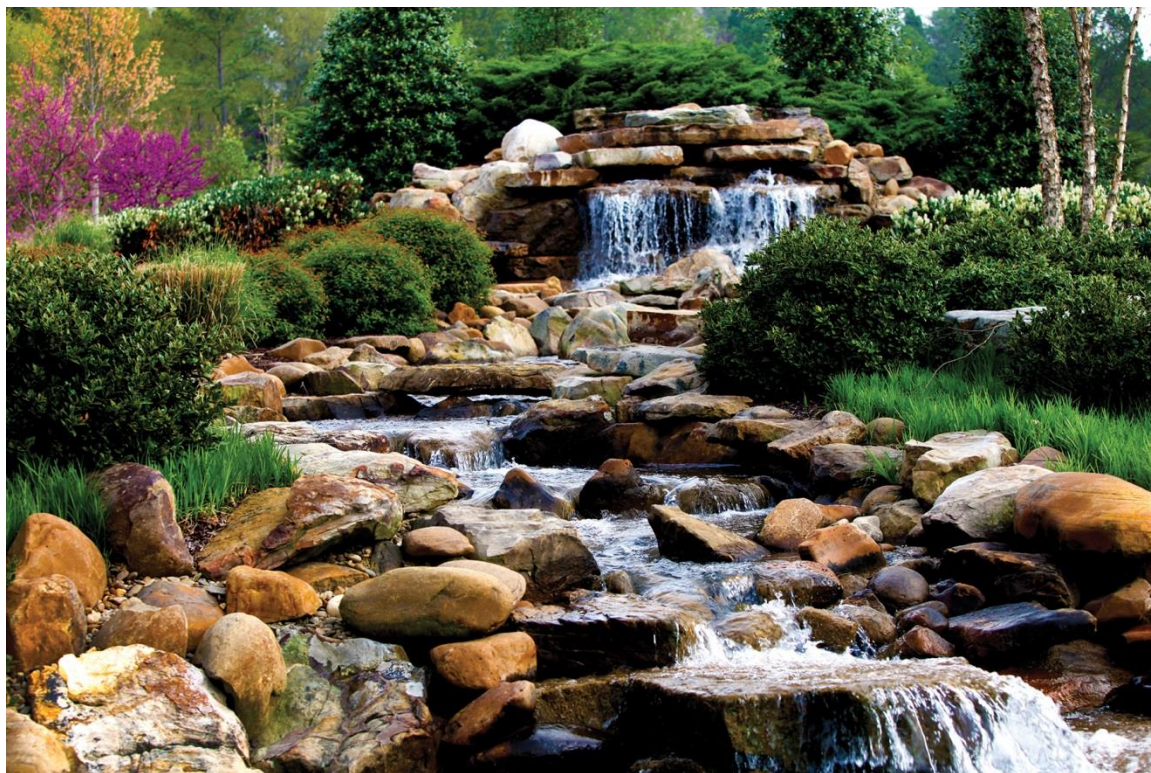


Oak Ridge National Laboratory 2025 Site Sustainability Plan

With FY 2024 Performance Data

Prepared November 2024



Amy Albaugh Miller
Melissa Madgett
Scott Sluder
Laura Touton
Seaira Stephenson

November 2024



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Facilities and Operations Directorate
Integrated Operations Support Division
Sustainable ORNL Program

**OAK RIDGE NATIONAL LABORATORY
2025 SITE SUSTAINABILITY PLAN
WITH FY 2024 PERFORMANCE DATA
PREPARED NOVEMBER 2024**

Amy Albaugh Miller
Melissa Madgett
Scott Sluder
Laura Touton
Seaira Stephenson

November 2024

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, TN 37831
managed by
UT-BATTELLE LLC
for the
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**US Department of Energy
Sustainability Performance Office**

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ABBREVIATIONS

AEE	Association of Energy Engineers
AFFECT	Assisting Federal Facilities with Energy Conservation Technologies
AFV	alternative-fuel vehicles
AML	Advanced Microscopy Laboratory
ASER	annual site environmental report
BAS	Building Automation System
C&D	construction and demolition
CEDS	Central Energy Data System
CEM	Certified Energy Manager
CFE	carbon pollution-free electricity
CNMS	Center for Nanophase Materials Sciences
DLiA	Discover Life in America
DOE	US Department of Energy
DOSAR	Dosimetry Applications Research
EAC	energy attribute certificate
EAct 20	Energy Act of 2020
ECM	energy conservation measure
EE&S	energy efficiency and sustainability
EFP	excess facilities program
eGRID	Emissions and Generation Resource Integrated Database
EISA	Energy Independence and Security Act of 2007
EO	executive order
EPA	US Environmental Protection Agency
EPAct	Energy Policy Act
EPEAT	Electronic Product Environmental Assessment Tool
ESPC	energy savings performance contract
EUI	energy use intensity
EV	electric vehicle
EVSE	electric vehicle supply equipment
F&O	Facilities and Operations
FAR	federal acquisition regulation
FCA	facility condition assessment
FDD	fault detection and diagnostics
FIMS	Facilities Information Management System
FLC	Foothills Land Conservancy
FMD	Facilities Management Division
FY	fiscal year
G/GSF	gallons per gross square foot
GHG	greenhouse gas
GIS	geographic information system
GPP	General Plant Project
GSA	General Services Administration
GSF	gross square foot
GWP	global warming potential
HEMSF	high-energy mission-specific facility
HFIR	High Flux Isotope Reactor
HPC	high-performance computing
ILA	industrial, landscaping, and agricultural

IT	information technology
JCI	Johnson Controls Inc.
LED	light-emitting diode
M&V	measurement and verification
NA	not applicable
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
ORNL	Oak Ridge National Laboratory
OTC	once-through cooling
PHEV	plug-in hybrid electric vehicles
POV	privately owned vehicle
RA	Resource Advisor
REC	renewable energy credit
SA	sustainable acquisition
SC	US Department of Energy Office of Science
SLI	Science Laboratories Infrastructure
SME	subject matter expert
SNS	Spallation Neutron Source
SPO	Sustainability Performance Office
SSP	site sustainability plan
TVA	Tennessee Valley Authority
VARP	vulnerability assessment and resilience plan
WUI	water use intensity
ZEV	zero-emissions vehicle

1. ABOUT THIS REPORT

1.1 ANNUAL DEVELOPMENT OF THE OAK RIDGE NATIONAL LABORATORY SITE SUSTAINABILITY PLAN

At the close of each fiscal year, the US Department of Energy (DOE) Sustainability Performance Office (SPO) issues instruction documents and technical resource aids/tools necessary for DOE sites and national laboratories to complete sustainability reporting requirements. SPO is part of the DOE Office of Asset Management. As required by DOE Order 436.1A, *Departmental Sustainability*, each site develops and commits to an annual site sustainability plan (SSP) that identifies its respective contribution toward meeting DOE's sustainability goals. SPO collects and compiles information reported by each site to develop an agency-wide sustainability report and implementation plan, which are used to report DOE sustainability progress to the federal government as required by all major federal agencies.

