for 20 high energy intensity buildings at SNL/NM and SNL/CA.

3.4.2 Plans and Projected Performance

Meters are not installed in some buildings so it can be a challenge to quantify energy usage and evaluate performance. The efforts to track and benchmark all metered buildings and facilities will continue in the next several fiscal years. Once meters are installed for buildings that currently do not have them, those buildings will be benchmarked using Energy Star Portfolio Manager. As meters are brought into compliance with the new metering security plan, they will begin communicating with the SkySpark analytics tool, which can feed directly into Portfolio Manager, thus automating the benchmarking process (Section [3.3.1.3](#)).

In FY 2023, programs such as monitoring-based commissioning, EISA energy audits, and the improved energy reporting process will help identify facilities that had a major impact on energy performance and provide guidance and options for reducing energy waste.

In FY 2023 a pilot project to evaluate the benefit and feasibility of expanding these audit reports to incorporate detailed information will be completed. At a minimum, the following tasks and information will be incorporated into one report for an SNL/NM building and one for an SNL/CA building:

- Evaluate metering sparks
- Review apportioning if applicable
- Review life cycle asset management plans to identify projects
- List planned and completed investments for the building
- Identify resiliency concerns
- Clean up ECMs in the SkyPark analytics dashboard
- Validate Portfolio Manager data for the building
- Define a *Guiding Principles* net zero project for the building

- Identify vulnerability assessment and resilience plan commentary on the building
- Use building energy models to evaluate potential ECMs if applicable and available

3.5 Facility Metering

3.5.1 Performance Status

The DOE Sustainability Dashboard contains building-level electric, natural gas, chilled water, hot water, and potable water meter information. Steam is not used at any SNL location. The *Utility Metering Life Cycle Asset Management Plan* (provided as a separate attachment on the DOE Sustainability Dashboard) provides more detailed information.

Utility metering is an energy management tool that is critical to many SNL goals. Without metering, tracking compliance with Executive Order 14057, ISO 50001, and energy-reduction goals is challenging and, in some cases, not possible. Existing metering infrastructure relies on an antiquated communications system that results in data interruptions, low-resolution data, and minimized potential for technology advancement.

A life cycle asset management plan was developed to address the current state of the SNL utility metering system. This document contains a strategic investment plan as well as a proposed maintenance and replacement strategy that would bring the metering system up to current technical and security standards. The *Utility Metering Life Cycle Asset Management Plan* also includes a routine maintenance and end-of-life replacement strategy that would enable the current utility metering system to maintain functionality as technology and standards continue to progress.

The first steps in the *Utility Metering Life Cycle Asset Management Plan* were developed to fully understand the current state of the system. This included a comprehensive utility metering study of all covered buildings that was completed in collaboration with NNSA and several indirectly funded studies that explored

metering on uncovered buildings. The energy management team has also started locating and tagging all existing utility meters so they can be entered into Maximo, the SNL centralized maintenance management system. This will result in the ability to track meter inventories and maintenance tickets. Maximo is also integrated with Builder, a tool that tracks estimated end-of-life and replacement costs and benefits for these meters.

This work is setting the foundation for a comprehensive upgrade of the utility metering system; however, meters continue to fail, and energy must be managed. Until proper funding is in place to make a large-scale upgrade to the metering system, the limited indirect sustainability compliance budget is used to replace high-priority meters. In FY 2022, the energy management team kicked off the replacement of electric meters in buildings 971 and 727, the natural gas meters in buildings 983N and 956, the Btu flow meters in buildings 823 and 880, and the water meters in buildings 700 and 856. These projects are moving energy management in the right direction, but this is not a feasible solution for upgrading all meters. The proposed large-scale plan for upgrading all meters lives in the Sandia Infrastructure Investment Database, a tool that program leaders can use to prioritize needs based on program risk. Unfortunately, utility metering doesn't hold a high program risk, so it is typically ranked as a low priority on all funding streams.

As part of utility meter upgrades, communication among systems will also need to evolve. To enable the use of smarter and more connected meters, the energy management team has partnered with Sandia cybersecurity and networking specialists to develop a security plan that will support both the Facilities Control System and utility meters. This plan will enable the use of modern ethernet-based communications protocols. The first SNL Ethernet-based natural gas meter is currently being worked on in Building 954. This meter will communicate directly with the SkySpark analytics tool, which was built in FY 2022 to serve as the Sandia metering dashboard.

The SkySpark-based metering dashboard (Figure 3-9) provides the following capabilities to the energy management team:

- Visualize energy data for individual buildings or groups of buildings and track changes over time.
- Compare energy between facilities of similar location and type.
- Track progress toward energy goals.
- Perform energy apportioning.
- Identify issues with meter data quality.
- Identify metering infrastructure needs that prevent accurate energy tracking.

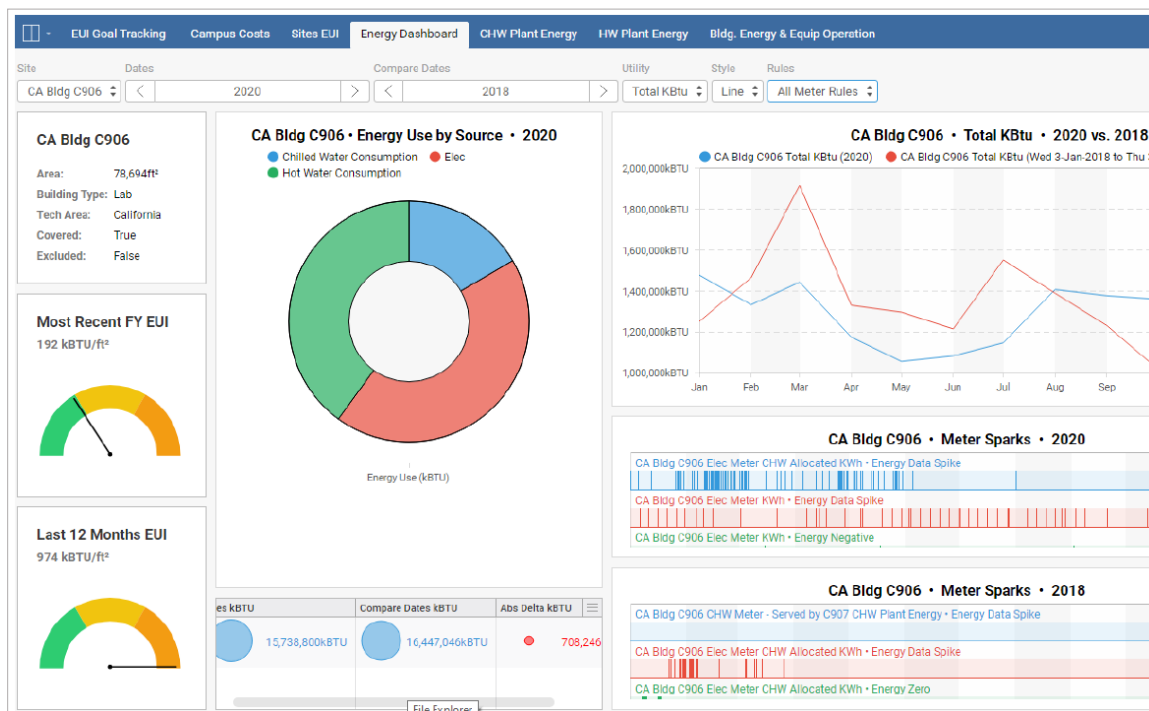


Figure 3-9. Personalized energy metering dashboard in SkySpark

3.5.2 Plans and Projected Performance

The largest barrier to implementing the *Utility Metering Life Cycle Asset Management Plan* is funding. Currently, no indirect or direct funding streams are tailored for utility metering projects. Some metering projects have been funded, but finding the appropriate funding source for the large-scale plan is the key to success.

Advocating for metering funding will be a high priority now that the preliminary work outlined in the life cycle asset management plan has been completed.

There are several chilled and hot water loops at SNL. Accurately capturing the energy used to produce this water and tracking the water’s destination results in a complex metering system called apportioning (see Figure 3-10). This complexity can lead to errors in the data. In a recent evaluation of the Building 823 chilled and hot water loop, it was discovered that some uncalibrated and poorly maintained flow meters were causing this energy apportioning process to produce faulty numbers. Future work will include verifying apportioning in all loops and developing logical apportioning baselines to identify issues. As issues are identified in the loops, apportioning baselines can also be used for reporting until funding is designated to fix the equipment issues. Flow meters will continue to be added to Maximo, further supporting implementation of the *Utility Metering Life Cycle Asset Management Plan*.

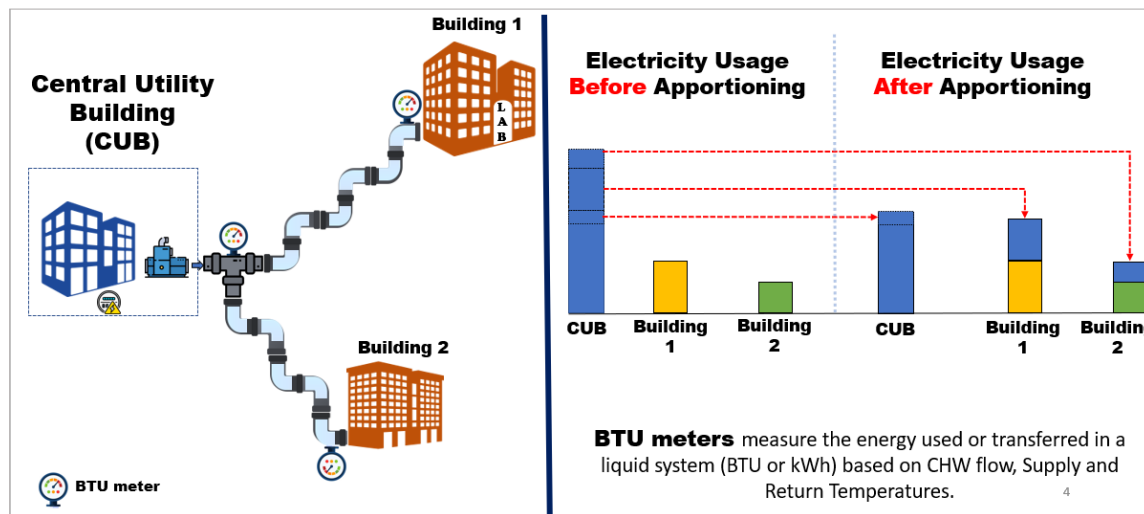


Figure 3-10. Apportioning explained

3.6 Carbon Pollution-Free Electricity

3.6.1 Performance Status

In order to demonstrate sustainability stewardship and lead the way to achieving net zero GHG emissions and net zero energy consumption, while improving

energy resilience and demonstrating new technologies as requested in Executive Order 14057, action has been taken to evaluate carbon pollution-free electricity strategies.

In FY 2022, total electricity usage was about 314,854.83 MWh for SNL/NM and SNL/CA. On-site renewable generation at both sites only accounted for 673.5 MWh. However, several studies and efforts evaluated the pathway to develop on-site carbon pollution-free electricity.

A project that will have a major impact on carbon pollution-free electricity is the SNL/CA Net Zero Plan. This plan includes three main strategies: reduce energy consumption, increase system efficiency, and increase use of renewable energy. The plan recommends the deployment of a 15–20 MW DC solar array with an AC capacity of 13.5–18 MW. The ground-mounted, single-axis tracking array would match the ground coverage ratio of similar installations in the area.

Other carbon pollution-free electricity initiatives, projects, and assessment have been made in current and previous fiscal years, including the following:

- **SNL/NM facility net zero energy upgrade.** This FY 2023 pilot project will be funded through the ERICA fund with the goal of making Building 848 100 percent electrified with no natural gas and all electricity generated on-site.
- **SNL/NM concentrating solar power study.** This study's objective was to develop a conceptual design of a concentrating solar power plant that can provide clean, carbon-free electricity for SNL/NM and KAFB.
- **SNL/NM renewable energy design philosophy.** A photovoltaic production conceptual location analysis was conducted in 2019 to evaluate site configurations and model scenarios and to compare performance, materials, and costs. Findings were shared with interested SNL stakeholders.
- **SNL/NM and SNL/CA fleet electrification.** A fleet assessment was conducted in FY 2022 to provide a recommended strategy for fleet replacement. This study resulted in plans that describe current fleet and site

conditions as well as recommendations for zero-emission vehicle acquisitions and associated installment of electrical vehicle supply equipment. At SNL/NM, the plan is to locate 388 charging stations within various technical areas in existing lots as well as in central hub locations. The plan will be implemented strategically across fiscal years to support fleet transitions. A similar approach was taken at SNL/CA with six new charging stations.

3.6.2 Plans and Projected Performance

In order to increase carbon pollution-free electricity levels, securing funds to invest in renewable energy technologies is very important. Although levelized costs of electricity for renewable technologies (particularly solar) have decreased significantly over the last few years, the low electricity rates at SNL/CA and SNL/NM make it difficult to finance renewable generation systems. Internal policies and operational practices may also need to be revisited and altered in order to ensure that roof-mount type systems do not represent structural risks or cause impacts on building operation.

3.7 Non-Fleet Vehicle and Equipment Usage

3.7.1 Performance Status

Non-fleet vehicle and equipment use is an important aspect of executing mission work and conducting operation and maintenance activities at each site. Diesel- and gasoline-fueled power generators are used throughout SNL to ensure backup power for critical building functions and operations as well as to enable outdoor field test activities in remote locations. Heavy equipment is also used to support operation and maintenance requirements associated with buildings, utility and site infrastructure, material handling and movement, and remote field-testing activities. Based on the nature of SNL sites, a significant number of gasoline-powered carts are used for on-site personnel transportation needs. Landscape maintenance is not a significant source of non-fleet vehicle and equipment fuel use at any SNL site.

Non-fleet vehicle and equipment fuel usage and greenhouse gas (GHG) emissions are tracked and reported in the SPO dashboard.

3.7.2 Plans and Projected Performance

Opportunities to reduce non-fleet vehicle and equipment fuel consumption will be evaluated. The following plans and measures will continue to be implemented:

- Replace gas-powered personnel carts with solar-powered carts.
- Implement xeriscape low-water use and low-maintenance landscape designs.

4.0 Water Management

Water management focuses on all water-related topics, such as potable water intensity and industrial, landscaping, and agricultural water consumption.

4.1 Performance Status

Water used at SNL/NM is purchased from KAFB, which has on-site water wells. No non-potable water sources are used. The Albuquerque Bernalillo County Water Utility Authority, which is the secondary water supplier, is currently pursuing aquifer recharge activities; SNL/NM personnel are not involved in these efforts.

Potable water used at SNL/CA is purchased from LLNL and is primarily supplied by the San Francisco Public Utility Commission from the Hetch Hetchy watershed. The Alameda County Flood Control and Water Conservation District, Zone 7, supplements this primary water source as needed. No alternative water sources for SNL/CA have been identified.

4.1.1 Water Use at SNL/NM

At SNL/NM, water uses consist of process, comfort cooling, irrigation, domestic, construction, and laboratory operations. Accurately measuring water use is an ongoing process, as some water uses are not currently metered individually.

[Figure 4-1](#) shows a breakdown of water usage at SNL/NM for FY 2022.

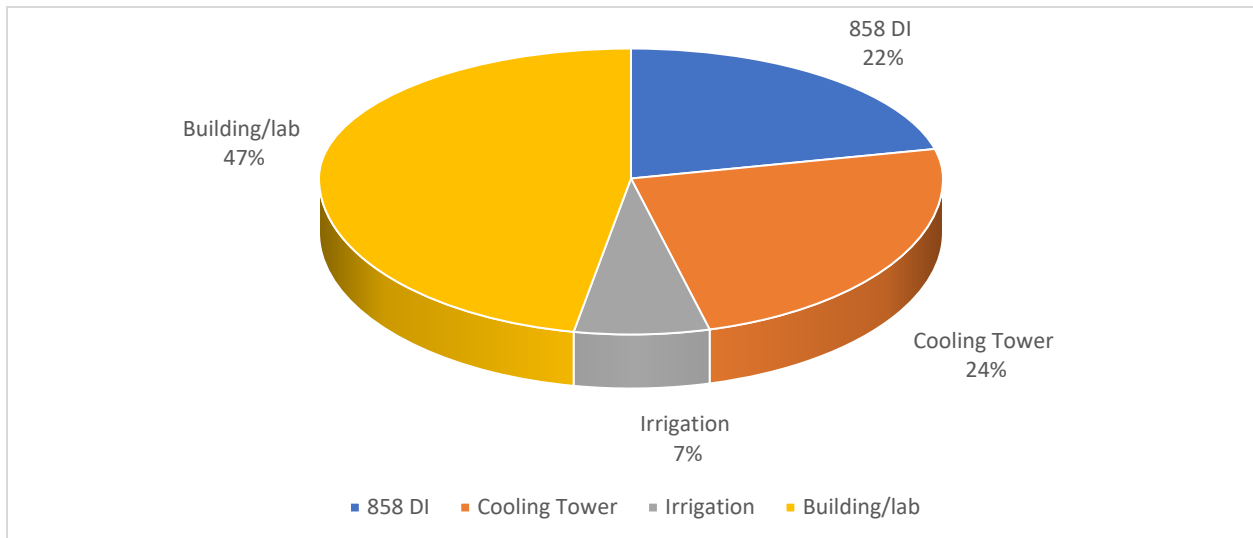


Figure 4-1. Water use at SNL/NM, FY 2022

Water used at SNL/NM is monitored at the site, building, and system levels. When the capability is available, the meters are connected to the Facilities Control System. This allows for real-time monitoring and historical data logging. At the building and system level, a current effort is underway to upgrade any outdated meters to types that will connect to the Facilities Control System. Due to their remoteness, site meters are not connected to the Facilities Control System but instead communicate with an on-site server via radio. Water use at the site level is recorded and analyzed monthly by technical area.

As of FY 2022, potable water intensity is down approximately 33 percent at SNL/NM when compared to the 2007 baseline. The FY 2022 intensity was 49.9 gal/GSF, as compared to 46 gal/GSF in FY 2021.

A significant portion of the workforce returned to on-site work during FY 2022 and that drove up water consumption. A challenge in the coming years will be to continue to meet year-over-year water reduction goals as more of the workforce is brought on-site as the pandemic comes to an end. The 858 Complex continues to utilize process reclaim water in the air scrubbing equipment, helping to drive water use totals down.

In FY 2022, high water use and high water intensity buildings continued to operate at SNL/NM. The Building 858 deionized water system alone accounted for 22 percent (70.5 million gallons) of overall water usage sitewide (see [Figure 4-1](#)). The reclaim system for the 858 deionized waterloop is online and being used in air scrubbing equipment; calculations indicate that approximately 12 million gallons of spent water was reclaimed last year and put to use in the air scrubbers. Operations at the other portion of the 858 Complex, including 858 J Central Utility Building and 858 N Central Utility Building, consumed a total of 5 percent of total water use at 15.5 million gallons per year. Cooling towers accounted for 24 percent (77 million gallons) of overall water usage sitewide. The remaining water consumption is domestic, various labs, irrigation, and unmetered flow. The water treatment program requires all the cooling towers to operate at three cycles of concentration, with water being cycled through the systems three times before it is discharged.

Currently there is no water management plan at SNL/NM, though water conservation goals continue to be managed by maintaining and operating water-conserving systems. Any plan would include KAFB.

Implementation of a site-wide centralized metering system will help in understanding water use at SNL/NM and will assist in water conservation efforts (see [Section 3.5](#)). This is an ongoing process and an important part of water conservation efforts. In FY 2021, work began on adding four additional meters to the sitewide metering network. This will lead to more accurate totals and will include buildings that are outside the metering network. In addition, 18 building-level meters were either added or upgraded to smart meters with Facilities Control System connectivity in FY 2021. Work on adding meters at the building level will continue into the future.

Other water conservation efforts include building audits. Water conservation audits are conducted on one-fourth of the highest water-consuming buildings each year. This helps to identify locations where outdated fixtures and laboratory equipment can be updated and to drive down water consumption. Twenty-two water conservation audits were completed in FY 2022. Another area of progress in the

water conservation program this year was identifying leaks and taking corrective action. The primary leak that was located this year was found in Technical Area V, resulting in an estimated savings of 10,000 gallons per month.

Upgrades to the water metering system were made in FY 2022. A critical water meter used for totalizing water consumption at Coyote Test Field was upgraded to a smart meter with capabilities for data trend analysis and real-time flow monitoring. In addition, a project has been funded to connect all the critical water meters to the Facilities Control System. Once the meters are connected, users will be able to identify leaks and anomalies in real time and respond in a timely manner.

Various federal, state, and local water regulations have been integrated into management practices in order to maintain compliance. For example, EISA requirements and LEED standards are incorporated into design and construction documents.

Landscape management is accomplished by combining two disciplines: landscape architecture and civil engineering. Objectives are to accomplish water conservation and water control goals by watering landscape plants using bio swells, retention ponds, and other water-collecting devices in constructed landscapes.

4.1.2 Water Use at SNL/CA

Many facilities at SNL/CA rely on cooling towers as the primary cooling mechanism. Another major water usage is landscape irrigation. For FY 2022, water use at SNL/CA was 33 percent for cooling and domestic uses, 7 percent for irrigation, and 59 percent for unknown losses. Fire system testing accounted for 1 percent of water use. SNL/CA does not have any non-potable water sources.

Water usage for the site ([Figure 4-2](#)) is updated based on available meter data. Unknown losses consist of system leaks and construction activities. Personnel continue to better analyze unknown losses so that more water use in this category will be accounted for in future years.

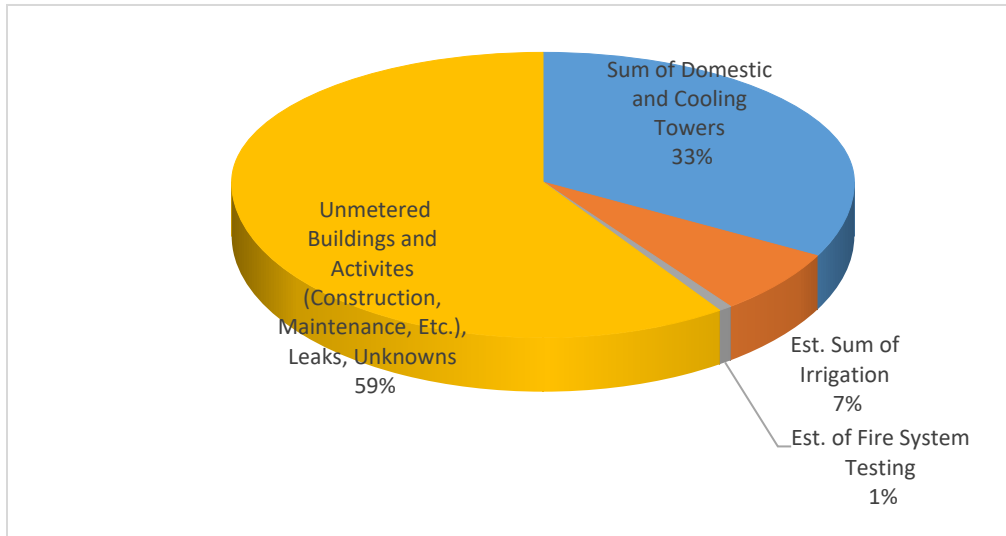


Figure 4-2. Water use at SNL/CA, FY 2022

Factors likely to impact water consumption are new building construction, water main breaks and repairs, and unpredictable rainfall and weather patterns.

The following efforts are being pursued to reduce potable water consumption at SNL/CA:

- Closed-loop systems are still being installed and encouraged when equipment requiring water usage is replaced or bought for the first time. This mainly concerns cooling units.
- Improved metering, especially for irrigation, is still being pursued. However, this is a slow process. Landscaping and irrigation in the innermost campus is being improved. There is still a fair amount of opportunity for irrigation repairs, improvements, and metering. Zero and drought plantings are being pursued.
- The Facilities Department (8540) suspends irrigation uses during the wet season if there is sufficient or frequent rainfall.
- The Water System Upgrade Project was completed in October 2022, which replaced older potable water lines and hydrants with new ones. This will prevent and minimize leaking from the replaced systems.

SNL/CA water usage for FY 2022 was 34, 923, 831 gallons. The FY 2022 intensity was 38 gal/GSF as compared to 45 gal/GSF in FY 2021. [Figure 4-3](#) shows potable water consumption at SNL/CA from FY 2007 to FY 2022.

There is currently no comprehensive water management plan at SNL/CA. However, water conservation activities continue.

The metering system at SNL/CA has been modernized and is currently operating in an easily maintainable state. However, this only covers most of the large buildings on-site. Overall water consumption decreased 13 percent in FY 2022 from FY 2021 ([Figure 4-3](#)).

There have been some replacements and additions in best management practices for stormwater management.

Various federal, state, and local water regulations have been integrated into management practices. For example, California's water restriction guidelines are followed during droughts. In addition, EISA requirements and LEED standards are incorporated into design and construction documents.

The *Landscape Master Plan* has been developed for SNL/CA, and stormwater is managed in compliance with federal and state regulations. Retention and infiltration basins that are being installed currently are non-vegetative and thus do not need irrigation. Stormwater captured in these ponds evaporates into the air and infiltrates the ground.

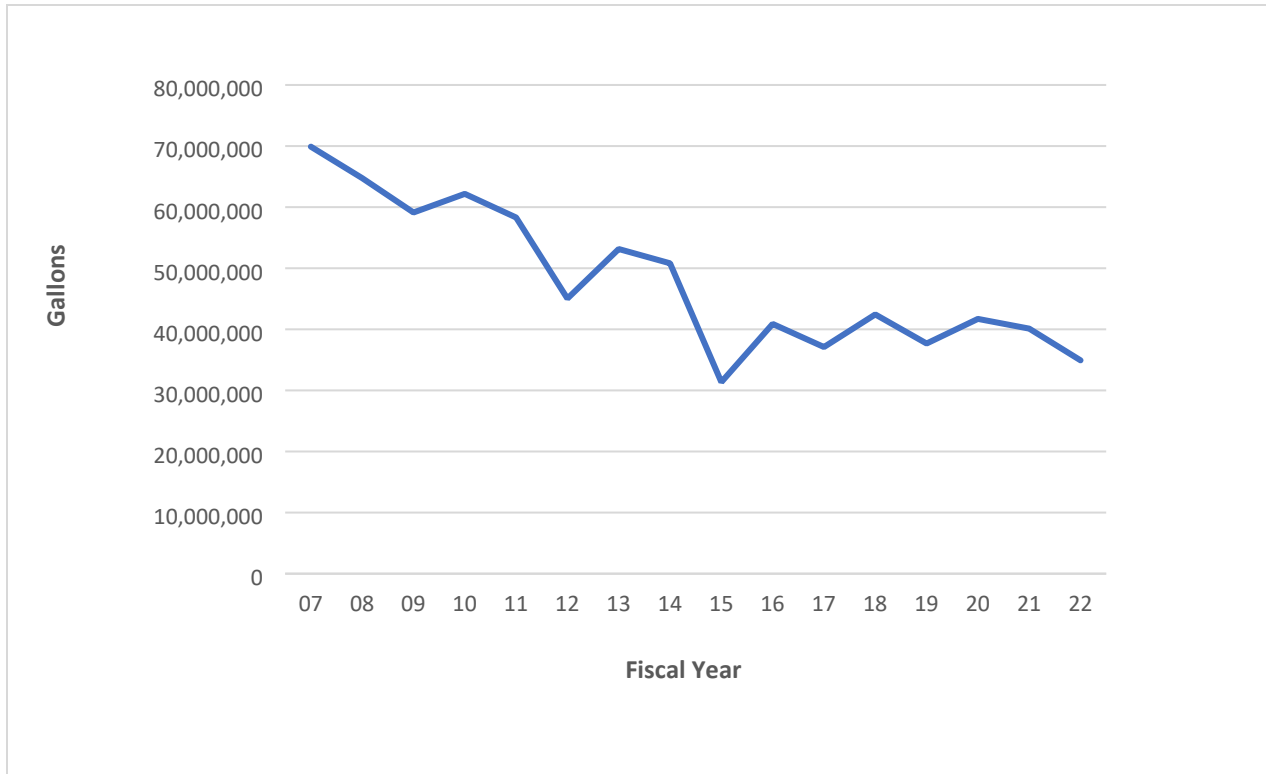


Figure 4-3. Water consumption at SNL/CA, FY 2007–FY 2021

4.2 Plans and Projected Performance

SNL personnel will continue to explore water conservation opportunities.

4.2.1 Water Use at SNL/NM

At SNL/NM, cooling loads due to data centers and other process cooling demands are expected to create challenges to maintaining the current reduction numbers. However, conservation projects will be implemented wherever feasible. Some of these projects for SNL/NM include the following:

- The Infrastructure Services organization has created a long-term plan to address the aging water infrastructure. This plan will systematically replace domestic water lines that are deemed to be at the end of their useful life.
- Restrooms will be retrofitted with high-efficiency fixtures.
- Green building guidelines will be followed, and recycled water will be used wherever possible to realize water savings when designing and constructing new data centers.

- Metering will be improved and added to further account for building water usage, including user process equipment. Meters will be installed in buildings that are not currently metered.
- Water meters will be connected to the Facilities Control System to allow for real-time monitoring and data trend analysis.
- Water lines will be replaced to help reduce the frequency of flushing due to line and/or valve repairs or replacements.
- Reclaim water will continue to be used in the acid scrubbers into the future. Other ways to utilize any unused reclaim water will also be investigated.
- Water audits will continue to identify opportunities for water use reduction.
- Landscape management best practices will be implemented to reduce stormwater runoff, minimize water use, and promote resilience.

Building water audits are conducted as part of internal energy audits and condition assessments. Findings from these audits range from identifying the need for bathroom retrofits to the elimination of once-through cooling loops. Inefficient and outdated fixtures will be replaced as funding becomes available, particularly in buildings identified to meet goals for high-performance sustainable buildings through implementation of the *Guiding Principles*.

4.2.2 Water Use at SNL/CA

At SNL/CA, water conservation efforts will be continued in FY 2022, including the following:

- As new facilities are built or facilities are renovated, water meters will be added.
- New cooling equipment will use closed-loop systems to minimize water demand.
- New potable water lines are being installed as part of the Water Line Project, which can help reduce and replace old leak points.
- Existing landscaping will be converted to low water-use landscaping, as funding allows.

There are no plans at this time to develop alternative water sources at SNL/CA. Aquifer replenishing activities are not performed at SNL/CA.

5.0 Waste Management

Waste management focuses on all waste-related topics, such as waste diversion, municipal solid waste, wastewater treatment, and associated GHG emissions.

5.1 Waste Diversion and Municipal Solid Waste

5.1.1 Performance Status

5.1.1.1 Waste Diversion at SNL/NM

Off-site solid waste disposal, which is referred to as commercial solid waste disposal in program documents, is subcontracted. At SNL/NM, the City of Albuquerque Cerro Colorado Landfill and the Waste Management-owned Rio Rancho landfill (commercial landfills) are used for off-site solid waste disposal.

The Materials Sustainability and Pollution Prevention Program has continued to pursue Zero Waste by 2025 with management support. The campus-wide awareness campaign is growing, and local training sessions for departments have increased.

The diversion rate for construction and demolition waste in FY 2022 was 20.1 percent. Of 2,474.7 metric tons generated, 496.4 tons were recycled or reused and 1,978.3 metric tons were disposed of at the KAFB C&D Landfill. In FY 2022, Facilities personnel created a dedicated budget line for processing and removing asphalt and concrete from the Concrete and Asphalt Recycle Area. This process improvement and secure funding should help increase the construction and demolition diversion rate at SNL/NM in subsequent years. Efforts are already scheduled to remove material from the Concrete and Asphalt Recycle Area in early FY 2023, as the efforts to implement the improvements were completed late in the fourth quarter of FY 2022.

Personnel at SNL/NM have been working with construction contractors to divert concrete and asphalt from the KAFB C&D Landfill to the Concrete and Asphalt Recycle Area. Credit for diversion cannot be taken until the concrete and asphalt

stored at the Concrete and Asphalt Recycle Area is processed and removed to a recycle vendor. Construction contractors are encouraged to use the on-site truck scale to document their recycle efforts. The truck scale tickets were revised to support data collection.

In FY 2022, SNL/NM operations generated 1,370.9 metric tons of solid waste. Of this amount, 502.9 metric tons (36.7 percent) were sent to the Cerro Colorado Landfill. SNL/NM personnel diverted 862 metric tons (62.9 percent) of solid waste from this commercial landfill by recycling, composting, and reusing material (Figure 5-1).

SNL/NM has a multi-stream recycling program, which means there are dedicated bins for different types of recyclables. Dedicated bins help reduce contamination and increase safety for personnel who handle and process the waste and recyclables throughout the campus. Collected materials are processed and baled at an on-site facility. Bales are either sent to the landfill or delivered to the applicable recycle vendor.

The amount of waste generated in FY 2022 (1,370 metric tons) was greater than that generated in FY 2021, which was 1,223 metric tons. This is owing to personnel returning to work on-site following the easing of restrictions due to the COVID-19 pandemic. The diversion rate decreased from 73.8 to 62.9 percent. If waste generation continues to increase, additional training and communication may be needed to help reeducate Members of the Workforce about existing resources to reduce waste generation at SNL/NM.

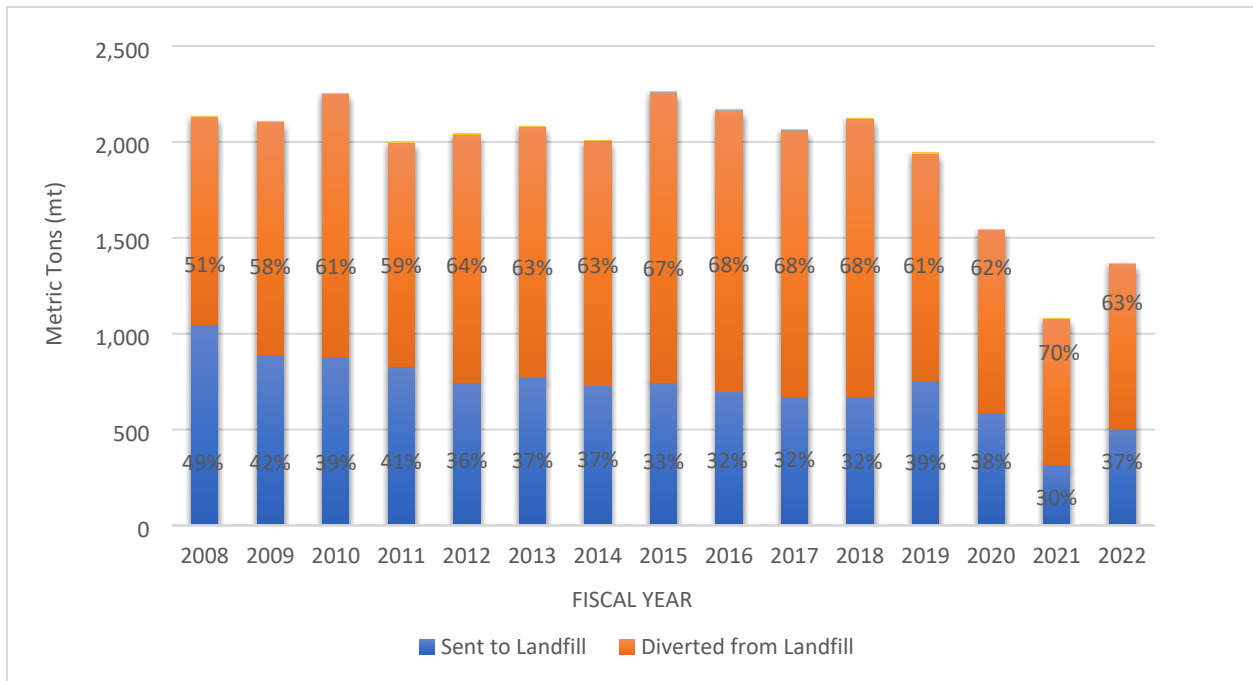


Figure 5-1. Municipal solid waste and diversion at SNL/NM, FY 2008–FY 2022

Environmental Management System personnel engage with the Solid Waste and Pollution Prevention program leads to create waste-reduction objectives, which are adopted and executed at the corporate and division levels. An example of a goal would be to establish a percentage of personnel in a center and inspire them to enroll in and complete the Zero Waste Challenge. The Zero Waste Challenge consists of emails that provide information on zero waste principles and existing waste reduction resources at SNL that, when implemented, will reduce an individual’s environmental impact.

SNL/NM personnel divert a significant amount of electronic waste and metal for recycling. The revenue from electronic waste and metal recycling largely supports the recycle program. Revenue also comes from recycling aluminum cans and cardboard. White paper is shredded on-site under witness, and the shredded material is recycled at a cost. In FY 2022, the equipment in the scale house was replaced with a more sophisticated system that will help drivers complete scale tickets more effectively. Scale tickets are reviewed for materials, vendor destination, and weights, and the data are tracked and included in annual reports.

The ChemPro tool is well established, helping to control and grant approval for the purchase of all new chemicals. ChemPro customers are encouraged to use acceptable nontoxic or less-toxic alternative chemicals and processes, while minimizing acquisition of hazardous chemicals and materials. Increased inventory maintenance and reductions are an ongoing part of Environmental Management System objectives.

5.1.1.2 Waste Diversion at SNL/CA

At SNL/CA, the Facilities Management organization owns and manages solid waste disposal contracts and works in conjunction with SNL/CA Pollution Prevention Program personnel to ensure that reporting and recycling requirements are met.

To meet the Alameda County recycling ordinance to divert 90 percent of easily recyclable and compostable materials, SNL/CA personnel continue to evaluate and improve solid waste management activities. Facilities Management personnel haul mixed recycle waste and solid waste directly from the SNL/CA site to the Republic Services Vasco Road Landfill in Livermore, California. The mixed recycle waste is transferred to and managed at Republic Services Newby Island Resource Recovery Park in Milpitas, California. The solid waste is disposed of at the Republic Services Vasco Road Landfill.

Livermore Sanitation picks up SNL/CA compostable wastes and transports the waste to Recology Blossom Valley in Vernalis, California, for composting. Livermore Sanitation also picks up cardboard, carpeting, concrete, construction and demolition debris, green waste, wood, and solid waste on an as-needed basis. The recyclable waste streams are managed at Alameda County Industries in Alameda, California.

The amount of solid waste sent to the landfill in FY 2022, 86.86 metric tons, decreased from 111.74 metric tons in FY 2021. Diversion rates were 71.2 percent of nonhazardous solid waste, excluding construction and demolition debris, and 95.5 percent of construction and demolition debris.

Removing asphalt from a large parking lot to build a new facility and replacing pavement generated 331 metric tons of asphalt in FY 2022. The asphalt was recycled off-site.

The ChemPro tool is well established, helping to control and grant approval for the purchase of all new chemicals. ChemPro customers are encouraged to use acceptable nontoxic or less-toxic alternative chemicals and processes, while minimizing acquisition of hazardous chemicals and materials.

5.1.2 Plans and Projected Performance

The SNL mission and population grew over the past year and likely will continue to grow through FY 2023, not only from new hires, but from personnel returning on-site following the COVID-19 pandemic. This will directly impact the volume of waste generated. A continued focus on communication and training about recycling will target new personnel regarding the effort to reach Zero Waste by 2025.

5.1.2.1 Waste Diversion at SNL/NM

SNL/NM personnel are expanding paper towel composting throughout non-limited area buildings (29 buildings) in Technical Area I, Technical Area II, and Technical Area IV, and will consider expanding this effort to buildings in the limited areas over the course of the next year.

The focus on communicating the importance of recycling and providing recycling training will increase, and new personnel will be familiarized with the effort to reach Zero Waste by 2025.

Construction activities are expected to continue at SNL/NM, which will generate significant amounts of dirt, rock, and grub (stumps and roots) to be delivered to the KAFB C&D Landfill. Large amounts of green waste from landscaping projects, which are always ongoing, continue to be delivered to the KAFB C&D Landfill. The KAFB C&D Landfill is slated to be closed in FY 2025. A contingency plan was started in FY 2022 and will continue in FY 2023 to capture an alternate plan in the event the Kirtland C&D Landfill were to ever shut down. The contingency plan will evaluate

the environmental and cost impacts from diverting landfill material to off-site landfills in Albuquerque and Rio Rancho. Alternative means to segregating materials so they do not have to be classified as construction and demolition waste will also be assessed.

Construction contractors will continue to be encouraged to recycle and to report their recycle achievements. In the past this was not done effectively.

5.1.2.2 Waste Diversion at SNL/CA

At SNL/CA, the *Solid Waste Management – Improvement Action Plan* was implemented in FY 2021. The plan addresses solid waste management challenges and provides a pathway to ensure that solid waste is managed as required by local regulations. Information is being provided to Members of the Workforce and contractors through education and signage regarding recyclable or compostable materials.

5.2 Wastewater Treatment

5.2.1 Performance Status

Wastewater discharge permits with the local publicly owned treatment works are in place for SNL/NM and SNL/CA. The number of personnel served by the wastewater treatment system every workday at SNL/NM was estimated as 8288 for FY 2022. This number was calculated by taking the total number of SNL/NM Members of the Workforce (13,588) and multiplying it by 61 percent, which was the percentage of Members of the Workforce estimated to be reporting on-site during FY 2022. This resulted in 45 metric tons of wastewater treatment-related GHG emissions.

At SNL/CA, an estimated 804 personnel were served by the Livermore Water Reclamation Plant every weekday in FY 2021. There are 1,786 Members of the Workforce at SNL/CA, with an estimated 45 percent reporting on-site daily. This resulted in 4.9 metric tons of wastewater treatment-related GHG emissions in FY 2021.

Wastewater at SNL/TTR is discharged to an evaporation lagoon that is owned and operated by the U.S. Air Force.

6.0 Fleet Management

Fleet management focuses on all fleet-related topics, such as GHG emissions and fleet inventory, mileage, and fuels, including petroleum reduction and alternative fuel use. The FY 2022 Federal Automotive Statistical Tool data is not yet available on the DOE Sustainability Dashboard. The data discussed in this section is through FY 2021.