DOE launched a formal Sustainability Office and annual SSP process in 2011. Each year, Oak Ridge National Laboratory (ORNL), in concert with the US Department of Energy Office of Science (SC), commits to delivering an annual SSP that captures performance data for entry into the DOE Sustainability Dashboard managed by SPO. The performance data entered by each DOE site are then combined to disclose the progress of each DOE program office and are further combined to show comprehensive progress for the agency. Per DOE, each SSP should provide an overview of the site's planned actions and of efforts and accomplishments during the reporting period. SPO collects and compiles information reported by each site to develop DOE's annual sustainability report, climate adaptation and resilience plan, and annual energy management report to Congress.

The Office of Asset Management assists program offices in sustaining their missions, freeing up resources by reducing waste, avoiding excess expenditure on utilities, maximizing productivity, and improving the efficiency of facilities and processes. By focusing on mission needs, programs and associated DOE sites can help the agency meet its sustainability goals as outlined in federal statutory and regulatory requirements. Each year, SPO's SSP instructions are updated to capture current requirements from executive orders (EOs) and newly added laws. Updates in annual SSP instructions help to minimize and streamline reporting while simultaneously addressing updated federal requirements and DOE priorities.

The ORNL SSP narrative report (this document) and the reporting of DOE SPO Sustainability Dashboard performance data are a collaborative effort of approximately 30 subject matter experts (SMEs) from ORNL facility management, mission support, and research divisions. Annually, these associates come together to provide a report that can be used by DOE to demonstrate continued agency progress in energy efficiency and sustainable federal operations.

2. INTRODUCTION

2.1 WHO WE ARE

2.1.1 ORNL Mission

ORNL delivers scientific discoveries and technical breakthroughs needed to realize solutions in energy and national security and provide economic benefit to the nation. ORNL addresses national needs through impactful research and world-leading research centers. ORNL, managed under contract by UT-Battelle LLC, is DOE's largest science and energy laboratory and, as such, executes the widest range of mission capabilities. Diverse expertise spans a broad range of scientific and engineering disciplines, enabling the research and science achievements needed to accelerate the delivery of solutions to the marketplace. ORNL supports DOE's national missions of scientific discovery, clean energy, and security. To execute these activities, ORNL has grown significantly with 80 years of continuous operations; it comprises an extraordinary set of distinctive scientific facilities and equipment with commissioning dates ranging from the 1940s to the present. The complexities of such a variety of facilities require teamwork among divisions, a wide variety of conservation projects, and creative strategies to achieve the desired energy and water savings. Such a diverse and unique set of major facilities, totaling approximately 5.5 million ft² with more than 7,000 employees, requires an innovative plan to accomplish advancements in operational efficiencies.

ORNL is tasked with managing an extraordinary set of distinctive scientific facilities and equipment for DOE. ORNL is mission driven, and its mission has grown significantly over the decades. ORNL's core research capabilities provide broad science and technology support for DOE in the areas of energy, environment, and national security. Currently, ORNL is a world leader in materials, neutron, and nuclear science and engineering and in high-performance computing (HPC) and data analytics. These areas are further identified within various sections of this report. ORNL's vast portfolio of research facilities must be maintained and carefully upgraded to protect the country's investment in scientific analysis. The goal of sustainable operations is to enable more effective and efficient execution of ORNL's science and technology mission. Implementing sustainable operational practices involves striving for enhanced operational results while remaining diligent in energy and environmental stewardship.

2.2 SUSTAINABLE ORNL

Continuous improvements in operational and business processes must be integrated into the fabric of the ORNL culture to maximize the return on investment made in modernizing facilities and equipment. The Sustainable ORNL program promotes the legacy of system-wide best practices, management commitment, and employee engagement that will lead ORNL into a future of efficient, sustainable operations.¹ ORNL leadership and Sustainable ORNL champions receive status reports on the progress of each project and focus area (i.e., road map) and periodic summary reports as needed.

The Sustainable ORNL road map structure includes 15 vital road maps. Figure 1 summarizes the current project assignments and was designed to convey that each sustainability area contributes to the well-being of the whole. Continuous employee engagement and regular status reports confirm the ideals of the program.

¹ More information is available at the Sustainable ORNL website: <https://www.ornl.gov/sustainable-ornl>.

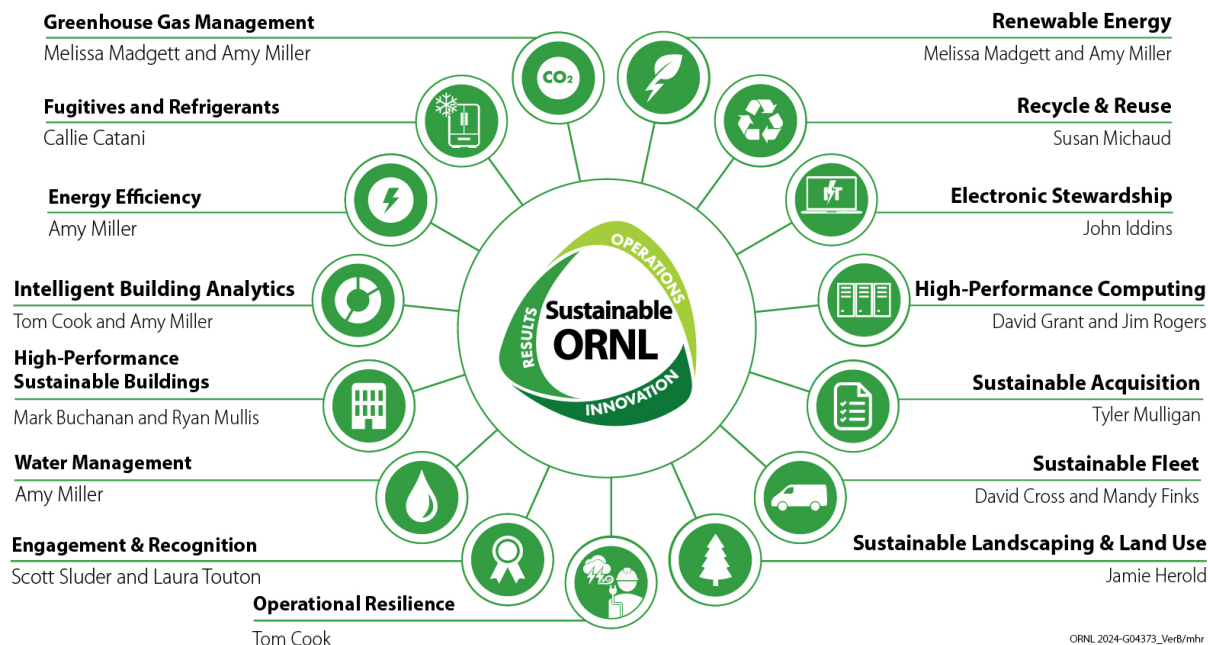


Figure 1. Sustainable ORNL focus areas (road maps) and subject matter experts for FY 2024.

The road map structure is not static; as the science mission advances and the needs of the organization evolve, the Sustainable ORNL road map structure elements are modified to align with developing priorities.

The current Sustainable ORNL road maps align with the reporting requirements and focus areas of the SSP and greenhouse gas (GHG) reporting. The carbon pollution-free electricity (CFE) and net-zero goals are crosscutting for all road map owners, but the Greenhouse Gas Management and Renewable Energy road maps capture ORNL’s holistic approach toward achieving these goals.