The SNL Fleet Services department mission is to provide fleet management expertise with a consideration to safety and the customer while focusing on sustainability.

The main Fleet Services operational areas are asset management, employee safety, environmental assurance, fuel management, loan pool, shop operations, and training management. The activities in the operational areas are supervised by team leads, performed by Members of the Workforce, and supported by management, which includes the budget and finance, quality system, information technology, and office administration groups.

The Fleet Services management team ensures effective operation and control of processes through strategic planning, appropriate resources allocation including staffing and performance planning, environmental management, a personnel safety program, project management and marketing, staff meetings and training, and continual improvements (including performing management reviews and monitoring, measuring, and analyzing the processes, objectives, and outputs).

Personnel at SNL/NM manage the vehicle and equipment fleet for New Mexico and all other SNL sites: SNL/CA, SNL/TTR, SNL/KTF, and SNL/Alaska. The current structure of Fleet Services management and operations is presented in [Table 6-1](#) and [Table 6-2](#), respectively.

Table 6-1. Fleet Services personnel

Title or Service	Name	Phone	Bldg.	E-mail
Fleet Services manager	Justin Teo	284-4566	875	jpteo@sandia.gov
Office administrative assistant	Amanda Tena	844-9373	875	atwalke@sandia.gov

Vehicle Fleet administrator	Michael Delgado	845-9381	874	madelga@sandia.gov
Vehicle fleet administrator	Theodore Gunther	284-4278	874	trgunth@sandia.gov
Vehicle fleet administrator	Rebecca Ivey	844-0609	874	rdivey@sandia.gov
Vehicle fleet administrator	To be determined			

Table 6-2. Fleet Services operations

Title or Service	Name	Phone	Bldg.	E-mail
Fleet operations team lead	To be determined			
Maintenance coordinator	Cynthia Cain	284-1105	874	cbcain@sandia.gov
Maintenance coordinator	Deborah Garcia	845-8459	874	dgarc10@sandia.gov
Fleet operations planner	Steven Padilla	239-9017	876	sppadil@sandia.gov
Fleet operations planner	Chelsea Yarborough	328-8979	876	ceyarbo@sandia.gov

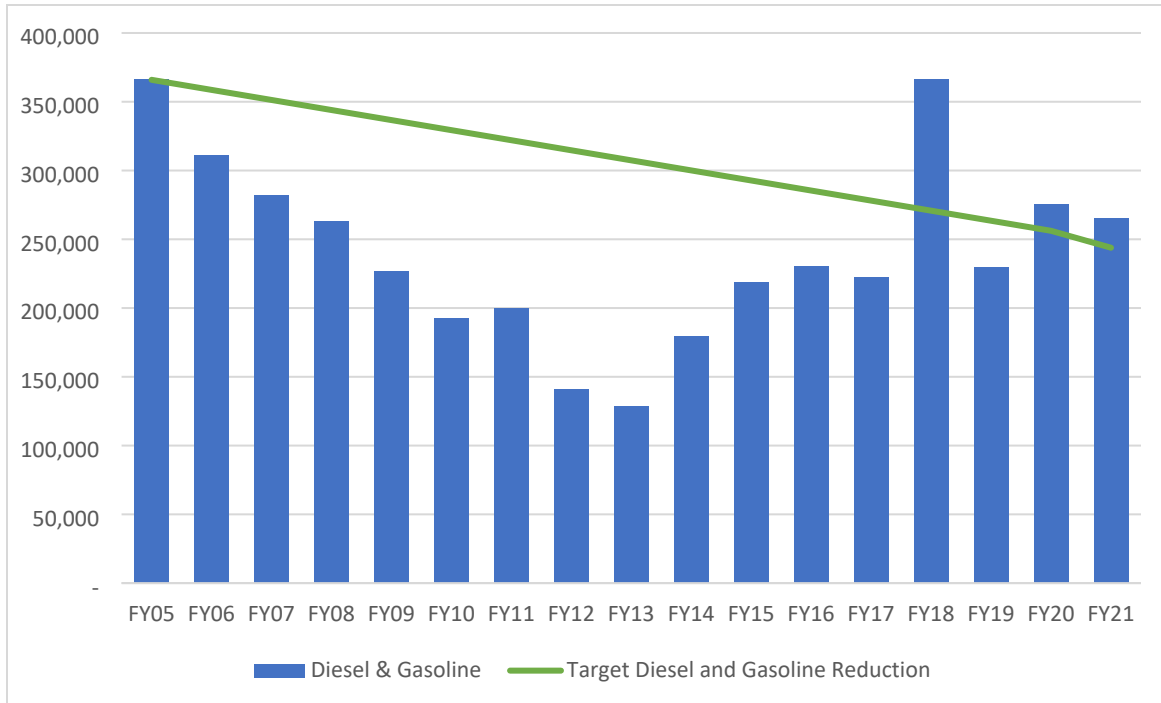
Contact information for the current DOE headquarters Fleet Manager and NNSA headquarters Fleet Manager is listed below:

Benjamin A. Robles, DOE HQ Fleet Manager
 U.S. Department of Energy
 Office of Asset Management (MA-52)
 950 L’Enfant Plaza SW
 Washington, D.C. 20024
 Office: (202) 287-6933
 Email: benjamin.robles@hq.doe.gov

Albert Mitchener, NNSA HQ Fleet Manager
 U.S. Department of Energy/NNSA
 Personal Property Branch (NA-PAS-112)
 Acquisition Policy & Oversight Division
 Washington, D.C. 20585
 Mobile: (240) 204-2775
 Email: albert.mitchener@nnsa.doe.gov

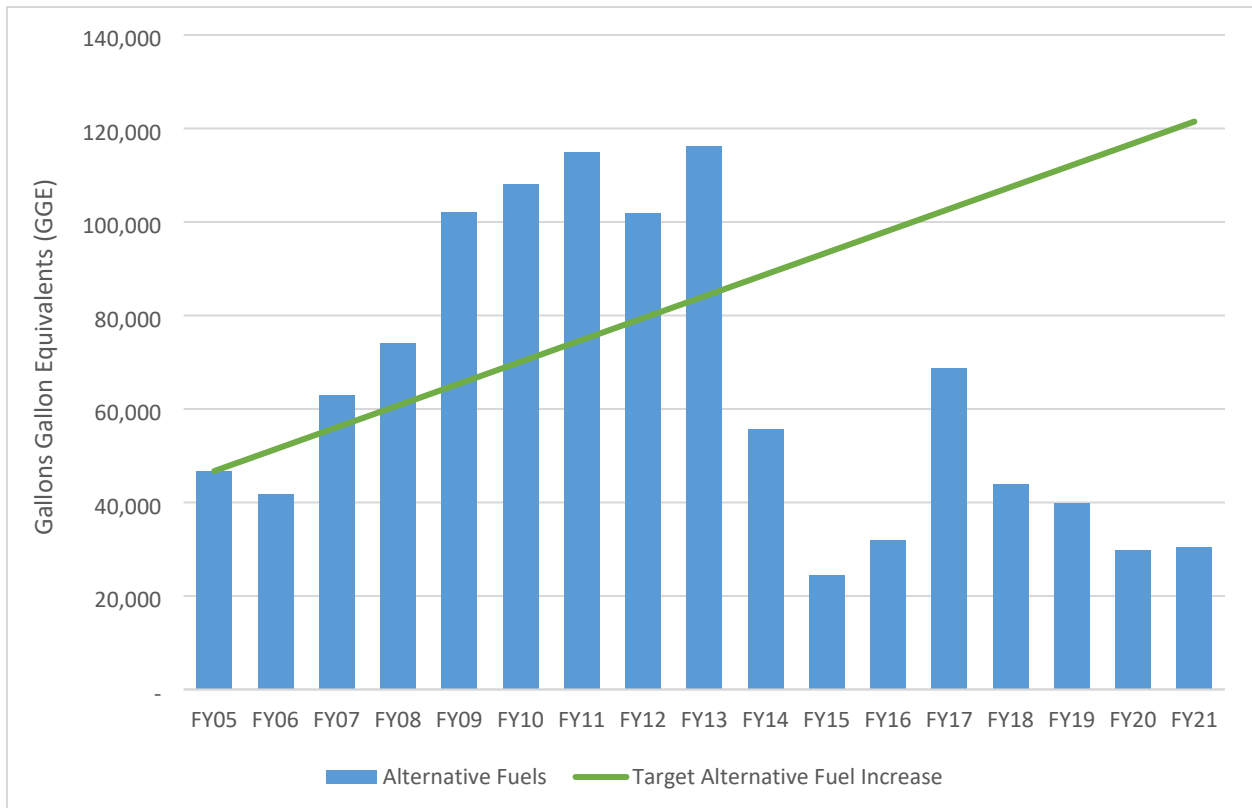
6.1 Performance Status

Figure 6-1 and Figure 6-2 depict fleet petroleum and alternative fuel use through FY 2021, respectively.



Note: Includes all sites. Petroleum fuels include gasoline, diesel, and the diesel portion of B20 (biodiesel that is 20 percent biobased and 80 percent petroleum). Data is presented in gasoline gallon equivalents.

Figure 6-1. Petroleum fuel use, FY 2005–FY 2021



Note: Includes all sites. Alternative fuels include the non-diesel portion of B20, E85, compressed natural gas, and electricity; electrical use includes only SNL/NM data. Data is presented in gasoline gallon equivalents.

Figure 6-2. Alternative fuel use, FY 2005–FY 2021

A slight decrease in petroleum fuel use correlated to a slight increase in alternative fuel use in FY 2021. Vehicle utilization has remained consistent with FY 2020 levels. In previous years, security patrol vehicles at SNL/NM and SNL/CA developed performance issues when using E85 (ethanol-based fuel that is 85 percent ethanol and 15 percent unleaded); these issues were resolved by using gasoline. As a result, E85 was not used for SNL/NM and SNL/CA security patrol vehicles for several years. Although security patrol vehicles are exempt from using alternative fuels, in FY 2021 SNL/NM and SNL/CA personnel requested security patrol vehicles to be fueled with E85 once again.

A significant increase in mission work activities has resulted in an increase in the fleet vehicle inventory and associated fleet vehicle fuel use. Additionally, alternative fuel vehicle options from the U.S. General Services Administration (GSA) are limited

as manufacturers are offering fewer alternative fuel vehicle models than in previous years.

Table 6-3 illustrates the fleet light-duty alternative fuel vehicle acquisition status through FY 2021. In FY 2022, 73 percent of the fleet vehicle inventory (not acquisitions) was comprised of alternative fuel vehicles (E85, B20, hybrid, or electric). Alternative fuel, light-duty vehicles are acquired when available and when functional need exceptions are not required.

Table 6-3. Light-duty alternative fuel vehicle acquisitions, FY 2005–FY 2021

Year	Replacement with Alternate Fuel Vehicles (Percent)	Year	Replacement with Alternate Fuel Vehicles (Percent)
FY 2005	60	FY 2014	98
FY 2006	60	FY 2015	80
FY 2007	68	FY 2016	93
FY 2008	95	FY 2017	61
FY 2009	100	FY 2018	74
FY 2010	96	FY 2019	58
FY 2011	100	FY 2020	100
FY 2012	96	FY 2021	61
FY 2013	100	FY 2022	To be determined

Note: Includes all sites.

All 42 light-duty alternative fuel vehicles acquired in FY 2021 were flex fuel vehicles that can use E85. Most of the FY 2021 alternative fuel vehicle acquisitions were medium duty. Flex fuel vehicle offerings from the manufacturers are declining, and availability will have an impact in the future. High-efficiency vehicles were purchased or leased when cost competitive and available on the U.S. General Services Administration schedule.

Fleet vehicle operators are required to use alternative fuel when available per corporate policy FAC006, *Government Vehicles and Motorized Equipment Policy*, and MAN-008, *Government Vehicle and Motorized Equipment User Guide*. E85 and compressed natural gas are available at the KAFB fuel station for SNL-owned E-plated fleet vehicles that use a fuel key. B20 is no longer available at the KAFB fuel

station. The WEX credit card used by GSA vehicles is no longer accepted at the KAFB station, so GSA vehicles must purchase E85 or B20 at off-site commercial fuel stations. E85 fueling stations are available for use at SNL/CA. Fleet vehicle operators at SNL/NM and SNL/CA are encouraged to use E85 and B20 fuels. Remote sites (SNL/TTR, SNL/KTF, and SNL/Alaska) do not have alternative fuel options available on-site.

To increase the use of E85 in FY 2022, several reminders were placed in the *Sandia Daily News*, designated vehicle owners were contacted, and reminder stickers were placed on the dashboards of newly acquired fleet vehicles. Facilities and Protective Force team leads at SNL/NM were also reminded of the requirement to use E85. Any proposed increase in all-electric vehicles in the fleet vehicle inventory could potentially have a negative impact on future increases in E85 usage.

In 2016, NNSA approved adding 80 vehicles to the fleet vehicle inventory. They were added over a two-year period; 50 vehicles were added in 2017 and 30 were added in 2018, which brought the fleet size to 898. Acquisition of additional all-electric vehicles in FY 2022 was not accomplished because of supply chain delays and the lack of available vehicles from manufacturers and GSA. As a result, the inventory of all-electric vehicles remains at four (all are Chevrolet Bolt models), with three located at SNL/NM and one at SNL/CA. However, charging infrastructure availability was increased for all electric and plug-in hybrid electric vehicles.

- Two solar-powered Level 2 charging stations with capacity for two vehicles each were installed at SNL/NM, and two were installed at SNL/CA in FY 2022. SNL/NM now has seven stations, and SNL/CA has seven stations. These charging stations have been removed from service temporarily pending Nationally Recognized Testing Laboratory certification. A return to service is anticipated in FY 2023.
- At SNL/CA, 10 Level 1 and 6 Level 2 hard-wired electric vehicle charging stations are maintained in two separate parking lots (16 total), with one charging port per charger and 16 designated parking spaces for charging vehicles. At SNL/NM, there are 8 Level 1 hard-wired electric vehicle charging

stations with one charging port each and 2 Level 2 hard-wired electric vehicle charging stations with two charging ports each.

- Thirty-four solar-powered electric carts were acquired in FY 2022, all of which are located at SNL/NM.

The SNL vehicle fleet has been impacted by recent market conditions such as supply chain delays, lack of alternative fuel vehicle and zero-emission vehicle inventory from manufacturers and GSA, and increased costs for vehicles, vehicle leases, replacement parts, and fuel. In addition, implementing a telecommuting and virtual work policy for a larger percentage of the workforce has resulted in reduced vehicle utilization.

The fleet size still stands at 898 vehicles, and the DOE June 2021 vehicle allocation methodology study determined the fleet size to be at an optimal level and did not need to be increased or decreased.

With no anticipation of fleet size increases, future cost projections will include yearly percentage increases and alternative fuel vehicle surcharges from GSA. SNL will continue to support efforts to achieve the DOE optimal fleet profile as prescribed by the DOE June 2021 vehicle allocation methodology study by ensuring that fleet vehicle inventory data is correct, increasing the inventory of plug-in hybrid vehicles and zero-emission vehicles when available, and expanding the use of telematics (telecommunication networks in vehicles for collecting performance data).

SNL/NM has a waiting list of over 100 vehicle requests from multiple departments that have not been filled due to the 898-vehicle maximum. To address these vehicle requests without increasing fleet size or cost, vehicle utilization data is being analyzed to determine whether underutilized vehicles can be shared or reallocated to other departments with vehicle needs.

Vehicle use policies are governed by corporate policy FAC006, *Government Vehicles and Motorized Equipment Policy*, and MAN-008, *Government Vehicle and Motorized*

Equipment User Guide, which apply to both long-term vehicle assignments and short-term loan pool vehicles. Members of the Workforce can access the Fleet Services Loan Pool by using the self-service KeyValet reservation portal or by contacting a maintenance coordinator. Members of the Workforce are required to abide by the operator requirements listed in MAN-008, including the Government Vehicle and Motorized Equipment Operator Checklist and the “Appropriate Use of Government Vehicles and Motorized Equipment,” “Authorization to Take a Government Vehicle Home,” and “Fueling and Fuel Consumption” sections.

As electrical vehicle supply equipment and zero-emission vehicles are incorporated into the fleet to align with Executive Order 14057, training on electrical vehicle supply equipment and zero-emission vehicle operation will be developed to ensure a smooth transition for Members of the Workforce to an all-electric vehicle fleet.

SNL currently maintains a personal electric vehicle charging program. The program allows Members of the Workforce to use the existing Fleet Services electric vehicle charging infrastructure to charge their personal vehicles when charging stations are not in use for Fleet Services vehicles. This benefit is available at SNL/NM and SNL/CA, and the cost to Members of the Workforce is \$10.00 per month.

Fleet Services personnel comply with SNL procurement processes and procedures when reviewing contracts and requirements. When customers communicate the need for acquiring a fleet asset, existing assets are reviewed to determine how to best fill the need through loan, rental, reassignment, lease, or purchase. A needs analysis is performed by reviewing technical specifications and functional requirements with the customer. The analysis ensures a match with actual need, the ability to maintain the unit, and consideration for safety and environmental matters including right-sizing the fleet and reducing petroleum consumption. The acquisition process is described in PCD-114, *Acquisition, Reassignment and Replacement of Vehicle and Motorized Equipment*. Technicians, staff, and management verify that purchased and leased vehicles, motorized equipment, and other fleet assets meet ordered requirements.

A vehicle fleet administrator is responsible for oversight of the vehicle disposition process and for ensuring compliance with 41 CFR 102-39, *Replacement of Personal Property Pursuant to the Exchange/Sale Authority*. Vehicles and motorized equipment are continuously evaluated and analyzed for disposition. Asset disposition may be performed by transferring an asset to another SNL organization or government agency, integrating it into the Fleet Services loan pool, trading it in, auctioning it off, and, in rare cases, cannibalizing it. Recovered funds from auctions are applied to the acquisition of other assets. The disposition process is described in PCD-116, *Disposition of Vehicles and Motorized Equipment*.

Vehicles and motorized equipment assigned to organizations for long-term use must meet minimum utilization requirements known as local use objectives. The current local use objectives, presented in [Table 6-4](#), have been negotiated and established with NNSA in accordance with utilization requirements in 41 CFR 109-38.5103, *Motor Vehicle Utilization Standards*, and 41 CFR 109-38.5105, *Motor Vehicle Local Use Objectives*.

SNL uses Fleet Focus, a commercial off-the-shelf fleet management system developed by Assetworks, to manage vehicles and motorized equipment at all SNL sites. This includes vehicle and equipment data, preventive maintenance schedules, work order management, parts and labor costs, utilization, fuel use, and various report generation.

Mileage information for 70 percent of fleet vehicles is reported on a continuous basis to Fleet Focus via Verizon Network Fleet telematics. The remaining 30 percent of the fleet vehicles use an internal mileage application that requires manual entry on a monthly basis to report mileage. Installing telematics on the remaining 30 percent of the fleet is a goal for FY 2023.

Table 6-4. Local use objectives

Vehicle Type	Local Use Objective
Passenger vehicles – Sedans with general purpose use	150 miles per month
Light-duty vehicles and trucks (4X2) – Vans, trucks, and sport utility vehicles (less than 12,501 GVWR)	150 miles per month

Vehicle Type	Local Use Objective
Medium-duty vehicles and trucks – Vans, trucks, and sport utility vehicles (12,500 to 23,999 GVWR)	130 miles per month
Light-duty all-wheel drive (4X4) vehicles and trucks – 4X4 vans, trucks, and sport utility vehicles (less than 12,501 GVWR)	130 miles per month
Heavy-duty vehicles and trucks – Trucks (24,000 GVWR and over)	130 miles per month
Motorized carts – Albuquerque	10 miles per month or 1 hour of use per month
Motorized carts – Livermore	5 miles per month, or 0.5 hours of use per month (1 hour every 2 months)
DOE special-purpose and other motor vehicles – Vehicles and motorized equipment used or designed for specialized functions are exempt from utilization requirements. These units include but are not limited to trailers, semitrailers, trailing equipment, trucks with permanently mounted equipment, material handling equipment, firefighting equipment, emergency vehicles, law-enforcement vehicles, and buses.	No local use objective requirements

GVWR = gross vehicle weight rating

Fuel transactions for SNL-owned vehicles and equipment are recorded by FuelMaster, a commercial off-the-shelf fuel management system. Data from FuelMaster is uploaded regularly to Fleet Focus. Fuel transactions for GSA-leased vehicles are reported directly to GSA through the WEX credit card associated with each GSA vehicle.

In addition, SNL is required to use federal systems to maintain information on SNL-owned and GSA-leased vehicles. GSAFleet.gov is used to track and manage all government-owned license plates. SNL-owned E-plated vehicles that were formerly entered and maintained in FEDFMS are now maintained in GSAFleet.gov, and GSAFleet Drive-Thru is used to track preventive maintenance and generate FAST reports for GSA-leased vehicles.

In FY 2022, studies were conducted to transition the fleet to zero-emission vehicles at both SNL/CA and SNL/NM. These studies resulted in plans that describe current fleet and site conditions as well as recommendations for zero-emission vehicle acquisitions and associated installment of electrical vehicle supply equipment. The electrical vehicle supply equipment plans include total project costs for both SNL/NM and SNL/CA. FY 2024 ERICA funding was requested to begin design and

construction phases associated with these planning efforts. It is unknown whether or when funding will be awarded.

6.2 Plans and Projected Performance

DOE sets petroleum fuel (diesel and gasoline) reduction goals; however, property management requirements and the high cost of alternative fuel vehicles pose a challenge to meeting these goals. Although hybrid vehicles (gas-electric configurations) are considered alternative fuel vehicles and impact the 75 percent alternative fuel vehicle-replacement goal for light-duty vehicles, hybrid vehicles do not increase alternative fuel consumption.

Petroleum fuel consumption for fleet vehicles will be reduced by doing the following:

- If available, specify alternative fuel (E85 and B20) vehicles when ordering replacements to reduce reliance on petroleum fuels.
- Continue to monitor and manage fleet vehicle utilization to minimize vehicle miles driven and optimize future acquisitions.
- Continue to replace gas-powered carts with electric- or solar-powered carts. In FY 2022, 18 gas-powered carts were retired or replaced. There are 58 gas-powered carts left in the fleet: 26 at SNL/NM, 23 at SNL/CA, and 9 at SNL/KTF.
- Convert existing Club Cars to a solar photovoltaic-powered capability.
- Right-size the inventory of fleet vehicles based on determination of the most fuel-efficient vehicle for the required task, and provide the appropriate type and number of vehicles relative to need.
- Employ strategies that improve fuel use efficiency, including use of low-rolling-resistance tires and use of synthetic oil to extend replacement frequencies.
- Employ anti-idling measures, including telematics technology, on all fleet vehicles to monitor compliance with the anti-idling policy.
- Continue to encourage fleet vehicle operators at SNL/NM to purchase E85 fuel at off-site commercial fuel stations. This will include reminders in the

Sandia Daily News, emails to the designated vehicle owners, and stickers on the dashboards of every E85-compatible vehicle.

- Continue to evaluate opportunities to accommodate and encourage the use of personally owned electric and hybrid gas-electric vehicles by Members of the Workforce who commute to work (e.g., by expanding the existing vehicle-charging infrastructure).
- Purchase or lease high-efficiency vehicles when cost competitive and available on the GSA schedule.

If there are no barriers to attainment, such as lack of funding for electrical vehicle supply equipment or availability of GSA electric vehicle replacements, light-duty vehicles will be fully electric by 2027 at SNL/CA (Figure 6-3) and by 2032 at SNL/NM (Figure 6-4). Both sites will have replaced all medium-duty vehicles with electric vehicles by 2035.

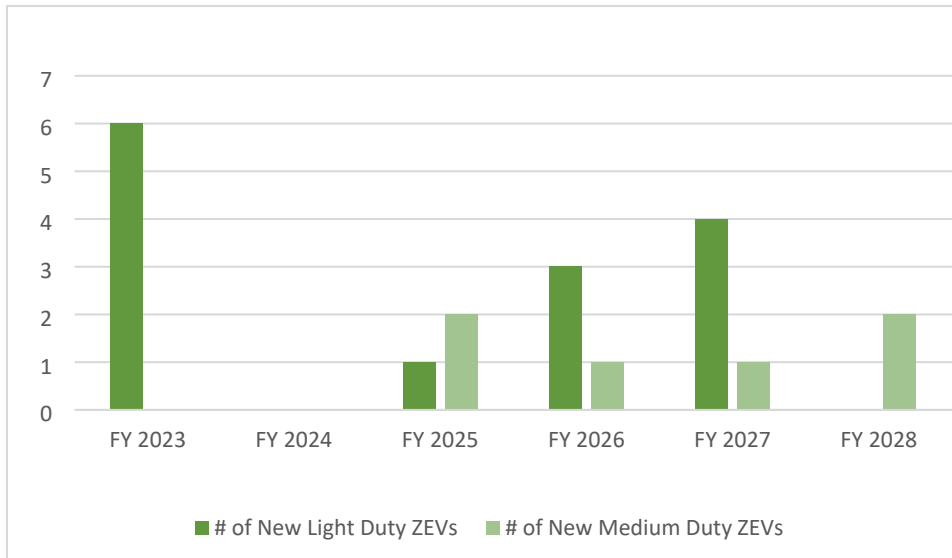


Figure 6-3. Zero-emission vehicle acquisition schedule at SNL/CA, FY 2023–FY 2028

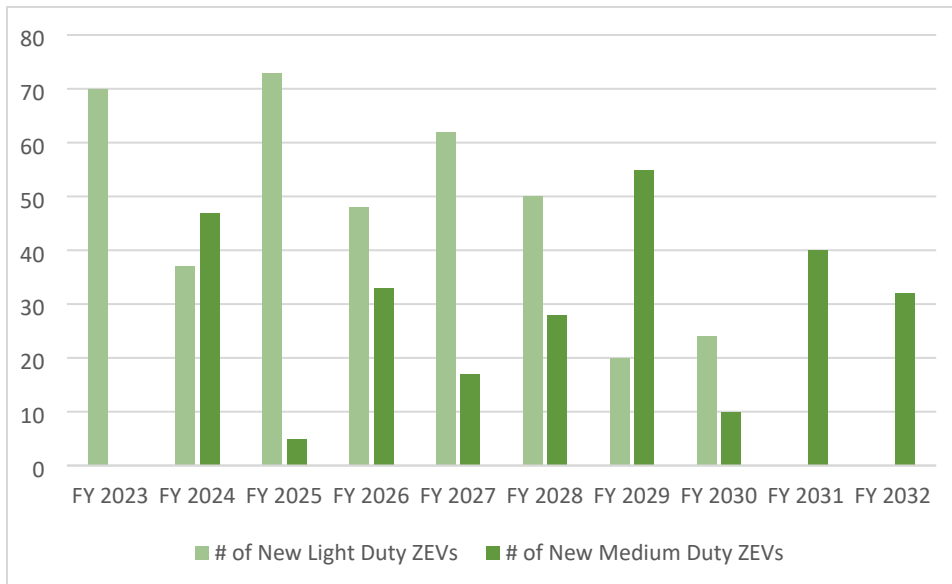


Figure 6-4. Zero-emission vehicle acquisition schedule at SNL/NM, FY 2023–FY 2032

Over 388 charging stations are planned to be located in various technical areas in existing lots as well as in central hub locations at SNL/NM; this will be implemented strategically across fiscal years to support fleet transitions. A similar approach is planned for SNL/CA with 6 new charging stations. Both plans utilize existing charging stations and infrastructure wherever possible.

The most prominent risks to attaining fleet management goals are the potential lack of electrical capacity to support expanding electrical demand (both at the building level and capacity beyond SNL), the availability of funding for electrical vehicle supply equipment, the availability of zero-emission vehicles on the market, and GSA’s ability to provide zero-emission vehicles. These risks may also impact emissions goals found in Executive Order 14057 and other federal directives.

7.0 Clean and Renewable Energy

Clean and renewable energy focuses on clean and renewable energy use as a percentage of overall energy use.

7.1 Performance Status

As part of efforts to increase the use of carbon pollution-free electricity and clean and renewable energy, energy managers have developed a strong working relationship with the SNL research and development community. A collaborative working group, Resilient Energy at Sandia, meets monthly to discuss topics of interest and potential partnerships between communities.

On-site renewable energy systems at SNL/NM are managed by the Photovoltaic System Energy Laboratory and the Distributed Energy Technology Laboratory. These small-scale systems are used as research testbeds and have modular designs that result in fluctuating energy production.

[Figure 7-1](#) shows renewable electric generation through FY 2022.

SNL personnel are working with NNSA to develop a new electrical contract for SNL/NM. This contract will address the statutory requirements around carbon pollution-free electricity.

Currently, renewable energy goals at SNL/NM, SNL/CA, and SNL/TTR are met through procurement of renewable energy credits. The scope for procuring these credits is being adjusted to meet the most recent requirement for energy attribute credits as identified in Executive Order 14057.

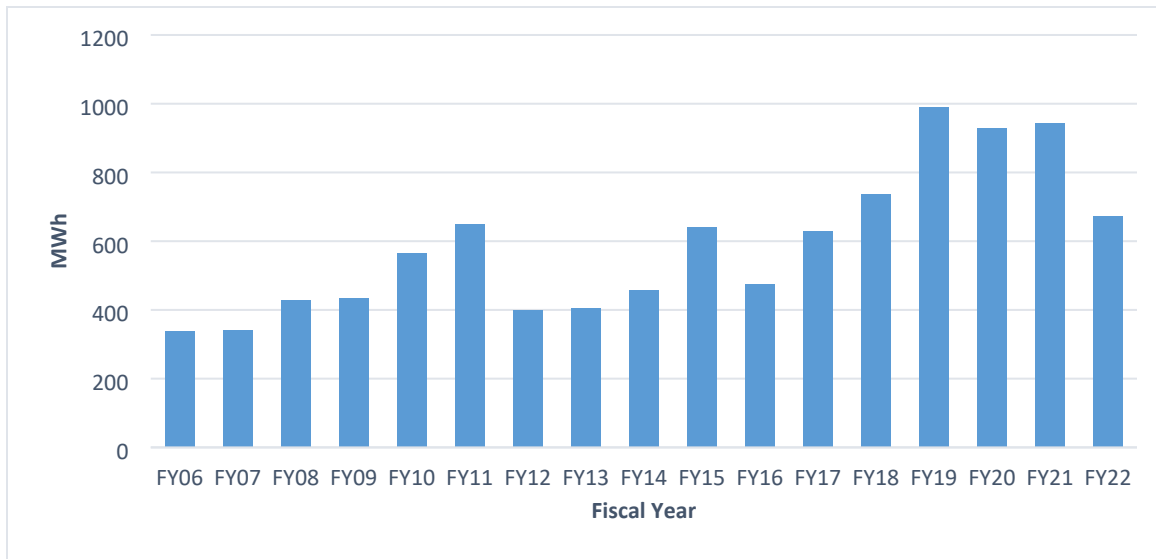


Figure 7-1. Renewable electric generation at SNL/NM and SNL/CA, FY 2006–FY 2022

SNL personnel have developed several solutions that could enable the use of carbon pollution-free and renewable energy resources. Several microgrid configurations have been modeled as a potential resiliency solution at SNL/NM. The Sandia California Net Zero Plan also includes the development of a microgrid. In addition, mechanical engineering subject matter experts are evaluating the replacement of fossil fuel-based heating systems. As appropriate, they are updating designs and standards.

The electrical contract for SNL/NM is approaching end of term, and SNL personnel are supporting NNSA in the development of a new contract. This contract will reflect DOE procurement policy guidance on the purchase of electricity, energy products, and energy by-product from Native American tribes.

7.2 Plans and Projected Performance

Several future renewable energy system configurations are being considered for SNL/NM. Researchers have developed models and documentation for solutions that address peak demand for both SNL and KAFB and solutions that could provide resiliency solutions for groups of buildings. However, the complexity of the models may slow implementation speeds. Energy managers at SNL have collaborated with

researchers on a renewable energy design philosophy that modeled several smaller scale projects for SNL/NM (Table 7-1).

Table 7-1. Installation power potential at possible photovoltaic sites

Site	Area (Acres)	Type	Minimum Power Potential (MW)	Maximum Power Potential (MW)	Average Power Potential (MW)	Average Annual Power Potential (MWh)	Annual Benefit (\$0.04/kWh)
1	8.5	Covered parking	3.3	6.5	4.7	8,605	344,207
2	8.25	Covered parking	3.2	6.2	4.5	8,352	334,083
3	8	Covered parking	3.1	6.1	4.4	8,099	323,960
5	18	Open space, 1-axis	3.75	3.9	3.8	8,912	356,490
6	18	Open space, 1-axis	3.75	3.9	3.8	8,912	356,490
Totals			17.1	26.6	21.2	42,880	1,715,230

SNL personnel developed a solar power plan, *100% Carbon-Free Electricity for Sandia NM and KAFB Using Concentrating Solar Power (CSP)*, in 2021 as a concept that could meet and potentially exceed the power need to support SNL and the U.S. Air Force base it is located on. Concentrating solar thermal power systems provide clean electricity, heat, and long-duration energy storage. A system illustration is provided in Figure 7-2. This system uses an array of mirrors to reflect sunlight in order to heat a material to high temperatures. A heat exchanger is used to extract the heat stored in the material. That heat is used to operate a turbine or generator for electricity production.

Separate from the concentrated solar power project, a study was performed on a set of buildings to evaluate the benefits and feasibility of a microgrid with renewable energy to increase the reliability of electrical service. The study focused on islanding a selected cluster of buildings for grid outages of up to 30-days. The energy generation assets to be evaluated for conceptual design included photovoltaic, battery storage, and diesel generation, with an emphasis on maximizing renewable energy usage. The SNL Microgrid Design Toolkit was chosen as the simulation

platform to evaluate and compare conceptual microgrid designs, both in performance and capital costs.

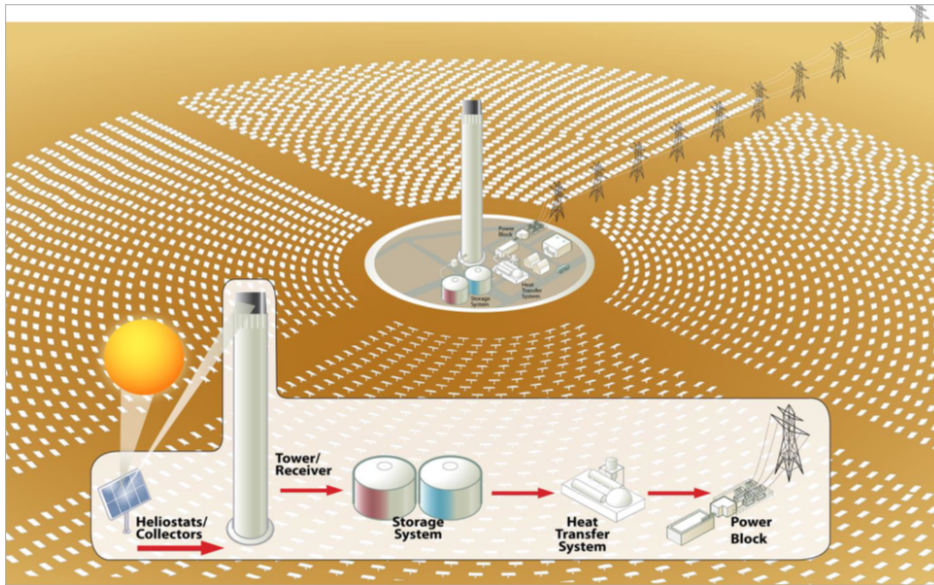


Figure 7-2. Example of a power-tower concentrating solar power facility

As part of the wholistic approach to making the SNL/CA campus net zero emissions, a 17.5 MW solar array with energy storage is being proposed as shown in [Figure 7-3](#). This array would support the larger net zero emission microgrid concept for the campus.



Figure 7-3. Proposed solar array for SNL/CA

Time frames for all these projects are unknown. Best-case timeline scenarios were developed; however, it is unlikely that any of these projects could be constructed before FY 2028. Renewable electric and thermal energy forecasts can be found in [Table 7-2](#) and [Table 7-3](#).

[Table 7-2](#) projects on-site renewable electric energy generation and consumption, purchased green electric energy, renewable energy credits, and total electricity consumption through FY 2027. All on-site renewable electric energy generation is consumed on-site.

Table 7-2. Renewable electric energy generation and consumption, FY 2022–FY 2027

Renewable Electric Energy (MMBtu)	Actual FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
On-site renewable electric energy generation ¹	2,296	3,215	3,215	3,215	3,215	3,215
On-site renewable electric energy consumption	2,298	3,215	3,215	3,215	3,215	3,215
Purchased green electric energy ²	1,364	1,364	1,364	1,364	1,364	1,364
Renewable energy credits ³	310,504	310,504	310,504	313,904	317,316	320,728
Total electricity consumption ⁴	1,074,315	1,127,738	1,208,490	1,365,954	1,375,670	1,385,482

Notes:

¹Renewable electric energy generation in FY 2022 is for projects installed. No contracted, funded, or otherwise specific renewable energy generation systems can be projected beyond FY 2022.

²Purchased green electric energy is based on the approximate 7 percent provided from the LLNL photovoltaic system.

³Renewable energy credit purchases are based on goal requirements and not on an increase in total site energy use from FY 2021.

⁴Total electricity consumption is based on SNL/NM and SNL/CA numbers for FY 2022.

Table 7-3 projects total renewable energy (electric and thermal) generation and consumption relative to total site energy consumption through FY 2027.

Table 7-3. Total renewable energy (electric and thermal) generation and consumption, FY 2022–FY 2027

Renewable Thermal and Electric Energy (MMBtu)	Actual FY 2022	Planned FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
On-site renewable electric energy generation ¹	2,296	3,215	3,215	3,215	3,215	3,215
On-site thermal energy generation ²	445	445	445	445	445	445
Purchased green electric energy ³	1,364	1,364	1,364	1,364	1,364	1,364
Renewable energy credits ⁴	310,504	310,504	310,504	313,904	317,316	320,728
Total energy consumption ⁵	1,381,541	1,475,492	1,562,041	1,731,391	1,744,579	1,757,898

Notes:

¹Renewable electric energy generation for FY 2022 is for projects installed. No contracted, funded, or otherwise specific renewable energy generation systems can be projected beyond FY 2022.

²Thermal energy generation for FY 2022 is for the Building 848 geothermal energy system.

³Purchased green electric energy is based on the approximate 7 percent provided from the LLNL photovoltaic system.

⁴Renewable energy credit purchases are based on goal requirements and not on an increase in total site energy use from FY 2021.

⁵Total energy consumption is based on SNL/NM and SNL/CA numbers in FY 2022.

The new requirements for energy attribute credits have created a challenge for SNL. SNL personnel have been notified by the renewable energy credits provider that there are no credits for systems built after 2021 for any of the Sandia grid regions.

As personnel become more familiar with carbon-free technologies, they can implement them into designs more effectively. To evaluate functionality, there are plans to pilot new technologies in existing buildings while also incorporating these technologies in new build designs. The ESPC will also incorporate energy conservations measures related to carbon pollution-free electricity.

The electrical contract for SNL/NM is approaching end of term, and SNL personnel are supporting NNSA in the development of a new contract. This contract will reflect DOE procurement policy guidance on the purchase of electricity, energy products, and energy by-product from Native American tribes.

As other energy contracts reach end of life, SNL personnel will support NNSA with the renewal process. SNL personnel will continue to advocate for the procurement of clean and equitable utilities.

8.0 Sustainable Buildings

Green building development focuses on green building-related topics, such as the *Guiding Principles* for high-performance sustainable buildings and building inventory changes and design.

8.1 Guiding Principles

8.1.1 Performance Status

In FY 2022, three new building designs received LEED Gold certification. Buildings 812 and 706 at SNL/NM and Building C902 at SNL/CA received their third-party LEED certification for new building design and construction. With the addition of these buildings, progress toward sustainable building goals is represented [Table 8-1](#).

Table 8-1. Meeting goals through implementation of the *Guiding Principles*

Compliance Calculation Method	Compliant Building Values	Total Building Values	Percent Compliant
Calculated by number of buildings	36	192	18.75
Calculated by building square footage	1,376,671	6,587,349	20.89

All buildings constructed at SNL sites are required to conform to a simple box energy model that shows the building design is projected to perform 30 percent better than an ASHRAE 90.1-2013, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, baseline case. This ensures that designers consider the most efficient approaches in their designs and then buildings operate in an efficient manner. An energy management team reviews design documents for all new buildings to ensure that this requirement is met. This fiscal year, the energy management team developed a sustainable building checklist for ensuring that all new designs meet 42 USC 6834, *Federal Building Energy Efficiency Standards*.

Currently all new buildings and major renovations with a cost greater than \$50 million require at a minimum LEED Gold certification. The new requirements released as part of the Deputy Secretary of Energy’s *Memorandum on Climate*

Adaptation, Resilience and Sustainability in Project Management, April 5, 2022, have not yet been added to Sandia's Prime Contract. Energy managers can and will encourage project teams to incorporate these requirements; however, it is unlikely that project teams will make major adjustments to their projects without the backing of a Prime Contract requirement. This is especially true if they anticipate changes in project cost. On recent line item-sized projects, NNSA personnel have provided support. Their participation and suggestions have encouraged SNL project teams to incorporate sustainability requirements even when not required by the Prime Contract. Their continued support is invaluable.

Energy management personnel are part of the SNL Standards Review Committee and also maintain ownership of the site sustainability sections of MAN-004, *Sandia National Laboratories/New Mexico Design Standards Manual*, and specifications. The Standards Review Committee reviews all suggested changes to the design manual, specifications, and standard drawings and then adopts them by vote. Energy management personnel review changes to ensure that they do not conflict with sustainability requirements.

SNL has several leased buildings, and Energy Star certification has not been required for those spaces. New requirements will need to be added to future leasing agreements.