Net-zero initiatives do not operate in isolation; rather, they work in conjunction with other priorities to reach several agency objectives. Sustainable ORNL provides the collaboration needed for the advancement of the sustainability initiatives at ORNL. Throughout the ORNL campus, projects are evaluated on several sustainability priorities, including energy, water, and cost savings from energy conservation measures (ECMs), net-zero initiatives, and operational resilience. ORNL has an opportunity and a responsibility to lead by example and integrate climate and sustainability into all aspects of its operations.

2.3 EXECUTIVE SUMMARY TABLE OF ORNL'S PROGRESS TOWARD FEDERAL GOALS

Many DOE sustainability goals build on prior successes and strive for additional annual improvements. Table 1 summarizes these goals and related actions and information.

Table 1. Executive summary of SSP DOE goals and statuses

DOE goal	Current performance status	Planned actions and contributions	Overall risk of non-attainment
Energy management			
Reduce energy intensity (British thermal units per gross square foot [GSF]) in goal-subject buildings by 50% by the end of FY 2030.	ORNL's FY 2024 calculated energy use intensity (EUI) was 250,387 Btu/GSF. This is a cumulative reduction of 31.2% since FY 2003, a reduction of 39.1% from the FY 2021 baseline, but an increase of 5.42% from FY 2023. ORNL continues to improve identification of energy-consuming facilities as the mission expands.	Continued EUI reduction for goal-subject facilities is seen as attainable by concentrating on the best mix of ECM projects for energy savings and by incorporating net-zero strategies into all levels of lab planning efforts.	High
Achieve a net-zero emissions building portfolio by 2045 through building electrification and other efforts.	ORNL is currently looking into buildings that have dedicated boilers (not associated with the ORNL steam plant) to remove from fuel oil. A project to replace a fuel oil boiler with a rightsized electric boiler was proposed for Assisting Federal Facilities with Energy Conservation Technologies (AFFECT) program funding that if funded would make a small ORNL all-electric mini-campus.	Two new buildings are planned to be all electric in the near future. ORNL will work the AFFECT project, if awarded, to create an all-electric mini-campus that would help to increase the number of net-zero emissions buildings at ORNL.	High
Perform Energy Independence and Security Act (EISA) of 2007 Section 432 continuous (4-year cycle) energy and water evaluations.	In FY 2024, ORNL started the fourth year of the 4-year energy audit cycle by conducting 21 building audits throughout the year to cover a quarter of the buildings that are qualified for audit inclusion.	In FY 2025, ORNL will start the first year of the new 4-year energy audit cycle. ORNL will continue to work with the building energy audit evaluation tool together with the facility condition assessments (FCAs).	Low
Meter individual buildings for electricity, natural gas, steam, and water to adhere to federal metering guidance.	In FY 2024, ORNL added 27 new advanced utility meters (including computational metering and electrical utility distribution metering), migrated one new data stream from other systems across the lab, and replaced seven meters. ORNL meter installations include electrical, steam/hot water, natural gas, chilled water, and potable water.	ORNL will continue to use the metering-tracking process and plan for guidance in the installation of additional advanced utility meters on all utilities per the new federal metering guidance. ORNL is currently working on a plan to be fully metered per DOE Order 436.1A requirements.	Medium Cost, installation connections, and configurations combine to create a challenging task for meter installations.

Table 1. Executive summary of SSP DOE goals and statuses (continued)

DOE goal	Current performance status	Planned actions and contributions	Overall risk of non-attainment
Water management			
Reduce potable water use intensity (Gal per gross square foot).	Annual water consumption resulted in a water use intensity (WUI) of 155.7 G/GSF in FY 2024, which is an increase of 5.0% from FY 2023 and is 15.0% higher than the FY 2021 baseline. (The target is a 50% reduction by FY 2030.) Continued improvements in the identification of water-consuming facilities yielded a 2.8% decrease in GSF in support of the WUI calculation.	ORNL's WUI is subject to rise because of increased demands for cooling tower makeup water to support the growth of HPC systems. With continued modernization activities that include the elimination of old facilities and the addition of new facilities, ORNL will consider more water-efficient systems and maintain a focus on water management best practices to meet future WUI reduction goals.	High Without exclusions, meeting WUI goals is not attainable for DOE sites with critical mission growth.
Reduce non-potable freshwater consumption (gallons) for industrial, landscaping, and agricultural (ILA) usage.	NA. No ILA usage at ORNL.	No change expected.	NA
Waste management			
Reduce non-hazardous solid waste sent to treatment and disposal facilities.	In FY 2024, ORNL's diversion rate for municipal solid waste reached 71%.	ORNL will continue to identify source reduction opportunities.	Medium
Reduce construction and demolition (C&D) materials and debris sent to treatment and disposal facilities.	In FY 2024, ORNL's C&D diversion rate for waste building materials and deactivation and decommissioning debris was 42%.	ORNL will continue to employ terms and conditions within construction contracts to manage construction waste and recycling. C&D recycle rates will vary as the proper characterization of debris dictates.	Medium
Fleet management			
Reduce petroleum consumption.	ORNL continues to optimize utilization and to purchase vehicles with improved fuel economy, electric vehicle (EV) options when available, and vehicles with anti-idling technology.	Currently, ORNL is developing a plan for dual-use electric vehicle supply equipment (EVSE) that supports both government-owned and privately owned vehicle charging.	Low
Increase alternative fuel consumption.	Eighty percent of all ORNL vehicles are alternative-fuel vehicles (AFVs), with 86% of all replacements since FY 2020 being alternative fuel or EVs. Also, 77%	ORNL will continue to purchase AFVs and limit accessibility for non-alternative fuel at ORNL gas pumps.	Low

Table 1. Executive summary of SSP DOE goals and statuses (continued)

DOE goal	Current performance status	Planned actions and contributions	Overall risk of non-attainment
	of light-duty vehicles operate on alternative fuels.		
Achieve 100% zero-emissions vehicle acquisitions by 2035 and 100% zero emissions light-duty vehicle acquisitions by 2027.	If an AFV or EV has been available and has met mission requirements, then it has been purchased or leased during the replacement process. ORNL received the first 15 zero emissions vehicles (ZEVs) in FY 2024.	ORNL will continue the effort of replacing vehicles with AFVs or EVs if they are available and meet the mission requirements. In FY 2025, ORNL plans to establish twenty level 2 and two level 3 EVSE on-site. ORNL is also projected to acquire 12 new EV light-duty vehicles.	Low
<i>Clean and Renewable energy</i>			
Achieve 100% carbon pollution-free electricity (CFE) on a net annual basis by 2030, including 50% 24/7 CFE.	ORNL purchased 52,000 MWh renewable energy credits (RECs) to supplement on-site renewable energy generation. These RECs represent 9.2% of the lab's electrical energy consumption, exceeding the 7.5% statutory requirement. The Tennessee Valley Authority's specific percentage CFE per US Environmental Protection Agency (EPA) Emissions and Generation Resource Integrated Database (eGRID) FY 2022 data indicates a grid-supplied CFE of 39.6%.	ORNL will remain compliant with the Energy Policy Act of 2005 7.5% renewable electric energy requirement via REC purchases. ORNL will continue to explore innovative renewable energy projects. REC purchases will reflect significant mission growth in the near future but will transition to energy attribute certificates (EACs) as ORNL works toward CFE requirements.	Medium The numbers of RECs/EACs to purchase will increase with mission growth. REC/EAC pricing may become volatile and create budgetary issues as the market attempts to meet increasing demand for EACs.
Increase consumption of clean and renewable non-electric thermal energy.	NA under current statutes.	NA	NA
<i>Sustainable buildings</i>			
Increase the number of owned buildings that are compliant with the Guiding Principles for sustainable buildings.	ORNL did not reassess the Guiding Principles certified buildings in the 4-year reassessment cycle and therefore has no Guiding Principles certified buildings to report in FY 2024. ORNL will develop a reassessment plan by 2026.	ORNL plans to have at least two or three new construction buildings to add to the sustainable building count in the next 2 years.	Medium
<i>Acquisition and Procurement</i>			
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring all sustainability clauses are included as appropriate.	ORNL maintained 100% compliance in FY 2024. All subcontracts contain multi-statutory terms and conditions that invoke requirements for sustainable acquisitions as defined in the UT-Battelle prime contract as flow-down requirements.	ORNL will continue its mission commitment to include all applicable federal acquisition regulation (FAR) clauses and provisions in each new contract. ORNL will maintain compliance with DOE Order 436.1A and assist	Low