8.1.2 Plans and Projected Performance

Personnel will continue to get new buildings certified with LEED and *Guiding Principles* as defined in the Prime Contract. To enable recertification every four years, existing energy audit and monitoring-based commissioning efforts will be leveraged. For both new and existing buildings, the energy efficiency credits are always the most difficult. Sandia's mission and associate design methodologies can make this complex. SNL facilities are commonly built with the future in mind, and that often leads to over-design of a facility. Energy attributes credits are becoming more difficult to procure, and the new guidance in Executive Order 14057 may make it more challenging for new and existing buildings to be certified.

A life cycle asset management plan outlines the funding needed to bring existing buildings into compliance with the *Guiding Principles*. This can be a costly endeavor considering the age of many facilities. Cost is also a limiting factor for bringing existing buildings into compliance, and the new recertification requirement has an associated cost. There is concern that bringing more buildings into compliance will tax the sustainability compliance budget and pull funds from other efforts, such as utility metering.

New building designs will continue to be reviewed to ensure that they are performing 30 percent better than ASHRAE 90.1 standards. As new building requirements evolve, sustainability reviews will also have to adapt. There are plans to update the existing sustainability checklist to incorporate net zero emission and carbon pollution-free electricity requirements.

When requirements to integrate sustainability and resiliency measures with capital asset construction, renovation, and modernization projects that have an anticipated total project cost of \$50 million or more (critical decision 1 for a capital line item) are added to the Prime Contract, the requirements will need to be added to MAN-004, *Sandia National Laboratories/New Mexico Design Standards Manual*, and specifications. Training will be provided to project personnel to ensure that they understand the new requirements.

The sustainability sections of the design manual will continue to be reviewed and updated on an annual basis. New requirements will be incorporated as they are added to the Sandia Prime Contract. As changes are made, they will be conveyed to project teams.

Moving forward, the site sustainability team will ensure that the SNL leasing team is familiar with the requirements for leases to be Energy Star buildings.

8.2 Net Zero Emissions

8.2.1 Budget and Performance Contract Integration

The approach to integrating energy, water, waste, fleet, facilities, operations, resilience, and procurement activities with developing, prioritizing, and tracking sustainability projects within out-year budgets and with opportunities for alternative financing through performance contracts is all part of the net zero emissions goal.

8.2.1.1 Performance Status

To integrate energy, water, waste, fleet, facilities, operations, resilience, and procurement activities, SNL personnel have set up several reoccurring meetings. The Sustainability Across Organizations meetings will identify areas of concern and track progress on goals. Monthly sustainability status meetings will encourage collaboration with SFO. In these meetings, personnel from each program will highlight progress and barriers. The goal is to understand program priorities and keep SFO up-to-date.

Sustainability projects are developed in many ways. Most of the existing projects are driven by sustainability requirements and life cycle asset management plans. However, other projects are incorporated following input from Facilities subject matter experts and general Members of the Workforce. All projects are prioritized using the Sandia Infrastructure Investment Planning process and the Sandia Infrastructure Investment Database. Projects receive a score based on their potential to maintain sustainability compliance and reduce energy and water consumption.

8.2.1.2 Plans and Projected Performance:

Subject matter experts for energy, water, waste, fleet, facilities, operations, resilience, and procurement activities will continue to work together to implement sustainability goals including those related to sustainable buildings. The site sustainability team will continue to share their message with Sandia's leadership in an effort to encourage the implementation of sustainability projects.

8.2.2 Fossil Fuel Reduction

Integrating fossil fuel reduction design strategies per 42 USC 6834, *Federal Building Energy Efficiency Standards*, is part of net zero emission efforts.

8.2.2.1 Performance Status

The net zero emission plans for both SNL/NM and SNL/CA include a foundational effort to implement energy and fossil fuel conservation measures. Net zero emission efforts have not yet been added to Sandia's Prime Contract. The sustainability team can and will encourage project teams to incorporate these requirements; however, it is unlikely that project teams will make major adjustments to their projects without the backing of a Prime Contract requirement. This is especially true if they anticipate a cost change to the project. On recent line item-sized projects, the sustainability team from NNSA has been providing support. Their participation and suggestions have encouraged Sandia project teams to incorporate sustainability requirements even when not required by the Prime Contract.

8.2.2.2 Plans and Projected Performance:

When net zero emission requirements are added to the Prime Contract, the site sustainability team will ensure that the requirements are added to MAN-004, *Sandia National Laboratories/New Mexico Design Standards Manual*, and specifications. The team will also provide training to project personnel to ensure that they understand the new requirements.

8.2.3 Stakeholder Participation

Coordination is needed among stakeholders who are identified to promote net zero emission.

8.2.3.1 Performance Status

Several groups are focused on sustainability and net zero emissions. At SNL/CA, Department 8502, was developed to address net zero emission efforts. In addition, Department 8900, Climate Change Security, personnel address the oversight of corporate net zero emission goals. At SNL/NM, Department 4851 personnel are

taking the lead on developing a net zero emission plan. Along with these leads for net zero emission efforts, support has been provided from across Sandia.

8.2.3.2 Plans and Projected Performance

As the Sandia net zero emission plans move into the execution phase, more individuals will become stakeholders and coordination will need to expand.

8.2.4 Accelerated Goal Strategies

Strategies are needed to accelerate net zero emission goal achievements.

8.2.4.1 Performance Status

The ESPC is the current strategy for accelerating achievement of net zero emission goals, such as developing deep energy retrofits, building electrification, and replacing fossil fuel consuming equipment.

8.2.4.2 Plans and Projected Performance

SNL will continue to support NNSA in the execution of the ESPC. This will be critical since funding is the limiting factor for achieving net zero emission goals, such as developing deep energy retrofits, building electrification, and replacing fossil fuel consuming equipment.

8.2.5 Technological Strategies

Technologies are needed to achieve net zero emission, and strategies are needed to address or collaborate on these challenges.

8.2.5.1 Performance Status

SNL has several unique facilities and mission needs that require great amounts of energy to operate. These facilities also have uptime requirements. Many new technologies will need to be identified, piloted, monitored, and deployed to achieve net zero emissions.

8.2.5.2 Plans and Projected Performance

Some technologies will be piloted on their own, and some will be benchmarked with other national laboratories to determine the best technologies for net zero emissions.

8.2.6 Site-Wide Framework

A high-level strategy is needed for applying a site-wide net zero emissions framework to complement building-level efforts.

8.2.6.1 Performance Status

The Net Zero Roadmap for SNL/CA addresses both building-level and site-level needs. The plan being developed for SNL/NM will also address individual building upgrades as well as site-level solutions.

8.2.6.2 Plans and Projected Performance

Energy efficiency needs to be increased at the building level so the site-level project can be sized properly. Comprehensive net zero emissions roadmaps will address issues at both SNL/NM and SNL/CA.

8.2.7 Modernization and New Construction Compliance

Efforts are in place to ensure that new construction and modernization projects greater than 25,000 square feet entering the design phase in FY 2022 and beyond are net zero emissions by 2030.

8.2.7.1 Performance Status

Net zero emission efforts have not yet been added to Sandia's Prime Contract. The energy management team can and will encourage project teams to incorporate these requirements; however, it is unlikely that project teams will make major adjustments to their projects without the backing of a Prime Contract requirement. This is especially true if they anticipate a cost change to the project. On recent line item-sized projects, the site sustainability team from NNSA has been providing support. Their participation and suggestions have encouraged Sandia project teams

to incorporate sustainability requirements even when not required by the Prime Contract.

8.2.7.2 Plans and Projected Performance

When net zero emission requirements are added to the Prime Contract, the energy management team will ensure that the requirements are added to MAN-004, *Sandia National Laboratories/New Mexico Design Standards Manual*, and specifications. The team will also provide training to project personnel to ensure that they understand the new requirements.

8.2.8 Fossil Fuel Opportunities and Challenges

Opportunities and challenges exist for reducing emissions from process loads that consume fossil fuel in support of manufacturing, industrial, commercial, or research processes.

8.2.8.1 Performance Status

SNL has several unique facilities and mission needs that require great amounts of energy to operate. These facilities also have uptime requirements. Many new technologies will need to be identified, piloted, monitored, and deployed to achieve net zero emissions. Process loads are not typically metered independently, and they are not commonly excluded from energy use intensity goals.

8.2.8.2 Plans and Projected Performance

Some technologies will be piloted on their own, and some will be benchmarked with other national laboratories to determine the best technologies for net zero emissions. Where required, Sandia may need to consider implementation of load submetering.

9.0 Acquisitions and Procurement

Acquisitions and procurement focus on nonelectronic acquisitions, procurement, and GHG supply chain topics.

9.1 Performance Status

To maximize acquisition of sustainable products, purchasing agreements at SNL/NM and SNL/CA adhere to DOE Acquisition Regulation Clause 970.5223-7, “Sustainable Acquisition Program,” which is part of Sandia’s Prime Contract.

In FY 2022, efforts to increase acquisitions that follow designated product environmental specifications for SNL/NM included the following:

- Existing acquisition workflows and processes were further evaluated to identify opportunities for improving compliance through collaboration among departments that owned the various portions of the processes. The interdepartmental team consisted of personnel from Procurement, Facilities Management and Projects, Prime Contract, ES&H, Integrated Supply Chain Management, Information Engineering, and SFO.
- Information on sustainable acquisition reporting requirements was added into the request for information and request for quote processes to alert interested parties of the additional work required to satisfy the contracts.
- Rules were created in Oracle that would add the updated 350APR clause (green language to satisfy FAR 52.227-17, *Affirmative Procurement of EPA-designated Items in Service and Construction Contracts*) into applicable contract categories, which resulted in the clause being added to 51 purchase orders and contract purchase agreements valued at over \$132 million.
- The ecomedes tool modifications were completed, user testing and feedback was conducted, and the tool was launched in January. Subcontractors were provided a user’s guide, training, and a video tutorial to familiarize them with the new reporting mechanism.
- Automated notifications are generated and sent to the subcontractor and Sandia Delegated Representatives, indicating that a newly awarded purchase

order or contract purchase agreement includes the 350APR clause. The email includes the clause language, reporting structure, link to the tool, sign-up code, and link to the user's guide and video tutorial. The Materials Sustainability Program lead sends a follow-up email to Sandia Delegated Representatives associated with contracts that include the 350APR clause to inform them when the subcontractor does not submit a quarterly report. The email includes a request for the Sandia Delegated Representative to reject any incoming invoices and notify the subcontractor that a report must be submitted to be compliant with the contract's terms and conditions.

- Communications, training opportunities, and the updated 350APR clauses were distributed to affected personnel at SNL/NM. A dedicated entity email account was created and advertised as the channel to submit requests for assistance, questions, and concerns related to the new reporting tool and associated work processes.
- ES&H personnel engaged with Facilities Materials Sustainability Program personnel to develop Environmental Management System objectives that focus on sustainable acquisitions for FY 2022.
- The Facilities Materials Sustainability Program lead aggregates data received from subcontractors and filters it accordingly for submittal into required reports, partners with Procurement personnel to obtain data on applicable contracts for the inclusion of sustainable acquisition language and the monetary value of applicable contracts, and enters the data into the DOE Sustainability Dashboard.

SNL personnel complete a National Environmental Policy Act (NEPA) checklist for all proposed construction activities. The NEPA Program lead evaluates each project for utilization of products that fall under various environmental specifications. If it is determined that a project will include use of designated products, a requirement is added to the checklist. The added requirement informs the NEPA checklist owner that the subcontractor hired to complete the construction project must submit a

report that includes the designated products using the ecomedes platform if the contract will be valued more than \$250,000.

Oracle software is used to identify applicable contracts using North American Industry Classification System codes, and sustainable acquisition clauses are added to contracts valued over \$250,000. The applicable terms and conditions include the Federal Acquisition Regulation and DOE Acquisition Regulation sustainable acquisition clauses. The Oracle database is queried to extract a list of contracts valued over \$250,000 that have sustainable acquisition clauses. The Materials Sustainability Program lead evaluates the list to distill which contracts should be included in reporting.

With regard to supply chain vulnerabilities and actions taken or planned to address each risk, the Quality Level Program establishes a graded approach to procurement and supply chain activities using four risk-based quality levels. Each quality level corresponds to a different level of rigor for various controls and assurance activities to mitigate risks throughout the supply chain life cycle. This program helps to identify and mitigate supply chain risks such as those associated with counterfeit products, tampering, theft, malicious software, poor manufacturing and/or development practices, and influence of foreign governments.

The Quality Level Program embraces and builds upon the existing Supply Chain Risk Management practices for various program areas and provides a uniform Supply Chain Risk Management framework for use across the corporation.

The following is a breakdown of purchase order actions in FY 2022 by quality level:

- Quality level 1: 4,610
- Quality level 2: 25,348
- Quality level 3: 24,671
- Quality level 4: 62,834

9.2 Plans and Projected Performance

The ecomedes application was designed to standardize the reports received from all subcontractors that have sustainable acquisition requirements in their contracts with SNL. The application includes a catalog of products that meet various environmental specifications. For example, subcontractors can add compliant products found outside the application and upload products that are noncompliant. Noncompliant products will require a justification for being selected (e.g., cost, availability, or performance). Further evaluation of existing work processes is expected to result in additional improvements to increase the amount of data being entered into the ecomedes platform by subcontractors.

The Materials Sustainability Program lead is evaluating construction product specifications and will submit recommended revisions to the approving council. The revisions will include the environmental specification parameters a product needs to meet, language associated with reporting on the product in the ecomedes platform, and the federal drivers. Including this information will inform all interested parties who may bid on a construction contract about the sustainable acquisition reporting requirements and provide them the opportunity to bid accordingly and maintain compliance with the 350APR clause.

Once all the acquisitions and procurement initiatives described for SNL/NM are completed, SNL/CA personnel will incorporate the processes.

10.0 Efficiency and Conservation Measure Investments

Efficiency and conservation measure investments focus on efficiency and conservation measures, performance contracts, appropriations and direct obligations, and training and education.

10.1 Efficiency and Conservation Measures

10.1.1 Performance Status

In FY 2022, the main funding sources used to implement awarded ECMs at SNL/NM and SNL/CA were reinvestment of utility savings and sustainability compliance funds. Both are indirect funds. These funds financed the FY 2022 EISA energy audits and the newest monitoring-based commissioning program that helped identify ECMs and energy efficiency opportunities. Monitoring-based commissioning is a process that uses automated data analytics to continuously monitor the performance of systems over the life of a building and helps identify low- or no-cost ECMs.

Nineteen awarded ECMs were financed through reinvestment of utility savings at SNL/NM in FY 2022. The majority of these projects were energy efficiency upgrades, such as the installation of energy valves and more efficient pieces of equipment. HVAC improvements such as replacement of air handler units and dampers accounted for 26 percent of the total ECMs. [Figure 10-1](#) shows the ECM type by percentage of the total number of measures. In FY 2022, budgeted funds available to finance ECMs through the reinvestment of utility savings program was \$2.3 million. Of the total money expended from the reinvestment of utility savings, 97 percent was allocated for ECMs at SNL/NM.

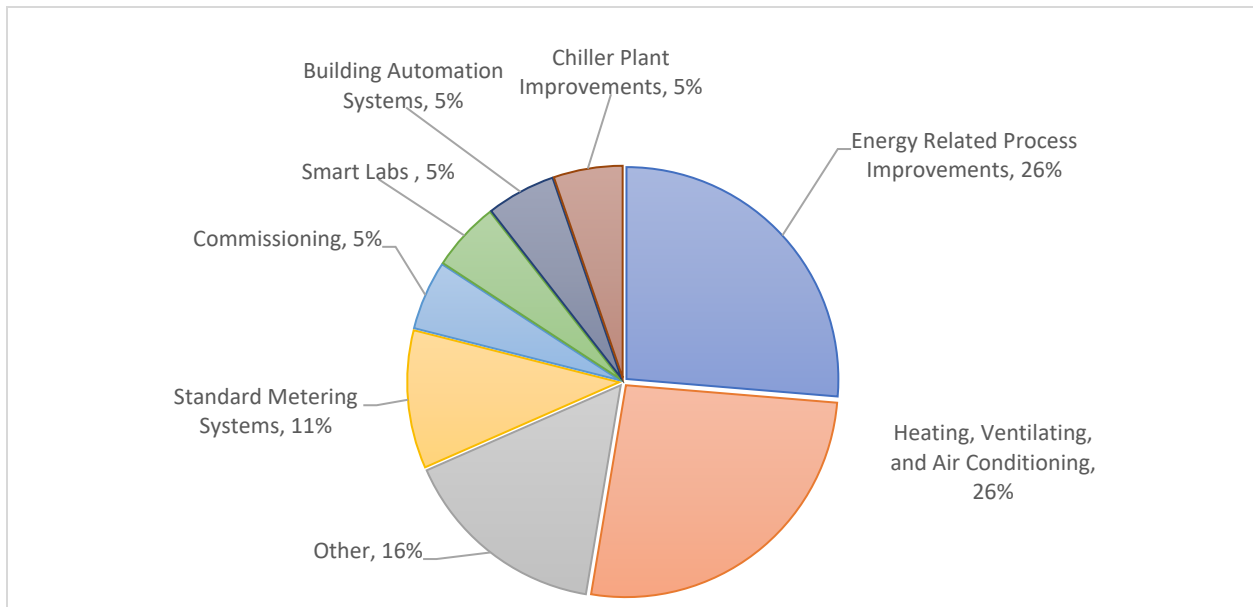


Figure 10-1. Types of ECMs financed through the reinvestment of utility savings program at SNL/NM, FY 2022

At SNL/CA, the Smart Labs initiative was the only effort funded through the reinvestment of utility savings in FY 2022. Smart Labs is an initiative that enables safe and efficient world-class science to be conducted in laboratories using high-performance methods. Smart Labs projects use a risk-based approach for managing ventilation air flow rates, improving ventilation effectiveness, increasing safety, and improving energy efficiency in labs. A lab ventilation risk assessment was completed for the project at SNL/CA, and a demand ventilation assessment will be completed in FY 2023.

A lab ventilation risk assessment was completed for the Smart Labs initiative at SNL/NM. A demand ventilation assessment was also completed and identified performance improvement measures.

Twenty-seven ECMs awarded at SNL/NM were financed through the sustainability compliance fund in FY 2022. [Figure 10-2](#) shows the ECM type by percentage of total. Energy studies related to net zero emission opportunities, *Guiding Principles* compliance, and standard meter system installation efforts accounted for 40 percent of all projects. Other important ECMs and measures financed through the

sustainability compliance fund were lighting and building automation system upgrades and other energy-related process improvements.

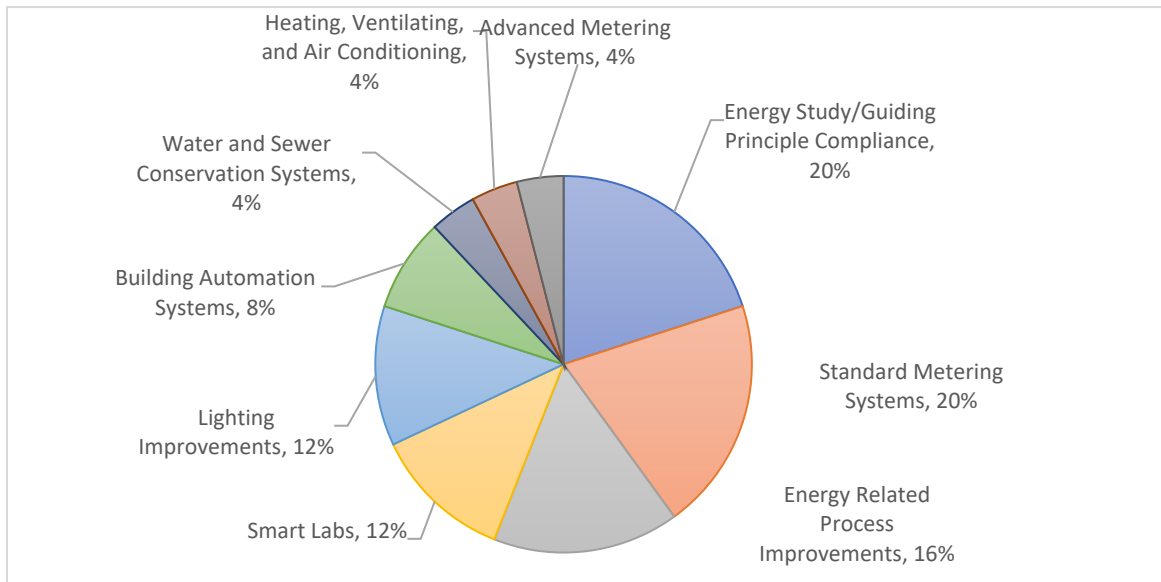


Figure 10-2. Types of ECMs financed through the sustainability compliance fund at SNL/NM, FY 2022

At SNL/CA, sustainability compliance funds financed four ECMs. Figure 10-3 shows the ECM types by percentage of the total. Lighting improvements, water meter improvements, building automation system, and Smart Labs were financed using sustainability compliance funds.

The available budget for the sustainability compliance fund was \$1.3 million in FY 2022.

In FY 2022, energy audits identified 155 ECMs for 20 high-energy intensity buildings at SNL/NM and SNL/CA. If funds are available for the next few fiscal years, these ECMs have the potential to reduce energy and water usage significantly. In FY 2023, the energy and water savings expected from these ECMs will be estimated to help prioritize projects. In FY 2022, a building energy savings calculation tool was developed to streamline this process and will help quantify energy and cost savings. The tool is currently being piloted at SNL/NM.

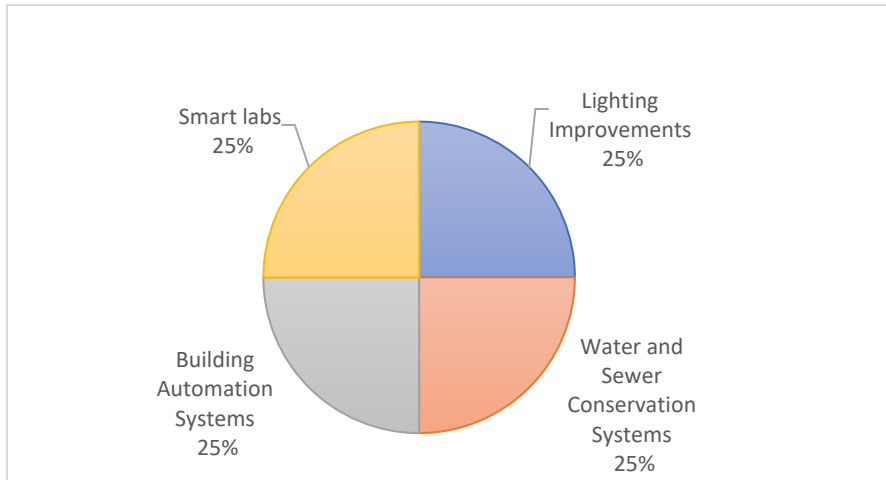


Figure 10-3. Types of ECMs financed through the sustainability compliance fund at SNL/CA, FY 2022

At SNL/NM, 129 ECMs were identified. Figure 10-4 shows the ECM type by percentage of the total. Forty percent of the total ECMs involve building envelope modifications, such as windows, insulation, and roof replacements. HVAC upgrades account for 13 percent of the total, while lighting upgrades represent 9 percent of the total identified ECMs.

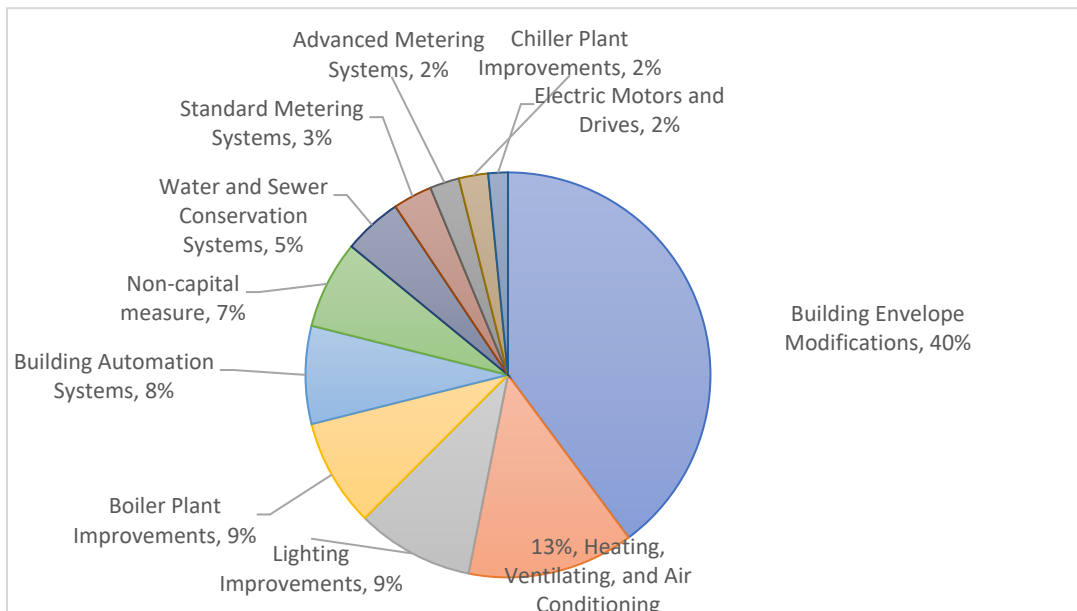


Figure 10-4. Energy audits: identified ECMs by type at SNL/NM, FY 2022

At SNL/CA, 29 ECMs were identified. Figure 10-5 shows the ECM type by percentage of the total. Lighting improvements represent the majority of the ECMs

identified at SNL/CA. Fifteen percent of the total ECMs represent low- or no-cost ECMs such as changes in operational set points that can help reduce energy waste.

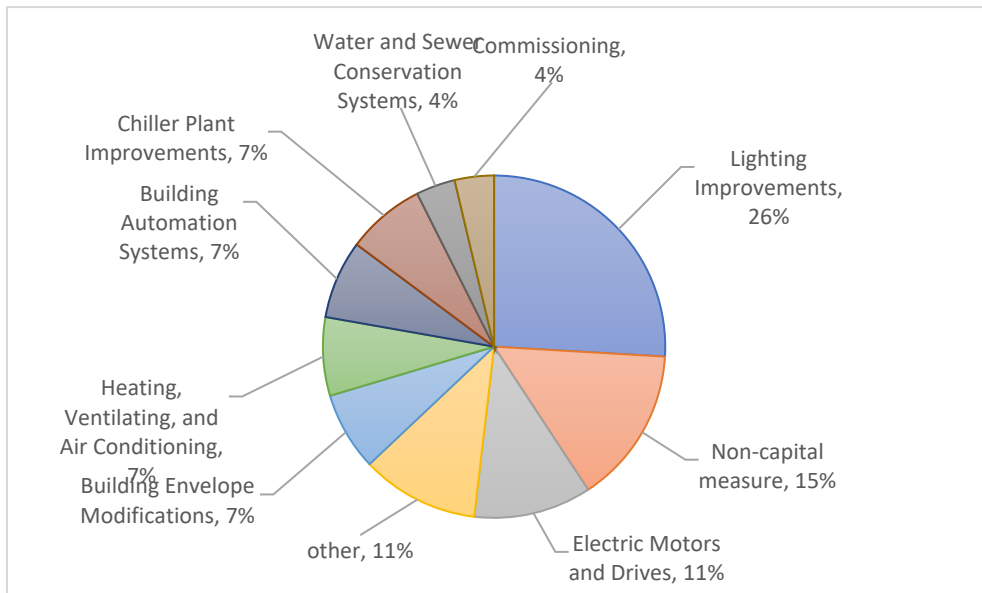


Figure 10-5. Energy audits: identified ECMs by type at SNL/CA, FY 2022

Another initiative that helped identify ECMs was the monitoring-based commissioning program. To date, the monitoring-based commissioning program has helped identify and solve operational and safety issues with a total savings equivalent to:

- 715 MWh of electricity
- 3,300 MMBTu of natural gas
- 125,000 gallons of water
- ~690 tons of carbon dioxide

As a result of this program, the realized cost savings were over \$150,000 in FY 2022.

Direct funds used to finance programs such as the Roof Asset Management Program (RAMP) and the Chiller Asset Management Program (CHAMP) were also used to finance projects that helped reduce energy usage. In FY 2022, for the first time, energy and cost savings from roof insulation replacement through RAMP were estimated for buildings at SNL/NM. Replacing insulation with more-efficient

materials reduces energy transfers from and through the roof and therefore helps with energy savings. From 2019 to 2021, RAMP projects for 14 buildings at SNL/NM avoided the usage of 14,500 kWh of electricity and 1,460 MCF (1,000 cubic feet) of natural gas. The total cost savings from these projects was about \$7,000.

The ERICA direct fund was used to finance sulfur hexafluoride (SF6) remediation in FY 2022. In FY 2023, ERICA funds will finance a facility net zero energy upgrade at SNL/NM with the goal of making a selected facility 100 percent electrified with no natural gas and all electricity generated on-site.

Going forward, savings from RAMP and CHAMP will be quantified on a fiscal year basis and compared against costs in order to understand the impact of the projects on energy usage.

10.1.2 Plans and Projected Performance

Energy and cost savings from awarded ECMs financed through the reinvestment of utility savings and sustainable compliance programs were not estimated in FY 2022. However, a building energy savings calculation tool was developed to streamline this process and will help quantify energy and cost savings. With this tool, ECMs can be prioritized based on a higher potential for savings. The tool is being piloted at SNL/NM and will be introduced to staff and managers at SNL/NM and SNL/CA at the beginning of FY 2023.

The energy intensity reduction goal through FY 2025 will be challenging to achieve. The goal to reduce energy intensity 30 percent from an FY 2003 baseline was achieved in FY 2015, in part by implementing many large-energy conservation measures with short payback periods. Going forward, uncertainty related to utility rates and project funding will impact implementation of future energy conservation measures with longer paybacks.

10.2 Performance Contracts

10.2.1 Performance Status

The NNSA is interested in pursuing an ESPC at SNL/NM and SNL/CA. The ESPC will help both sites identify and prioritize ECMs. Efforts to select an energy service company have been initiated, and the ESPC is expected to last up to 25 years.

The ESPC will help personnel identify, prioritize, and evaluate life-cycle costs of ECMs and assist with efforts that will reduce energy and water usage at SNL/NM and SNL/CA.

Internal efforts are being made to more accurately quantify energy and costs savings, paybacks, and the overall impact on energy usage from ECMs. Ultimately, new funding sources will be necessary to implement the identified ECMs.

High-priority needs for both SNL/NM and SNL/CA that the energy service company will address the following:

- Building automation systems and energy management control systems
 - Upgrade or replace obsolete or near-obsolete building automation systems with web-based Internet Protocol/Ethernet systems and smart controls while ensuring that cybersecurity requirements are met.
 - Upgrade the building automation system's graphics and capabilities.
 - Replace pneumatic controls with digital controls and integrate them with the building automation system.
 - Expand building automation systems by upgrading controls at smaller facilities and mobile offices and then integrating them with the building automation system.
- Chilled water and hot water plants
 - Address needed upgrades and operations improvements, including plant optimization and installation of energy valves to maximize energy efficiency at air handler coils and plants.

- HVAC system
 - Address needed upgrades, including air-handling units, controls, variable frequency drives, and optimization.
- Lighting
 - Improve lighting, including smart lighting, sensors, LiFi wireless communication systems, advanced controls, and integration with daylighting and building automation systems.
- Advanced energy metering for natural gas, electricity, water, chilled water BTu, hot water BTu, and submeters
 - Upgrade meters, replace obsolete meters, and expand advanced metering capabilities.
 - Upgrade from RS-485 to Internet Protocol/Ethernet.
 - Provide communication solutions for buildings separated by long distances where computer network infrastructure is not present by using wireless technology such as radio, cellular, or other and provide cyber solutions.
- Automated diagnostics and analytics
 - Integrate the energy analytics platform with the building automation system.
- Metering, lighting, and HVAC equipment (e.g., chillers and boilers)
 - Monitor energy.
 - Monitor building and system performance.
 - Perform fault diagnostics and detection.
 - Integrate monitoring-based commissioning, including using an Internet Protocol/Ethernet network through protocols such as BACnet, IP Modbus, and other application program interfaces while ensuring cybersecurity requirements.
- Energy security and resiliency measures.
- Smart Labs program
 - Remove and hibernate hoods, canopies, and snorkels.
 - Install a variable air volume for fume hoods.
 - Modify canopies and snorkels; implement variable air volume devices.

- Retrofit fume hoods.
- Upgrade air supply diffusers to reduce the number of air changes per hour.
- Install demand control ventilation (e.g., occupancy sensors and chemical sensors).
- Install a variable frequency drive on supply and exhaust fans.
- Install energy recovery systems.
- Install a manifold fume hood exhaust and consolidate exhaust fans.
- Reduce airflow (e.g., use fume hoods and increase the number of room air changes per hour).
- Reduce system static pressure.
- Optimize exhaust discharge velocity (e.g., wind direction).
- Optimize temperature set points.
- Test-and-balance and recommission.
- Repair and recommission terminal boxes.
- Ensure proper operation of energy recovery systems.
- Minimize simultaneous heating and cooling.
- Optimize fan operation.
- ISO 50001 certification

10.2.2 Plans and Projected Performance

Funding has a major impact on implementing ECMs. Increasing costs related to inflation and highly efficient equipment becoming more expensive are some of the expected challenges with regard to funding ECMs for the next few fiscal years. FY 2023 funds from reinvestment of utility savings and the sustainability compliance program are expected to remain at the same level and may be the main funding sources available.

It is expected that the ESPC will help identify, prioritize, and evaluate life-cycle costs of ECMs and assist with efforts to reduce energy and water usage at SNL/NM and SNL/CA.

10.3 Appropriations and Direct Obligations

10.3.1 Performance Status

In FY 2022, indirect obligations such as reinvestment of utility savings and sustainability compliance funds were used to fund ECMs. There were no appropriations or direct funding for ECMs. Reinvestment of utility savings are discussed in Section 10.5.

In FY 2022, sustainability compliance funds helped finance 27 awarded ECMs at SNL/NM and 4 at SNL/CA. Figure 10-6 shows the amount spent on design and construction against the available budget for this fund.

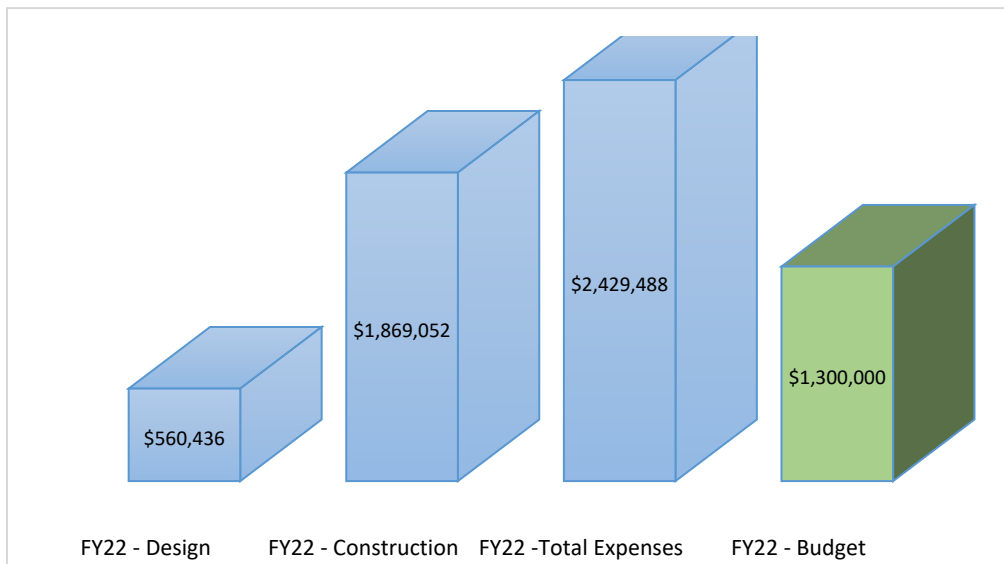


Figure 10-6. Sustainability compliance funds budgeted versus expended amounts spent at SNL/NM and SNL/CA, FY 2022

Figure 10-7 identifies the amount spent by each type of ECM at SNL/NM and SNL/CA in \$1,000 units. In FY 2022, \$557,000 (27 percent of the total spent) was spent on building automation system improvements, while other energy-related improvements accounted for 18 percent of the total invested with around \$449,000 spent. Efforts to upgrade lighting with more-efficient LED fixtures and Smart Labs represented 24 percent of total investments in FY 2022.

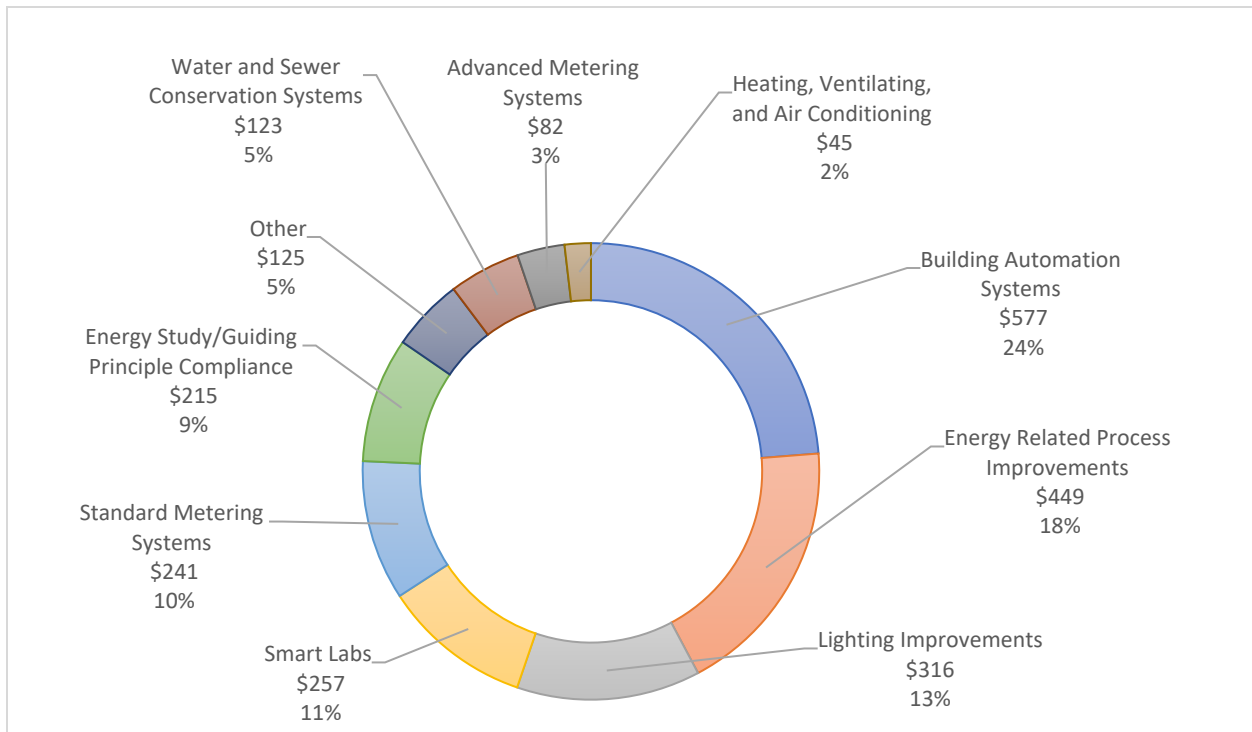


Figure 10-7. Sustainability compliance money spent by ECM type at SNL/NM and SNL/CA (\$1,000), FY 2022

Direct funds used to finance programs such as RAMP and CHAMP were also used to finance projects that helped reduce energy usage. In FY 2022, for the first time, energy and cost savings from roof insulation replacement through RAMP were estimated for buildings at SNL/NM. Replacing insulation with more-efficient materials reduces energy transfers from and through the roof. From 2019 to 2021, RAMP projects for 14 buildings from at SNL/NM avoided the usage of 14,500 kWh of electricity and 1,460 MCF (1,000 cubic feet) of natural gas. The total cost savings from these projects was about \$7,000.

Going forward, savings from RAMP and CHAMP will be quantified on a fiscal year basis and compared against costs in order to understand the impact of the projects on energy usage.

10.3.2 Plans and Projected Performance

Funding has a major impact on implementing ECMs. Increasing costs related to inflation and highly efficient equipment becoming more expensive are some of the expected challenges with regard to funding ECMs for the next few fiscal years.

FY 2023 funds from the reinvestment of utility savings and sustainability compliance programs are expected to remain at the same level and may be the main funding sources available.

10.4 Measurement and Verification

10.4.1 Performance Status

In FY 2022, a tool was developed to streamline building energy savings calculations and help quantify energy and cost savings. The tool is currently being piloted at SNL/NM. In FY 2023, the tool will be used to estimate energy and water savings expected from ECMs and to help prioritize projects. This methodology for compiling energy savings estimates is well-established in the energy engineering industry and uses best practices and guidelines defined by the International Performance, Measurement and Verification Protocol.

In addition, the ESPC effort will help evaluate ECMs to determine the most cost-effective option among competing alternatives. It is expected that the energy service company will follow measurement and verification best practices and standards in order to help prioritize ECMs with major impacts on SNL energy and water usage.

10.4.2 Plans and Projected Performance

Measurement and verification efforts require a very specialized technical staff as well as funding. These may be the biggest challenges to overcome in order to have a streamlined measurement and verification process.

10.5 Savings and Reinvestments

10.5.1 Performance Status

NNSA renegotiated the SNL utility contracts, resulting in an anticipated avoided cost of \$2.3 million per year through 2023. The new contract started in 2020, and at the encouragement of NNSA, SNL chose to reinvest this \$2.3 million in energy-efficiency projects at SNL/NM and SNL/CA. The reinvestment of utility savings

funds financed 19 projects (18 at SNL/NM and 1 at SNL/CA) in FY 2022.