Table 1. Executive summary of SSP DOE goals and statuses (continued)

DOE goal	Current performance status	Planned actions and contributions	Overall risk of non-attainment
		with the supply chain risk assessment moving forward.	
<i>Investments: improvement measures, workforce, and community</i>			
Implement life cycle cost-effective efficiency and conservation measures with appropriated funds and/or performance contracts.	ORNL spends over \$500,000/year to fund ECMs identified via audits. DOE has a contract with Johnson Controls Inc. for an ORNL energy savings performance contract (ESPC) project. The delivery order was July 31, 2008, with a term of 24 years and 7 months. It includes ECMs consisting of steam system decentralization, building management system improvements, advanced meter installations, energy-efficient lighting upgrades, and domestic water conservation.	ORNL's ECMs need to be evaluated to determine which are life cycle cost-effective and, if found to be so, to fund them and begin installation to the maximum level of funding available. ORNL will then continue to investigate the best potential funding pathway strategies as the life cycle cost-effective ECM list grows moving forward.	Medium
<i>Electronic stewardship</i>			
Increase acquisition of sustainable electronics and promote sustainable operations and end of life practices.	ORNL maintained 100% compliance in the acquisitions of environmentally certified products. ORNL actively maintained power management features on 100% of all eligible IT devices in operation. Disposition of 100% of end-of-life electronics was preformed through government reuse programs and certified recyclers.	ORNL plans to maintain 100% compliance with all electronic stewardship goals and categories. No obstacles to the goal are foreseen.	Low
<i>Adaptation and Resilience</i>			
Implement climate adaptation and resilience measures.	In response to EO 14008 and DOE directives, ORNL submitted the vulnerability assessment and resilience plan (VARP) in September 2022 along with a portfolio of actionable resiliency solutions. In FY 2024, three resiliency solutions were implemented, and three other projects are currently pursuing funding via Institutional General Plant Project (IGPP) or line item.	Updates of the implementation status of ORNL's solutions will be reported annually to SPO. ORNL will continue to investigate project funding for resiliency solutions. ORNL will prepare for the next VARP reporting year, 2026.	Low
<i>Multiple categories</i>			
Reduce scope 1 and 2 GHG emissions.	The FY 2024 scope 1 and 2 GHG inventory was 233,775 MTCO ₂ e (net after RECs), a year-over-year decrease of 1.4%. Purchased electricity (scope 2) comprised 74% of ORNL GHG emissions.	Mission growth as described in several sections in this report will limit the ability to decrease emissions in the next 5 years. However, the priority for nationwide clean energy	High

Table 1. Executive summary of SSP DOE goals and statuses (continued)

DOE goal	Current performance status	Planned actions and contributions	Overall risk of non-attainment
	EPA eGRID emissions factors and ORNL's increase in workforce contributed to ORNL's scope 2 GHG increase.	strategies is expected to result in the EPA eGRID emissions factors being favorable for reduction in scope 2 GHG emissions.	
Reduce scope 3 GHG emissions.	The FY 2024 scope 3 GHG inventory was 28,612 MTCO ₂ e, a 12% increase from FY 2023. Scope 3 activities at ORNL included distribution losses from purchased electricity and increased employee commuting and business travel. The increase in the ORNL workforce led to the increase in commuting scope 3 GHG emissions in FY 2024.	Employee commuting and business travel categories are expected to grow if the ORNL workforce continues to grow as it has in the past 2 years.	High

3. GREENHOUSE GAS (GHG) PERFORMANCE

3.1 GHG EMISSIONS IN METRIC TONS OF CO₂ EQUIVALENCY (MTCO₂E)

3.1.1 Performance Status

The sources of GHG emissions at ORNL and the inventory for FY 2024 are detailed in Table 2 and depicted in Figure 2. The science mission at ORNL is growing, and because federal accounting guidance allows no GHG emissions exceptions or exclusions, regardless of mission, emissions are expected to increase in the near term. Federal priorities should work together to reduce GHG emissions significantly by 2030 per EO 14008, EO 14057, and other federal programs and initiatives. Most significantly, national CFE goals will result in lower emissions for each megawatt of electricity consumed by ORNL.

Table 2. Sources of GHG emissions at ORNL in FY 2024

Source of GHG emissions	FY 2024 inventory (MTCO ₂ e)	Percentage of total (%)
Purchased electricity (net after renewable energy credits or RECs)	195,645	74%
Natural gas, facilities	34,566	13%
Employee commuting	17,218	7%
Transmission and distribution losses	9,993	4%
Fugitive gases and refrigerants	2,555	1%
Business air travel	1,213	Less than 1%
Fleet fuels (FY 2023 reported– year behind)	675	Less than 1%
Fuel oil, facilities	572	Less than 1%
Nonfleet vehicles and equipment fuels	415	Less than 1%
Business ground travel	189	Less than 1%
Wastewater treatment	21	Less than 1%
ORNL total GHG emission sources	263,062	100%