Figure 10-8 shows the dollar amount spent on design and construction as well as the total budget for FY 2022.

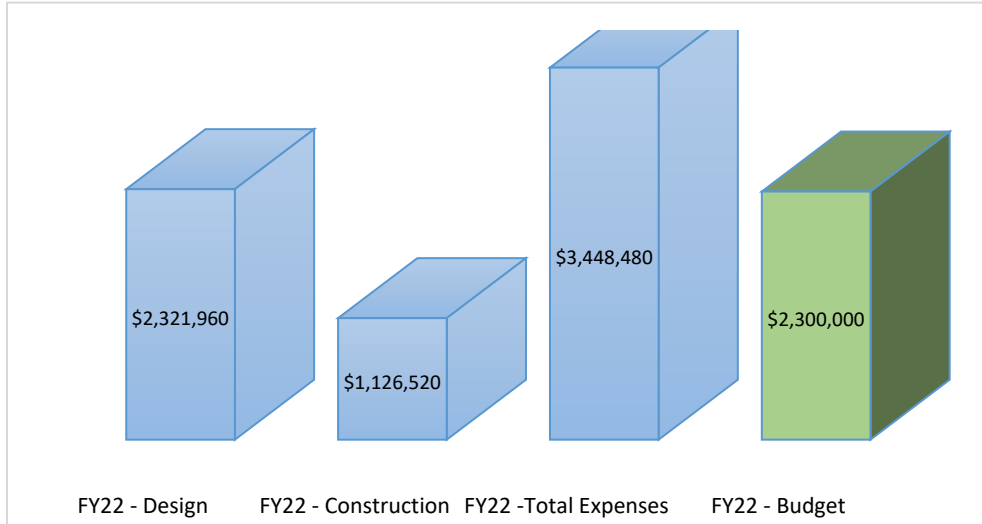


Figure 10-8. Reinvestment of utility savings budgeted versus expended amounts at SNL/NM and SNL/CA, FY 2022

Figure 10-9 identifies the amount spent by each type of ECM at SNL/NM and SNL/CA in \$1,000 units. Almost \$997,000 were spent on energy-related improvements, while HVAC upgrades accounted for 19 percent of the total invested with around \$646,000 spent. Monitoring-based commissioning efforts accounted for 17 percent of total investments in FY 2022.

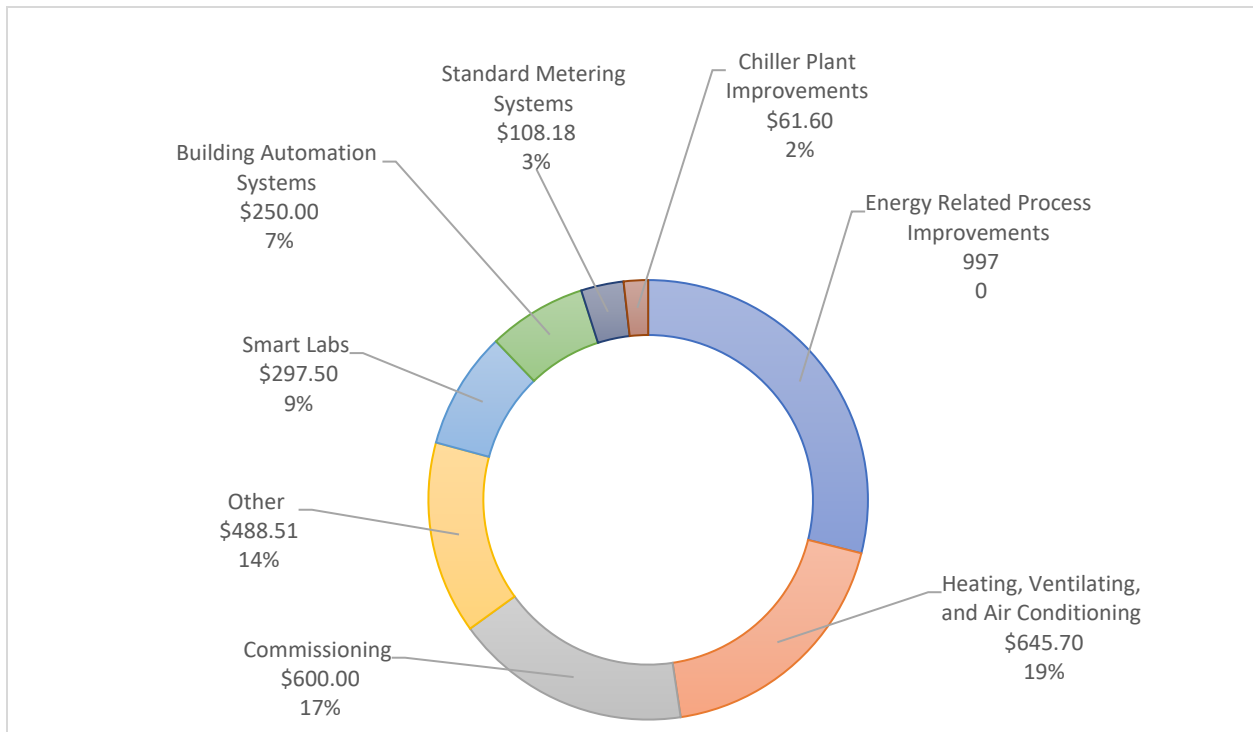


Figure 10-9. Reinvestment of utility savings amounts spent by ECM type at SNL/NM and SNL/CA (\$1,000), FY 2022

10.5.2 Plans and Projected Performance

Funding has a major impact on implementing ECMs. Increasing costs related to inflation and highly efficient equipment becoming more expensive are some of the expected challenges with regard to funding ECMs for the next few fiscal years. FY 2023 funds from the reinvestment of utility savings and sustainability compliance programs are expected to remain at the same level and may be the main funding sources available.

Low energy rates also impact the ability to finance major capital investments for ECMs due to long paybacks as result of lower cost savings.

10.6 Workforce and Community

10.6.1 Performance Status

Training is being provided to energy managers so they can maintain Certified Energy Manager credentials through the Association of Energy Engineers. This furnishes

energy managers with core competencies and complies with the Federal Buildings Personnel Training Act.

Several efforts were initiated in FY 2022 to enhance communication internally and externally. Some of the strategies used to engage the workforce and communities were as follows:

- An internal Modeling Sustainability webpage was created on Sandia's Energy Website. This page will be used to inform Members of the Workforce about sustainability and energy work and highlight energy-efficiency projects.
- An external Sustainability webpage was created. This page will be used to inform communities about sustainability, net zero emission efforts, and energy-efficiency projects happening at SNL.
- The *Energy Savings Newsletter* was created. This newsletter will provide information about successful projects and efforts that resulted in energy and costs savings as well as avoided carbon dioxide emissions. The newsletter will be published on a quarterly basis on the internal and external websites.
- Efforts are being made to submit internal monthly news notes using the available communication channels and platforms (e.g., organizations news notes and leadership emails). This effort aims to keep Members of the Workforce informed about sustainability and energy efforts.
- The energy management team participated in the DOE 50001 Ready program. This program requires training, communications, and Member of the Workforce awareness of the energy management system, including energy conservation activities and their importance. Ultimately, this program will help SNL prepare for ISO 50001 certification.
- Internal groups (e.g., employee research groups and the Energy Equity and Environmental Justice group) promote climate justice work and seek tribal engagement. Such efforts include:
 - Tribal energy webinars
 - Recruiting events with the American Indian Society for Engineering and Science

- Indian Energy Internship Program
- Tribal energy technology assistance

10.6.2 Plans and Projected Performance

Training and certification efforts will continue pending funding availability. Federally sponsored training and online training that are offered at no cost will be pursued.

It is expected that all the workforce and community efforts will help engage the workforce and local communities. Ultimately, the communication strategies will help develop collaboration across departments at SNL and keep the community informed about sustainability efforts that have local or state impact.

11.0 Indirect Emissions

Indirect emissions focus is on all travel-related topics such as Scope 3 GHG emissions, air travel, ground travel, and commuting.

11.1 Personnel Commuting

11.1.1 Performance Status

SNL personnel use an internally designed web application called the Commuter Profile in lieu of surveys to capture all commuting data. This application shows personnel their estimated Scope 3 GHG emissions footprint by analyzing their work schedule, driving distance, and commuting habits. The data are aggregated via the application and processed through a reporting dashboard to estimate the total SNL commuter Scope 3 GHG emissions footprint quarterly. Replacing surveys with the Commuter Profile has increased participation, data accuracy, and the ability to use the data dynamically.

The Commuter Assistance website gives Members of the Workforce an opportunity to connect with the following emissions-reducing resources:

- Rideshare. There are several rideshare options at both SNL/NM and SNL/CA. Personnel can set up carpooling through the Commuter Profile or designate a personal vehicle as a vanpool if the vehicle has seats for at least seven people and is used 80 percent of the time for the vanpool. Priority parking is provided as an incentive for selecting one of these commute methods. SNL/CA personnel have partnered with vRide, a local vanpool company, and can lease a vehicle through vRide. SNL/CA personnel may also ride on LLNL vanpools when room is available. Additional vanpool options are available through numerous cities in the region.
- Biking commuter SharePoint site. This web page provides information about biking gear, routes, on-site shower and locker facilities, safety, traffic, and the “Bike Buddy” bike commuter connector. Bike commuting is supported by bike commuter groups at both SNL/NM and SNL/CA and by the Virgin Pulse health points system. The points accumulate and translate into money in the

employee's Health Reimbursement Account or Health Savings Account and help them cover medical costs.

- Mass transit is currently unavailable at SNL/NM. While mass transit is available at no cost to all riders, the City of Albuquerque mass transit system does not have any bus routes to SNL/NM. This is due to declining ridership, difficulties accessing the site, and a bus driver shortage.
- Mass transit SNL/CA. There are two intercity rail systems, a local bus system, and multiple shuttles from transit stations to SNL/CA. These commuting options, as well as biking and vanpooling, are supported by the option of a Travel Spending Account or a tax advantaged reimbursed account to help Members of the Workforce offset costs of alternative commuting.
- Personal electric vehicles. Members of the Workforce are allowed to use designated fleet vehicle charging stations to charge personal electric vehicles at SNL/NM and SNL/CA, when available. This is done by joining the Personal Electric Vehicle Program and paying a monthly fee to cover all charging expenses, as well as by reserving preferred parking spaces near charging stations. This program incentivizes personal electric vehicle use by offering charging in priority parking locations.

Alternative work schedules also encourage the workforce to drive less and reduce commuter emissions. SNL offers a 9/80 work schedule and a 4/10 work schedule as well as a standard workweek, and both full-time and part-time telecommuting options are available.

11.1.2 Plans and Projected Performance

Full-time telecommuting for at least 30 percent of Members of the Workforce will be maintained into the future.

The potential future options for personal electric vehicle charging is currently being assessed for all sites through coordination with SFO.

Further development of “touchdown spaces” and other infrastructure specifically designed to meet the needs of a telecommuting workforce will continue throughout 2023 to ensure that any increase in telecommuting can be accommodated. This is a priority for the modernization of the workforce and for the reduction of scope 3 emissions and natural resource use.

In FY23 the Commuter Profile will undergo a complete redesign to bring into better alignment with reporting requirements, and to make it more user friendly.

11.2 Business Ground and Air Travel

11.2.1 Performance Status

Specific initiatives have not been established for reducing ground or air travel for the purpose of reducing Scope 3 GHGs; however, SNL policy FIN001, *Travel and Expense Report Policy*, encourages efficiency in business travel. Corporate travel may be undertaken only when alternative methods are not suitable. Members of the Workforce are expected to help minimize rental expenses by sharing a vehicle when traveling.

11.2.2 Plans and Projected Performance

The following efficiency measures to reduce vehicle miles traveled will continue:

- Encourage trip consolidation through carpooling and vanpooling.
- Increase the use of teleconferencing, videoconferencing, web conferencing, and web-based collaboration tools.
- Encourage electric vehicle use; install on-site charging stations.

12.0 Fugitives and Refrigerants

Fugitives and refrigerants focus on the management, use, and emissions of fugitive gases and refrigerants. Data on the use and emissions of fugitives and refrigerants for FY 2022 has been reported in the DOE Sustainability Dashboard.

12.1 Fugitives

12.1.1 Performance Status

The primary source of Scope 1 GHG emissions at SNL/NM is fugitive emissions, which are defined as any emissions that cannot reasonably pass through a stack, chimney, vent, or other functionally equivalent opening. At SNL/NM, SF₆ is the primary source of fugitive GHG emissions.

Pulsed power and high-voltage research and development applications account for the majority of SF₆ use at SNL/NM. The programs and the buildings that house them use large quantities of SF₆ as a necessary dielectric gas. Leak detection and repair processes and SF₆ reclamation units are used when feasible.

Addition of SF₆ to systems is tracked at several of the pulsed power facilities (the Z Pulsed Power Facility, High-Energy Radiation Megavolt Electron Source [HERMES] III, Saturn, Short Pulse Nano Second X-radiator [SPHINX], Sandia Lightning Simulator, and Electro-Magnetic Environment Simulator). This method of tracking provides better information about SF₆ emissions at the equipment level than tracking purchases alone. Emissions from all other operations continue to be estimated based on purchases. GHG purchases and estimated use are reported in the DOE Sustainability Dashboard.

The department that operates Saturn, HERMES III, and SPHINX decreased SF₆ usage from FY 2021 to FY 2022 by more than 1,700 pounds (approximately a

30 percent decrease). This decrease was attributed to the following SF6 emission-reduction strategies:

- The original 30-year-old SF6 supply system for HERMES III was replaced in FY 2022. The new SF6 supply system minimizes unnecessary connection points and includes new pressure system hardware where needed.
- Real-time monitoring and control of SF6 gas flow was added at the HERMES III control panel human machine interface.
- New feed valves and piping were installed to link the HERMES III reclaimer with the associated regulators.
- Supplier remote capability was added to both the HERMES III and Saturn reclaimers for improved troubleshooting and technical support.

Certain activities using much smaller quantities of SF6, typically less than 5 percent of the site's total SF6 emissions, do not recapture the gas. A portable micro-reclaimer was purchased in FY 2021 specifically to recover gas from this type of equipment without dedicated reclamation capabilities. Z Pulsed Power Facility personnel have been coordinating these recoveries successfully to prevent the release of small quantities of SF6 that would otherwise have been vented to atmosphere.

The 6 MV Tandem accelerator at the Ion Beam Laboratory utilizes a combination of ~22,000 ft³ of nitrogen/carbon dioxide/SF6 (59:39:2) as an insulating gas contained in a pressurized vessel. This accelerator is not a source of significant SF6 emissions during operation; however, there is no recovery system in place for the infrequent events (approximately every five years) during which the gases need to be released. For the first time, in FY 2022, mixed gas containing SF6 was recovered from the 6 MV Tandem accelerator during a planned maintenance event. SNL/NM personnel coordinated with an SF6 recovery vendor to bring in a mobile system to recover the gases to send to the vendor's facility for reclamation. Close to 100 percent of the gas was recovered, including approximately 230 pounds of SF6. SNL/NM personnel shared this success and lessons learned with the DOE Fugitive Emissions Working Group.

Based on the equipment and processes involved, currently there is no suitable alternative to SF₆ for its applications at SNL/NM.

Usage and emissions of fluorinated gases at SNL/CA are relatively minor compared to other DOE facilities. However, operations and emissions are highly regulated by the California Air Resources Board. In California, SF₆ is highly regulated because it is one of the most potent GHGs, having a global warming potential 23,800 times greater than that for carbon dioxide.

The major sources of SF₆ gas emission at SNL/CA are 20 SF₆-containing switchgear devices. The California Air Resources Board has a stringent requirement to minimize GHG emissions from gas-insulated equipment, which includes SF₆-containing switchgear.

To reduce further SF₆ emissions from the switchgear, preventive maintenance is performed monthly. In FY 2022, the maintenance team purchased a Dilo SF₆ Leak Pointer Sniffer. The Dilo leak detector is used during monthly preventive maintenance checks around any gasketed openings or fittings to capture possible leaks early.

Currently, the SF₆-containing switchgear is not being phased down. Phase-out will start January 1, 2025. The phase-out dates do not apply to SF₆ gas-insulated equipment that is currently in active use. Further, any SF₆ gas-insulated equipment currently held inactive in inventory for use as spare gas-insulated equipment is not subject to the phase-out dates.

The phase-out dates apply only to the acquisition of new gas-insulated equipment. Following the applicable phase-out dates, SF₆ gas-insulated equipment may not be acquired except through phase-out exemption or failure notification processes approved by the California Air Resources Board.

12.1.2 Plans and Projected Performance

Reducing SF₆ emissions is a critical part of meeting site sustainability and net zero emission goals. Funding is being actively pursued for the following initiatives.

12.1.2.1 SF6 Recovery and Abatement

The SF6 recovery and abatement projects to reduce emissions and increase SF6 recovery and reclamation can be broken out as stand-alone projects as follows, along with resulting estimated annual GHG reductions:

- Garner a Microsystems Engineering, Science and Applications abatement for five dry etch lines with verification testing (expected reductions up to 3,800 mtCO₂e annually).
- Purchase a new portable reclaimer for field X-ray test equipment (expected reductions up to 1,100 mtCO₂e annually).
- Purchase a new reclaimer for the Electromagnetic Environments Simulator (expected reductions up to 400 mtCO₂e annually).

12.1.2.2 SF6 Gas Handling Repairs and Upgrades

The SF6 gas handling repair and upgrade projects to reduce emissions and increase SF6 recovery and reclamation can be broken out as follows, along with resulting estimated annual GHG reductions:

- Replace the reclaimer for the Sandia Lightning Simulator (expected reductions up to 620 mtCO₂e annually).
- Replace SF6 manifolds and piping at the Sandia Lightning Simulator (expected reductions up to 100 mtCO₂e annually).
- Reduce SF6 emissions from Saturn's gas-handling systems by removing unnecessary piping and fittings, improving plumbing connections, and replacing poly flow tubing with hard pipe (expected reductions up to 640 mtCO₂e annually).
- Replace the Proportion Air's regulator at the Z Machine, a known emission source for SF6; replacement would involve identifying a replacement followed by testing and validation (expected reductions up to 3,100 mtCO₂e annually).
- Use monitoring, detection, and gas analysis equipment for SF6 emissions.

The portable micro-reclaimer operated by Z Pulsed Power Facility personnel will continue to be used to recover gas from smaller activities that are otherwise unable to recover gas. These recoveries are expected to increase as additional micro-reclaimer operators are trained and the recovery efforts are more widely known and available for more processes.

The pulsed power organizations have been relentlessly pursuing solutions to reduce SF6 emissions, including the following:

- They obtained funds to procure reclaimers, leak detection devices, and SF6 quality-monitoring products that will be used to reduce emissions in FY 2023
- They obtained funding for projects to develop and verify the use of SF6-free switches.
- They put in a laboratory-directed research and development request for \$250,000 so the ASAP Mission Campaign could hold a Climate Innovation Tournament and fund two exploratory projects on novel capture, abatement, or detection capabilities for SF6. This is in part an attempt to make more people aware of the need to reduce SF6 emissions and to get started on new transformative solutions.

Funding has been obtained and plans are in place to install a fixed recovery system for the 6 MV Tandem accelerator. Although the planned maintenance for this accelerator is infrequent (approximately every five years), the fixed system will be available to recover gas for unplanned repairs and maintenance.

Funding has also been obtained and plans are in place to purchase a micro reclamation system for various lab activities at the Ion Beam Laboratory. Small quantities of SF6 have been recovered from equipment at these labs over the past two years using the Z Machine's roving micro reclaimer, establishing the utility of the system for lab owners.

12.1.2.3 SF6 Emission Monitoring, Detection, and Gas Analysis Equipment for Pulsed Power Activities

A request for SF6 emission monitoring, detection, and gas analysis equipment for pulsed power activities includes a novel stationary monitoring system for the accelerators as well as portable detection equipment and gas analyzers, all of which could result in significant SF6 emission reduction, which is a critical part of achieving net zero emission, site sustainability, and GHG reduction goals. These capabilities would help reduce emissions from facilities with 2021 emissions totaling more than 12,000 pounds of SF6 or more than 127,000 mtCO2e.

12.1.2.4 SF6 Substitute Gas Verification Test Bed

Gas switches used in pulsed power applications are the dominant source of SF6 usage and emissions at SNL/NM. Verifying SF6-free switches for certain applications would reduce SF6 emissions, which is a critical part of achieving net zero emission, site sustainability, and GHG reduction goals. Total 2021 emissions of SF6 from use in high-voltage pulsed power switches was more than 12,000 pounds, or more than 127,000 mtCO2e.

The EPA Significant New Alternatives Policy program recommends substitutes for SF6. Alternative equipment choices and the hydrofluorocarbon phasedown are considered during planning and purchasing activities.

Funding is actively being pursued for an SF6 substitute gas verification test bed. Gas switches used in pulsed power applications are the dominant source of SF6 usage and emissions at SNL/NM. Verifying SF6-free switches for certain applications would reduce SF6 emissions, which is a critical part of achieving net zero emission, site sustainability, and GHG reduction goals. Total 2021 emissions of SF6 from use in high-voltage pulsed power switches was more than 12,000 pounds, or more than 127,000 mtCO2e.

The California Air Resources Board has recently approved the amendments to the California Code of Regulations Title 17, Division 3, Chapter 1, Subchapter 10, Article 4, Subarticle 3.1, Sections 95350–95359 for reducing GHG emissions from gas-

insulated switchgear. These amendments are intended to provide a structure and schedule for the planned phase-out of gas-insulated equipment that uses SF₆ gas as an insulating medium.

The acquisition of SF₆-containing switchgear (for voltage capacity greater than 38 KV) will be phased out starting January 1, 2025. Any new purchases after the phase-out date will be for switchgear with an alternative gas-insulated technology or a vacuum technology, if technologically feasible.

Recently purchased transformers at SNL/CA are dry type (no GHGs or SF₆).

12.2 Refrigerants

12.2.1 Performance Status

MN471022, *ES&H Manual*, “Refrigerants/Ozone-Depleting Substances in Equipment or Appliances,” applies to all operations and activities that involve the purchase and use of refrigerants and ozone-depleting substances, or that involve the purchase, servicing, or disposal of fugitive and ozone-depleting substance-containing appliances or equipment.

The Facilities Management and Projects organization maintains a procedure that defines the process for storing and handling refrigerants at SNL/NM. This procedure includes requirements for labeling cylinders containing refrigerant in accordance with Federal Acquisition Regulation ozone-depleting substance requirements.

SNL/CA operations use and emit relatively minor quantities of refrigerants compared to other DOE facilities. However, operations and emissions are highly regulated by the California Air Resources Board, the Bay Area Air Quality Management District, and EPA.

Refrigerant usage and emissions at SNL/CA are regulated by both the California Air Resources Board and EPA. Appliances containing Board-regulated refrigerants are leak tested annually or have automatic leak detection systems. Any detected leaks

are repaired within 14 days as required by the California Air Resources Board. Preventive maintenance and corrective maintenance are performed regularly on appliances that contain refrigerants. Also, an annual refrigerant inventory reconciliation has been instituted to help maintain control over the refrigerant supply and storage.

12.2.2 Plans and Projected Performance

SNL personnel will continue to manage refrigerants in accordance with applicable regulations and policies. There are plans to remove old appliances containing ozone-depleting substances and refrigerants and replace them with appliances that do not contain ozone-depleting substances or hydrochlorofluorocarbons in FY 2023.

Some equipment is reaching end of life. Numerous pieces of HVAC equipment containing R22 refrigerant will be replaced in the coming years with non-R22 alternatives.

All new equipment is being evaluated and selected based upon current EPA and California Air Resources Board regulations for refrigerants.

Also, the California Air Resources Board approved the EPA final rule “Phasedown of Hydrofluorocarbons” (effective January 1, 2022), to limit refrigerants with a significant global warming potential that are used in large (greater than 50 pounds) appliances.

The EPA Significant New Alternatives Policy program recommends substitutes for ozone-depleting substances. Alternative equipment choices and the hydrofluorocarbon phasedown are considered during planning and purchasing activities. Each of these actions move toward a reduced GHG footprint and reduced risks of release.

13.0 Electronic Stewardship and Data Centers

Electronic stewardship and data center management focuses on all electronics-related topics, such as acquisitions, operations, end-of-life disposal strategies, and data centers.

13.1 Acquisition

13.1.1 Performance Status

Procurement personnel continue to incorporate a green product purchasing section in contracts, which requires the just-in-time providers of electronic products to submit a quarterly report of furnished products and to give preference to those registered in the Electronic Product Environmental Assessment Tool (EPEAT). The report includes EPEAT product categories, quantity of products purchased, dollar amount of products purchased, EPEAT ratings, and other identifiers.

There is also a restricted items list, which identifies EPEAT requirements for personnel when using a corporate purchasing credit card. Electronic items that fall into an EPEAT category must be registered gold or silver in order to be procured with a corporate purchasing credit card. An exemption request can be submitted, reviewed for justification, and approved for purchase.

At SNL/NM, desktop computer and monitor purchases in FY 2022 were 95 percent compliant with EPEAT requirements. Applicable imaging equipment purchases (e.g., printers, scanners, and multifunction devices) in FY 2022 were 97 percent compliant. One hundred percent of mobile phone purchases were EPEAT Gold-registered products.

At SNL/CA, desktop computer and monitor purchases in FY 2022 were 91.1 percent compliant with EPEAT requirements. Applicable imaging equipment purchases (e.g., printers, scanners, and multifunction devices) in FY 2022 were 100 percent compliant. One hundred percent of mobile phone purchases were EPEAT gold-registered products. Server purchases in FY 2022 were 100 percent EPEAT compliant.

Fleet copiers are corporate supported, networked, multifunction (print, copy, scan, and/or fax) devices.

- Two standardized models of fleet copiers are used, both of which are EPEAT gold-registered.
- At SNL/NM, 37 fleet copiers were added to operations in FY 2022; printing, copying, and scanning functions are provided for multiple personnel at each machine. Assuming on average 12 individuals are served per machine, then approximately 7,776 individuals are served by these fleet copiers.
- At SNL/CA, there are 82 fleet copiers. Assuming on average 12 individuals are served per machine, then approximately 984 individuals are served by these fleet copiers.

13.1.2 Plans and Projected Performance

Efforts to address sustainable acquisition requirements among EPEAT purchases using a corporate purchasing card will begin in FY 2023. This will include requiring Members of the Workforce who have a corporate purchasing card to submit reports using the new reporting tool in ecomedes.

13.2 Operations

13.2.1 Performance Status

Power consumption by Windows computers is managed with Operating System settings. Power management features on Windows computers connected to internal networks are enabled with monitor standby after 15 minutes of non-use.

Of the eligible machines, 100 percent are managed with default power management capabilities.

In addition to the Windows computers, the Konica Minolta fleet copiers at SNL/CA are enabled with the following:

- Power Control and Sleep Mode. After one hour of inactivity, a machine assumes Sleep Mode.
- Energy efficient toner. Konica Minolta Simitri high-definition polymerized toner, used for both office and production printing, has a markedly lower environmental impact during its production, use, and recycling than conventional pulverized toner because the toner fuses at a lower temperature.
- Energy-efficient scanner light. The scanner's light source has been changed from conventional fluorescent lighting to LED, which no longer contains mercury. Customers benefit from power savings and low heat performance, while brightness and scanning speed are increased.
- Low typical electricity consumption value. Konica Minolta office products have especially low typical electricity consumption values; these represent a product's typical electricity consumption weekly based on average office use as defined in the Energy Star program.
- Induction heating fusing technology. Energy consumption is significantly reduced compared to other technologies, as the temperature needed for fusing is reached much faster and can be controlled precisely.
- Ozone-free roller charging. High-resolution output is possible over long periods, while suppressing ozone generation.

Just-in-time imaging equipment contracts require EPEAT-registered duplexing-capable desktop printing equipment. This first became a contractual requirement in FY 2013. The Konica Minolta fleet copiers are set up with duplex printing by default. In addition, the print driver is configured for duplex printing. To opt out of duplex printing, users must manually adjust the printer settings for each print job.

13.2.2 Plans and Projected Performance

No changes to electronic and data center operations are anticipated for the upcoming year. Power management program personnel will continue to perform the following activities:

- Advertise the preference for fleet copiers and large, networked printers as opposed to individual desk printers.
- Document the quantity of new EPEAT-registered imaging equipment (duplexing capable) deployed.

13.3 End of Life

13.3.1 Performance Status

All electronic assets and equipment are required to be processed through the Property Management and Reapplication Department at SNL/NM or the Logistics Department at SNL/CA to ensure adherence to applicable federal regulations. At the end of life, all functional electronics are first made available to the workforce.

Representatives from 15 schools visited SNL/NM in FY 2022 to pick up used desktop computers, laptops, tablets, keyboards, and other equipment as part of the SNL K-12 Computer Donation Program. Over 1,300 items were donated.

Broken or outdated computers and equipment at SNL/CA are sent for recycling to a vendor that is Responsible Recycling, e-Steward, and California state certified. Electronic equipment that can retain information (e.g., removable electronic media) is removed and then securely stored until there is a sufficient quantity to ship to a waste-to-energy incinerator under witnessed destruction.

In FY 2022, SNL/NM personnel recycled 297,702 pounds of electronic waste and transferred or donated 94,712 pounds. SNL/CA personnel recycled 39,883 pounds (18.1 metric tons) of electronic waste.

Currently, SNL/CA personnel remove all batteries and hard drives from electronic devices prior to shipment for recycling. The batteries are recycled as universal

waste through the Waste Management Program as required by the State of California. At SNL/NM, batteries are removed and recycled under the Universal Waste program. At SNL/CA, hard drives are shipped to SNL/NM for destruction following standard processes.

13.3.2 Plans and Projected Performance

Existing resources will continue to be reallocated to Members of the Workforce prior to purchasing electronic items. The next option is to accumulate items that can be donated to local schools.

13.4 Data Centers

13.4.1 Performance Status

Building 725E is a data center built to house high-performance computing machines. This building was designed for 85 percent water cooling and 15 percent air cooling. This design helps the data center to run efficiently, maintaining a power usage effectiveness of around 1.06 during the colder months. Thermosyphons were installed on the roof of Building 725E as a means of cooling the process water loop without water evaporation, saving around 8 million gallons of water per year.

During warmer months, the thermosyphons cannot cool the process water loop because they require the outdoor air to be 4° F cooler than the water. This loss of cooling capability requires use of the chiller plant in Building 726 to maintain the necessary water temperature. While the chiller plant is supporting the Building 725E data center, the power usage effectiveness raises to 1.13, nearly doubling the infrastructure power use. To combat this, a plan is in place to install a new cooling system adjacent to the data center. This system will utilize hybrid fluid coolers to improve the data center's energy efficiency. These fluid coolers will be able to return power usage effectiveness back to 1.06, even during summer months.

Another method for improving the data center's power usage effectiveness is through increased water temperatures. Currently, the process water loop is set to a supply temperature of 76° F. When built, Building 725E had a process water

temperature of 69° F. This temperature was required for the first high-performance computing system installed in the building, Astra. A medium-temperature water loop was implemented to feed this system directly from the chiller plant in Building 726. This allows Astra to run independently of the process water loop while maintaining nearly the same energy efficiency as before. With the rest of the high-performance computing systems in Building 725E able to operate with warmer water temperatures, the data center's efficiency improved by nearly 20 percent. In addition, Building 725E water usage was reduced considerably.

Power usage effectiveness is measured using Nlyte Energy Optimizer. All power distribution equipment in the data center and in supporting buildings is monitored. By importing this data to Nlyte, power usage effectiveness can be calculated accurately and in real time. The chiller plant supporting each data center is monitored, and all power in the data centers is monitored down to each individual circuit feeding computer racks.

Virtual services are being implemented wherever possible in the data center. Any new request for hardware must be validated as needed for work that is not viable on a virtual machine. Funding has been requested to optimize and modernize inefficient rooms in the data center. Water usage meters are being installed and will be used in Nlyte to calculate water usage effectiveness. A full audit of the data center is scheduled, which will identify underused servers and request their removal. A data center consolidation effort was enacted and completed; this closed many small data centers around SNL/NM and brought their hardware into the enterprise data center.

An energy-efficient high-performance computing prototype has been procured and is undergoing testing in the Building 725E data center. This machine utilizes direct impingement liquid cooling from Jetcool. Initial testing has shown processor temperatures well below thermal maximums and throttling ranges up to 142° F for supply water. These water temperatures will provide high-grade heat to surrounding buildings in addition to exploring other uses for heat such as electrolysis.

Electronics are typically acquired through just-in-time vendors. The data center team reviews all data center equipment before it is ordered. Equipment must meet established standards, which ensure energy efficiency, support standardization, and reduce waste. When possible, customers are required to use virtual machines instead of purchasing their own physical servers. During equipment reviews, data center space is analyzed to determine optimal placement for the incoming equipment to ensure proper cooling, power, networking, and space.

13.4.2 Plans and Projected Performance

To further improve the Building 725E data center's efficiency and ensure future sustainability for data centers at SNL, seven more projects are planned or in progress. The process water loop supply temperature is planned to reach 85° F over the next couple of years, further improving water usage and energy efficiency. New server cooling technologies are being researched and tested, which will allow supply water temperature to reach 100° F or more, even on extremely high-power processors. Another effort to improve energy usage is the installation of cooling doors on otherwise air-cooled racks. By using cooling doors, the heat from servers is transferred to water immediately upon being exhausted. This is much more efficient than air handlers while also allowing the room to maintain a cooler temperature. These cooling doors must be kept on the medium-temperature water loop.

The power usage effectiveness of Building 725E is expected to reduce to 1.05 during FY 2023 due to additional energy-efficient high-performance computing machines. Water usage effectiveness and energy reuse effectiveness are not currently implemented. Water usage effectiveness will be implemented shortly as there is a project to install the meters necessary for this calculation. Once the water temperature is high enough for reuse, energy reuse effectiveness will be implemented as well.

Room X53, which houses enterprise applications, will be modernized to provide three times the current power and cooling density with a much lower power usage effectiveness (~1.18 to ~1.06). This modernization will include reconfiguring power, enhancing cooling efficiency, and increasing the use of virtual servers. Increased

use of servers will reduce the footprint required and increase the data center's efficiency. This project will act as a proof of concept that can then be applied to other data center rooms.

Although Energy Star ratings are important on server power supplies, the data center requires power supplies with the capacitance to ride through small power events. High Energy Star ratings and this ride-through capability typically do not occur in the same power supply. Other DOE National Labs have been working with vendors to make this more common, and the data center team is working on a process that includes the requirement for future purchases.

14.0 Adaptation and Resilience

Adaptation and resilience management focuses on activities that impact resiliency at the Laboratories level.

14.1.1 Performance Status

SNL leadership recognizes the need to maintain performance of essential functions and operations during disruptive events.

In FY 2022, SNL personnel completed a climate vulnerability assessment and resilience plan. The assessment addressed anticipated changes in climate by the year 2050 and potential vulnerabilities to these changes in climate at SNL sites. In FY 2022, SNL personnel also participated in the Technical Resilience Navigator DOE cohort. The Technical Resilience Navigator is a tool that helps users assess risk for a site's critical functions following energy and water utility disruptions and then prioritize solutions that reduce risk.

In conjunction with safety basis and remote site subject matter experts, Emergency Management personnel instituted the use of a hazard analysis and qualitative risk assessment at multiple remote sites to comprehensively assess vulnerability to threats and hazards, including climate-related threats and hazards.

Continuity of Operations Program personnel are actively incorporating resiliency into its risk mitigation measures through the installation of generators at strategic locations to provide emergency backup power. Installation of all generators was completed in FY 2022.

The sustainment of critical infrastructure during emergencies is addressed at the Emergency Operations Center. The structure and approach for responding to extraordinary incidents that affect SNL sites and facilities is documented in the *Center 4700 and Center 4800 Response Operations Plan for SNL/NM*.

Emergency Management personnel conduct an all-hazards survey for SNL sites to address natural, technological, and human-caused hazards in accordance with DOE

O 151.1D, *Comprehensive Emergency Management System*. These surveys are revised every three years or upon significant changes. Emergency planning hazards assessments are created for facilities that are identified, in an all-hazards survey, as possessing quantities of hazardous materials that, if released, could produce impacts consistent with the DOE O 151.1D definition of an operational emergency involving hazardous materials. Emergency Management personnel have also completed emergency management plans and threat and hazard identification and risk assessments for multiple remote sites in accordance with the SNL DOE O 151.1D Implementation Plan.

There are ongoing efforts to integrate climate resilience into larger risk-management processes (e.g., emergency management, continuity of operations planning, and cybersecurity). DOE O 151.1D and DOE O 150.1A, *Continuity Programs*, require mitigation of identified risks. To comply with this requirement, Emergency Management and Continuity of Operations Program personnel implement risk-based planning and assurance measures to address a variety of hazards and assist in the prioritization of assets, efforts, and personnel. Climate change impacts are included in risk mitigation efforts. The Emergency Management Program is an integral part of ES&H, and team members partner with Meteorology Program and other ES&H program subject matter experts to provide decision support services, including on-site and local meteorological data and expertise. Integration spans from emergency planning to Emergency Operations Center coordination and support during and after an emergency.

Response to the COVID-19 pandemic resulted in many computing infrastructure enhancements. The Information Technology Services Center secured In Case of Emergency licenses to stabilize accessibility. In addition, the IT Disaster Recovery team collaborated with the Continuity of Operations Program office to identify the computing needs for five mission-essential function laboratories and one essential supporting activity. This effort allowed the IT Disaster Recovery team to update and expand its efforts to tier the laboratory systems and applications to increase IT resiliency efforts.

14.1.2 Plans and Projected Performance

Climate adaptation and resilience efforts will continue to be pursued to protect critical infrastructure and minimize the impacts of climate-induced disruptions to energy and water supplies, facility operations, information and communication technology capabilities, and transportation.

First, a new Emergency Operations Center is being constructed at SNL/NM, with an expected opening in FY 2023. The LEED Gold-certified facility aligns with the NNSA Enhanced Minor Construction and Commercial Practices initiative.

Second, a fuel storage facility is currently in the design phase and will complement existing generators as part of a Continuity of Operations Program short-term goal to ensure mission-essential function sustainability for 30 days. This project is expected to be completed between FY 2023 and FY 2024. Additionally, Continuity of Operations Program personnel are evaluating long-term opportunities to enhance emergency power-generation capabilities through the integration of a microgrid. The microgrid would include renewable energy sources, mitigate GHG emissions, enhance power resiliency, and defer costly investments in additional power generation.

Third, cross-disciplinary teams with expertise in climate and resiliency, including the Resilient Energy Working Group, will be maintained. These teams will continue to identify and pursue opportunities to increase resilience through innovative approaches. SNL personnel will continue to build on current efforts to help the SNL/CA site achieve net zero emissions and will conduct additional studies to define this possibility in more detail.

The efforts to integrate climate resilience into larger-risk management processes (e.g., emergency management, continuity of operations planning, and cybersecurity) described in this plan will continue into FY 2023.

In FY 2023, Continuity of Operations Program personnel will work with Employee Health Services personnel to revise and update the SNL pandemic plan. These updates will reflect lessons learned and best practices to enhance future pandemic

responses. Continuity of Operations Program personnel also seek to partner with Emergency Management and Employee Health Services personnel to test the point of distribution plan with the State of New Mexico.

Resources

Related Laboratory Policies and Processes

EM003, *Mission Critical Personnel Policy*

EM004, *Continuity of Operations Policy*

FAC002, *Space Management Policy*

FAC006, *Government Vehicles and Motorized Equipment Policy*

FIN001, *Travel and Expense Report Policy*

References: Internal

100% Carbon-Free Electricity for Sandia NM and KAFB Using Concentrating Solar Power (CSP)

Center 4700 and Center 4800 Response Operations Plan for SNL/NM

Closed Point of Dispensing COVID-19 Distribution Plan

Closed Point of Dispensing COVID-19 Vaccination Plan

Landscape Master Plan

MAN-004, *Sandia National Laboratories/New Mexico Design Standards Manual*

MAN-008, *Government Vehicle and Motorized Equipment User Guide*

MN471022, *ES&H Manual*

Sandia National Laboratories/New Mexico Design Standards Manual

Sandia National Laboratories DOE O 151.1D Implementation Plan

Solid Waste Management – Improvement Action Plan

Utility Meters Life Cycle Asset Management Plan

References: External

41 CFR 102-39, *Replacement of Personal Property Pursuant to the Exchange/Sale Authority*

42 USC 6834, *Federal Building Energy Efficiency Standards*

ASHRAE 90.1-2013, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

California Air Resources Board, CCR 95350–95359, *Regulation for Reducing Sulfur Hexafluoride Emissions from Gas Insulated Switchgear*

California Code of Regulations Title 17, Division 3, Chapter 1, Subchapter 10, Article 4, Subarticle 3.1, Sections 95350–95359

California Senate Bill 32, *California Global Warming Solutions Act of 2006: Emissions Limit*

DOE, Deputy Secretary of Energy, *Memorandum on Climate Adaptation, Resilience and Sustainability in Project Management*, April 5, 2022

DOE O 150.1A, *Continuity Programs*

DOE O 151.1D, *Comprehensive Emergency Management System*

DOE O 436.1, *Departmental Sustainability*

DOE Procurement Policy Guidance, *Purchase of Electricity, Energy Products and Energy By-Products from Indian Tribes*

Energy Independence and Security Act (EISA) of 2007

Energy Policy Act of 2005

Executive Order 14057, *Executive Order on Catalyzing Clean Energy Industries and Jobs through Federal Sustainability*

FAR 52.227-17, *Rights in Data-Special Works*

Federal Buildings Personnel Training Act

Guiding Principles for Sustainable Federal Buildings and Associated Instructions

ISO 14001, *Environmental Management Systems*

ISO 50001, *Energy Management*

National Energy Conservation Policy Act

U.S. EPA, *Federal Leadership in High Performance and Sustainable Buildings*
Memorandum of Understanding