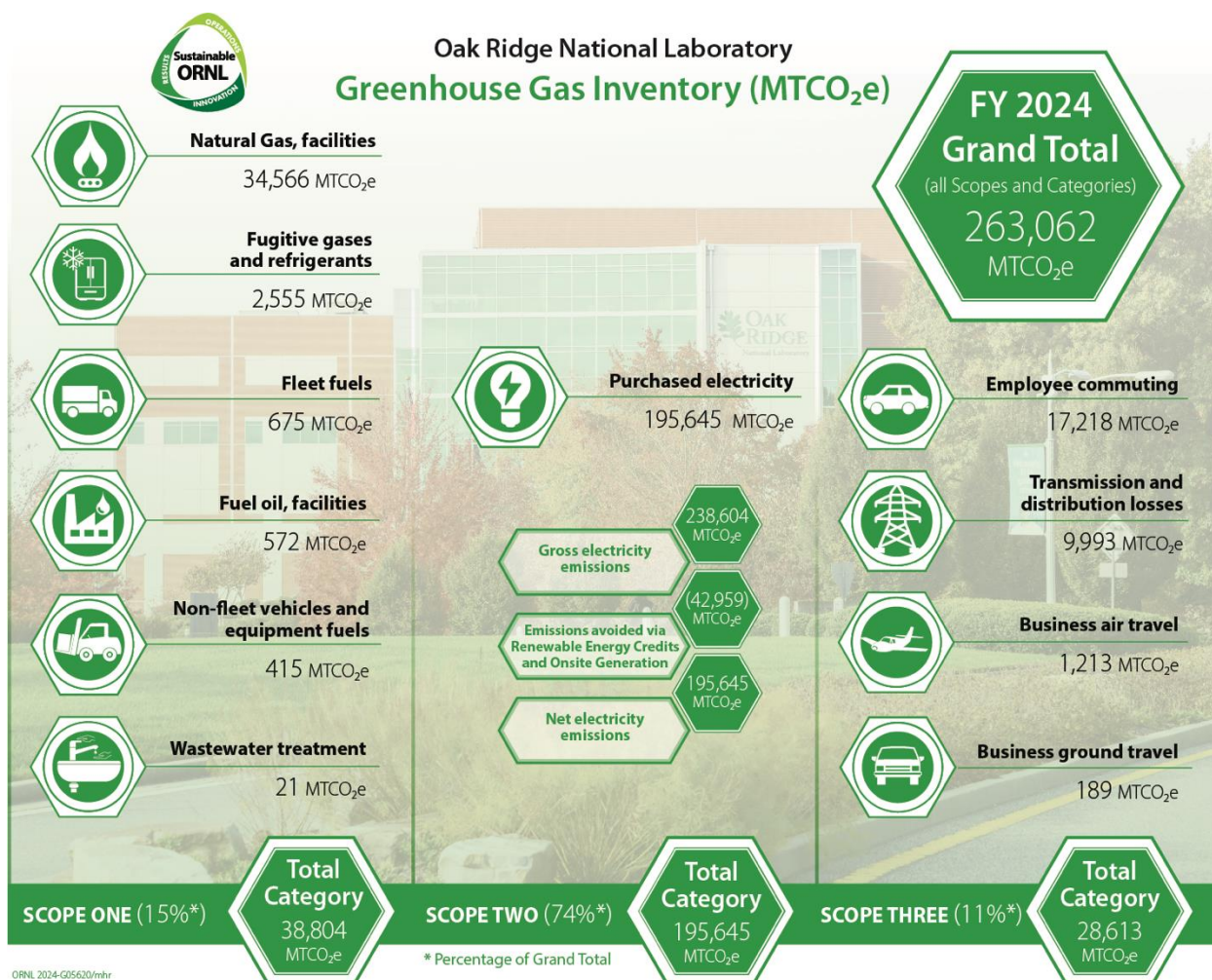


Figure 2. GHG emissions at ORNL for FY 2024.

3.1.2 Plans and Projected Performance

By far, the most significant components of GHG emissions are the production and distribution factors associated with electrical power production, netting 74% of ORNL emissions in FY 2024. As CFE strategies are positioned by the power plants, more efficient and cleaner energy sources will be used for electricity, and as correlated emissions are updated, favorable impacts will develop.

Over the past 15 years, GHG emission factors from electricity have improved slowly but steadily, but the rate of progress is expected to accelerate as clean energy strategies are deployed nationwide by the producers of CFE. ORNL will be able to use more relevant (and favorable) output emissions data for the grid region as clean energy strategies are deployed by utility producers, including ORNL's wholesale provider, the Tennessee Valley Authority (TVA).

In the coming years, ORNL will explore the feasibility of quantifying and reporting carbon sequestration that occurs on the Oak Ridge Reservation's 25,000 acres of unimproved land. Historically, 40% of the oak ridge reservation's unimproved land, or 10,000 acres attributed to ORNL, could be used for carbon sequestration credit, if a path for reporting this was established.

4. ENERGY MANAGEMENT

4.1 ENERGY MANAGEMENT PROGRAM OVERVIEW

The ORNL energy management program begins with comprehensive understanding through ongoing monitoring and assessments of all energy and water consumption. Site utility services include electrical power, natural gas, fuel oil, steam, chilled water, and potable/process water to support ORNL's mission and research programs. ORNL's utility consumption and costs reflect the ORNL main campus, the Spallation Neutron Source (SNS) site, various research and support facilities throughout the property, and leased spaces, primarily the National Transportation Research Center at the Hardin Valley Campus. ORNL's reporting includes energy and water from buildings that are owned by SC and the DOE Office of Environmental Management throughout the ORNL campus. The continued knowledge gained from the analysis of past and current energy consumption will better position ORNL to develop plans for improved energy efficiency and GHG reduction in facility operations.

4.1.1 Utility Consumption

Electricity, the largest energy commodity for ORNL, currently accounts for approximately 74.5% of ORNL's total energy consumption (Figure 3). Electrical services include basic power needs, chilled water service, and direct cooling applications. Electrical services dominate ORNL's energy consumption, primarily because of critical operations at high-energy mission-specific facilities (HEMSFs). Electricity accounts for 87% of the utility provider commodity budget at ORNL (Table 3).

Heating energy makes up 25.2% of fuels (non-electric energy consumption) at ORNL. Natural gas is the primary fuel used for steam generation at the ORNL main campus steam plant and the Melton Valley steam plant and for hot water generation at the Central Utilities Building supporting SNS. Natural gas is also used in direct natural gas heating and research applications. Fuel oil, which is used for steam generation during curtailment and maintenance periods and for heating at the Energy System Test Complex, accounts for less than 0.3% of the total energy consumed.

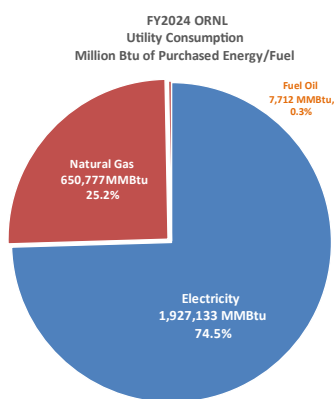


Figure 3. FY 2024 total utility consumption breakdown.

Table 3. ORNL FY 2024 utility consumption and cost

Utility	Consumption	Cost
Electricity	564,744 MWh	\$35,815,000
Natural gas	635,285 MCF	\$3,812,000
Fuel oil	56 kgal	\$164,000
Potable water	693.074 Mgal	\$1,386,000

4.2 PROGRAM INFORMATION FOR ORNL HEMSFS

ORNL's unique research mission results in energy efficiency challenges not typically experienced in conventional office and laboratory buildings. DOE and SC have designated a unique facility category for facilities housing exceptional operations: HEMSF. ORNL currently designates and tracks four unique facility/research systems as HEMSFSs. Appendix A contains brief program information for ORNL HEMSFSs and is included to better document the associated reduction challenges in terms of energy and water performance improvement efforts.

4.3 ORNL HEMSF ENERGY USE AND PROJECTIONS

The current and projected values for total energy consumption in millions of British thermal units (Btu), by all sources at ORNL are shown in Figure 4 in comparison with the energy consumed by the HEMSF systems. HEMSF energy consumption accounted for approximately 52% of ORNL's total energy use in FY 2024 and is expected to grow to 60% of total energy use by FY 2030. As shown previously in Figure 3, electricity is the dominant utility (approximately 75%) for all of ORNL, both at the HEMSFSs and the base site (or overall campus).

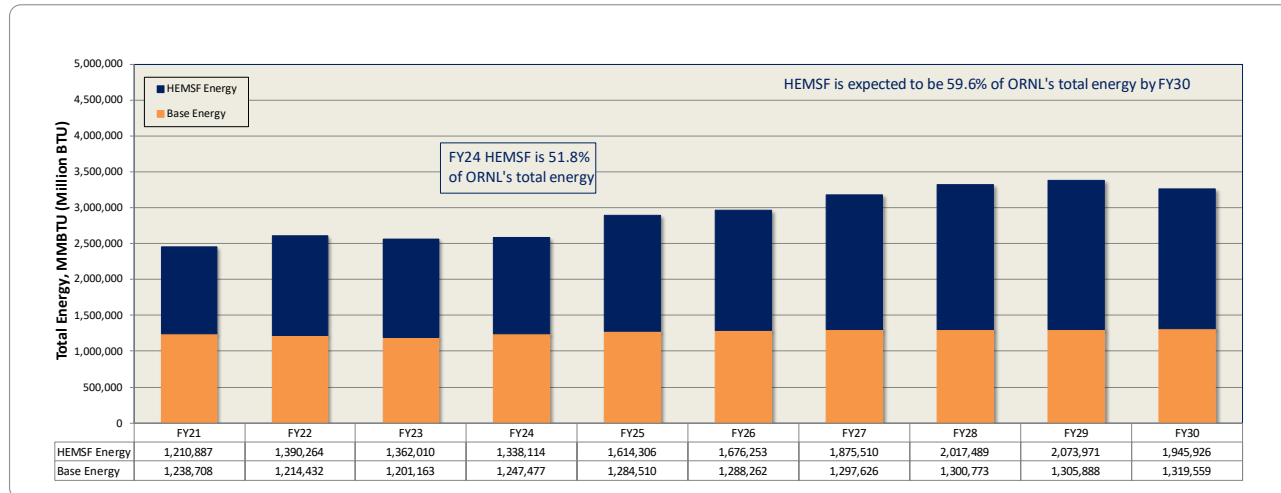


Figure 4. Total base energy use at ORNL vs. HEMSF energy use.

The top section of the bar graph includes all HEMSFSs. Other ORNL energy is shown on the bottom section of the bar graph and is identified as base energy consumption. For all comparisons, base energy includes electricity and other fuels used for basic facility operations and not consumed at HEMSF systems.

The HEMSF electrical energy use and projection bar graph in Figure 5 is provided to demonstrate the importance of electrical energy at ORNL. Electricity consumption is the largest component of HEMSF energy use. Around 66% of all ORNL electricity is consumed at these HEMSFSs. Electrical consumption increased slightly in FY 2024 as High Flux Isotope Reactor (HFIR) operations returned to a normal number of cycles. SNS operations were reduced because of the installation of the Proton Power Upgrade project for most of FY 2024 but are expected to increase in FY 2025. As the mission continues, HEMSF electrical consumption is projected to grow from 66% to nearly 71% by FY 2030 based on projections for HPC expansion and infrastructure improvements for SNS's Second Target Station.

The bar graph in Figure 5 shows the electricity use and projections for each of the four ORNL HEMSFSs. All other electricity consumption is also shown on the bar graph as base site usage.

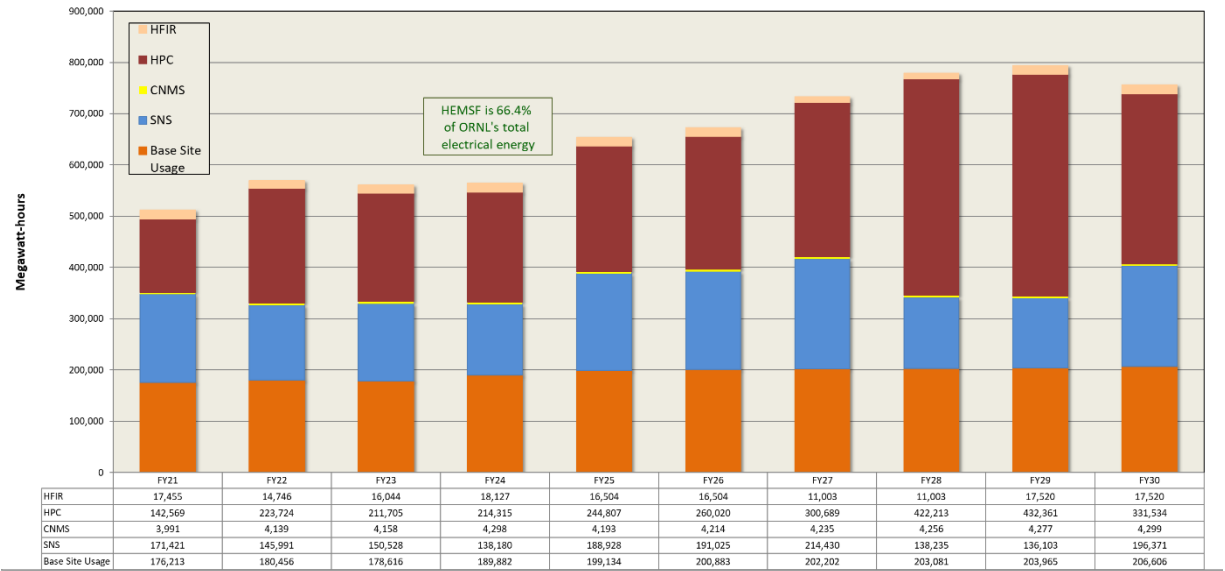


Figure 5. Electricity consumption of the four identified HEMSFs at ORNL.
CNMS stands for Center for Nanophase Materials Sciences.

Thermal energy consumption is also expected to increase with ORNL mission growth as HEMSF research needs increase (Figure 6); however, electricity will remain the dominant energy source. All other heating energy values are shown on the bar graph as base site usage.

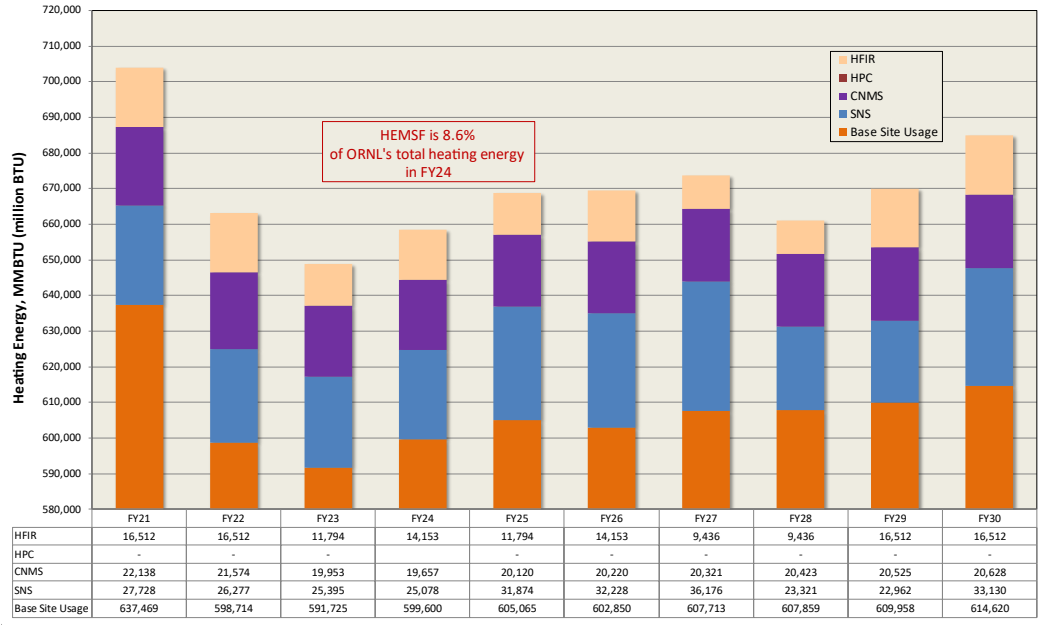


Figure 6. Projections of thermal energy consumption for the HEMSFs at ORNL.
CNMS stands for Center for Nanophase Materials Sciences.

4.4 ORNL GOAL ENERGY USE INTENSITY (EUI) AND EXCLUDED ENERGY USE AND PROJECTIONS

4.4.1 Performance Status

Based on FY 2024 data, energy use in the buildings category at ORNL is 1,062 billion Btu, not including ORNL's excluded facilities as defined by the Energy Policy Act (EPAct) of 1992. Given an area of 4,242,734 GSF (gross square feet) of energy-consuming buildings, trailers, and other structures and facilities identified in the Facilities Information Management System (FIMS), the FY 2024 calculated energy use intensity (EUI) was 250,387 Btu/GSF, resulting in a cumulative reduction of 31.2% since FY 2003, a reduction of 3.91% from the FY 2021 baseline, and an increase of 5.42% from FY 2023 (Figure 7).

ORNL managed resources during extreme winter weather conditions in January 2024 to continue to deliver reliable utility services, consuming additional energy and fuel and thus affecting the FY 2024 EUI.

ORNL's energy increased for goal-subject buildings in part because of an increase in employees on campus, new construction not yet occupied, and increased mission, all impacts of the return to normal operations after the COVID pandemic. The goal-subject gross square footage decreased 2.8% with improved reporting metrics for goal-subject facilities, resulting in a 5.42% increase in EUI from FY 2023.

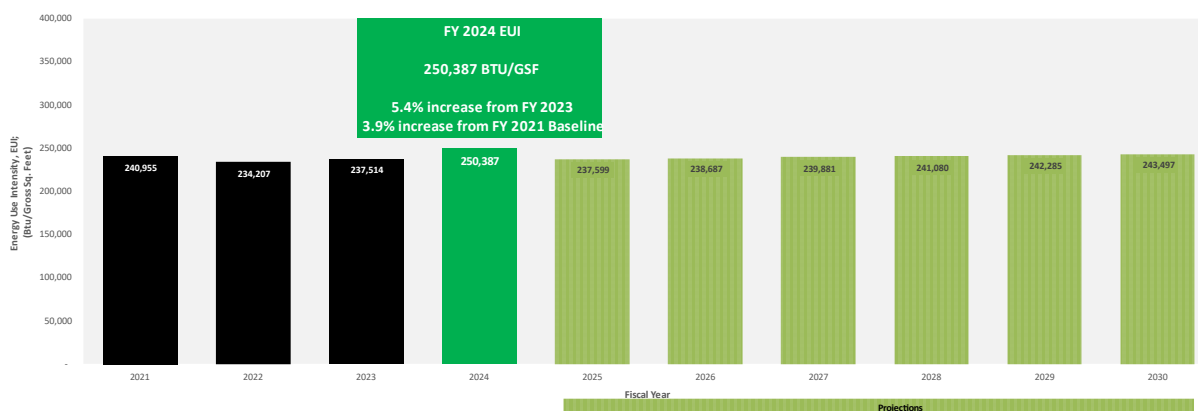


Figure 7. Historical, current (FY 2024), and projected EUI at ORNL.

ORNL's electrical consumption is primarily attributable to mission-critical buildings and systems. Approximately 73% of the total electrical load is formally assigned to the Excluded category, as is 17% of the thermal energy (natural gas and fuel oil). These mission-critical systems are not subject to conventional energy conservation methodologies.

The Excluded category energy and fuel projections are expected to increase as ORNL's HPC and SNS target station missions grow. Additional maintenance schedules for HFIR and SNS (due to the Proton Power Upgrade project) in FY 2024 are also reflected in the electrical consumption.

ORNL anticipates more buildings being constructed in FY 2025. These buildings are expected to be in the Goal Subject category, and they include the Craft Resources Support Facility (43,000 ft²) and the Translational Research Capability Building (90,000 ft²), with building completion expected in FY 2025.

Additional new construction and modifications are being considered by SC for ORNL's annual laboratory plan.

The ORNL workforce has grown by more than 1,000 employees within the past 2 years. This workforce growth has affected ORNL's current energy performance, and if this trend continues, it could influence future performance.

4.4.2 Plans and Projected Performance

ORNL's efforts toward energy intensity reduction have resulted in considerable progress by targeting readily applied ECMs in existing buildings. As these types of opportunities become less prevalent, ORNL will shift focus to a deeper level, leveraging the cooperation of data and operations staff to find new, innovative energy-savings potential. Throughout ORNL, projects are evaluated on several sustainability priorities, including energy, water, and cost savings from ECMs, net-zero initiatives, and enhanced operational resilience.

ORNL is continuing to build a foundation of awareness to make energy efficiency increasingly part of daily operations. Energy managers cannot be part of all decisions, so it is important that the decision-making process include considerations of energy efficiency and life cycle cost.

ORNL will continue to leverage the power of building operations data from existing systems, including the Building Automation System (BAS) and metering systems. New sensors and meters will be added in strategic locations, and new capabilities will be built out in existing systems or layered with new systems, as necessary. Focus will be placed on developing tools for operations staff to maintain building systems in a way that supports reliability, meets the needs of building occupants, and achieves energy efficiency. The Utilities Division will continue to evaluate utility systems for improving operations, improving reliability, and reducing maintenance costs.

ORNL expects the continued increase in its workforce to show in energy consumption throughout the lab and will have to continue looking for life cycle cost-effective energy savings opportunities to combat this increase.

4.5 ENERGY MANAGEMENT: INITIATIVES, PROJECTS, STRATEGIES, AND PROCEDURES

4.5.1 Performance Status

To maintain steady progress toward EUI reductions, ORNL focuses on energy-efficient initiatives, projects, strategies, and procedures to move the needle toward energy reduction. Fault detection and diagnostic software, smart repurposing of existing facilities, de-energizing excess facilities, and a drive for continuous improvement in large-scale utility operations make up ORNL's operational strategy for energy reduction. Efforts throughout ORNL that have impacts on energy consumption are described here.

4.5.1.1 Fault detection and diagnostics

EUI reduction in existing ORNL facilities is data driven, and efforts are made to quantify and bring awareness to building energy performance so that operations staff can make informed decisions. ORNL pursues approaches to energy consumption awareness using data visualization and reporting. Building data analytics, including fault detection and diagnostics (FDD), have been added to ORNL's energy conservation tools. In FY 2021, ORNL piloted SkyFoundry's SkySpark FDD system in two buildings. In FY 2022, ORNL utilized awarded Science Laboratories Infrastructure (SLI) General Plant Project (GPP)

funding to add 13 buildings to SkySpark, bringing the total number of buildings to 15, with more than 1.5 million GSF covered and nearly 32,000 data points connected (Table 4). The additional 13 buildings were chosen because they are significant energy users. Many are also very aged and/or complex and thus stand to benefit greatly from commissioning with improved monitoring and analytics. In FY 2024, ORNL has continued to reevaluate and optimize the established faults and key performance indicators for these buildings with input from facility operators and add data for one additional building to the system (Building 1005), bringing the total number of implemented buildings to 16, with more than 1.5 million GSF covered and nearly 34,000 data points connected (Table 4).

Table 4. ORNL buildings with SkySpark FDD

ID	Name	Year built	Size (GSF)	Data points
1005	Ultra-Trace Forensic Science Center	2004	35,973	1,799
1505	Environmental Science Laboratory	1978	88,843	922
1520	Joint Institute for Biological Sciences	2007	35,543	1,427
2033	Measurements and Controls Facility	1990	31,286	825
4100	Chemical and Materials Sciences Building	2011	155,712	8,614
4501	Radiochemistry Laboratory	1951	75,738	377
4508	M&C Laboratory	1962	97,781	1,260
4515	High Temperature Materials Laboratory	1987	65,093	1,676
5100	Joint Institute for Computational Sciences	2003	51,451	2,799
5200	ORNL Conference Center	2004	1,265	1,337
5600	Computational Sciences Building	2003	98,348	2,966
5800	Engineering Technology Facility	2003	77,492	1,742
7130	Research Operations Support Center	2020	29,049	371
8630	Shull Wollan Center	2010	32,046	1,661
4500N	Central Research and Administration–North	1952	363,758	4,087
4500S	Central Research and Administration–South	1961	317,258	2,647
		Total	1,556,636	34,510

4.5.1.2 LED implementation and standardization of energy-efficient equipment through division policies

Although many LED upgrade projects were pursued as ECMs in FY 2024, significant efforts were also made within the facilities to upgrade to LEDs when old, more inefficient lighting failed. These efforts were not captured as an ECM but rather as general maintenance. ORNL used the Esri ArcGIS system to track LED upgrade information such as energy savings for the lighting projects that were conducted for general maintenance, not dedicated ECMs. The LED tracking tool was established to track the details of LED upgrades throughout the ORNL campus (including those associated with ECMs and those not associated with ECMs). Information tracked in the LED tracking tool using ArcGIS includes location, old lamp count, new lamp count, wattage difference, type of replacement (e.g., retrofit kits, instant fit bulbs, new fixtures), and occupancy sensor status (before and after upgrade). With this information, the simple energy savings of each light replaced at ORNL can be calculated. The data are sorted by year and per building as shown in Figure 8. Figure 8 also shows the data input for FY 2024, but this application can show reported LED data for all years since this effort began. This dashboard helps show the overall effort ORNL is making in its facilities that is not directly funded with ECM funding.

In FY 2022, the Facilities Management Division (FMD) director implemented a new policy for 100% LED replacement of any lighting that needs to be replaced within ORNL FMD facilities moving forward. This policy was communicated to the division and to all those who purchase lighting for the facilities. The implementation of this policy can be tracked via the LED tracking tool. However, this tracking method is only as good as the data that are reported. If a group does not report their LED installations, but LEDs are still installed in workspaces, then ORNL does not capture the benefits even though the energy savings benefits will accumulate over time.

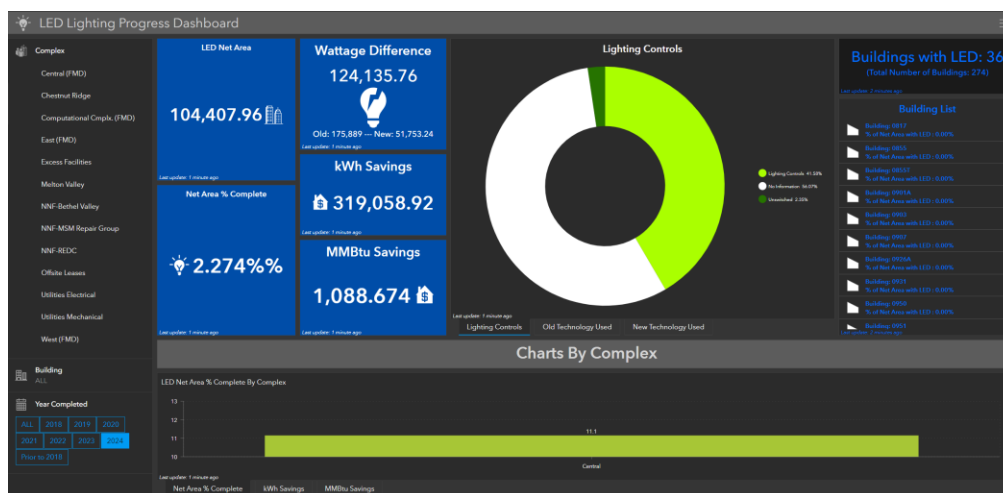


Figure 8. LED lighting upgrade tracking dashboard in Esri ArcGIS for FY 2024.

4.5.1.3 Excess facilities

ORNL continues to modernize its campus by demolishing shutdown facilities that are underutilized or no longer needed to support the mission. ORNL's excess facilities program (EFP) works with FMD and other building-owning organizations to mitigate energy waste after assets have been transitioned to excess. The EFP demolition plan is based on the availability of monetary and human resources, organizational and operational needs, and strategic modernization plans for the campus. On a case-by-case basis, after a facility is transitioned from operating to shutdown (excess) status, an analysis is performed to determine suitability for de-energized status. EFP typically demolishes these older, energy-inefficient facilities to make way for newer, more efficient buildings that better serve ORNL's mission.

Clean-out and demolition of the Decontamination Laundry Facility (2523) is expected to be complete in early FY 2025 (The 2523A Laundry Annex Trailer was demolished in August 2024.) EFP was involved with the demolition and renovation of several laboratory spaces within Buildings 4500S, 4505, 5500, and 6000. Eight laboratory spaces in these buildings were demolished in FY 2024. In addition to the demolition and renovation of the laboratories, the old associated lab hood exhaust fan systems in the Building 4500S attic were removed. The FY 2024 demolition and renovation space was approximately 3,900 GSF. It is ORNL's policy to install new LED lighting as these laboratories are renovated and rebuilt.

4.5.1.4 Utility improvements

Improvements in utility services have resulted in nearly 100% system availability and reliability in FY 2024. Utilities personnel continued to serve ORNL's mission during several days of extreme winter weather conditions (snow, ice, and below freezing temperatures) during January 2024 (Figure 9).



Figure 9. ORNL during January 2024 winter storm.

Electric Utilities

Electrical Utilities personnel continue to provide infrastructure to support ORNL’s growing mission and modernization activities. Projects include the Craft Resources Support Facility (Building 7140), the Translational Research Capability (Building 3700), the Advanced Microscopy Laboratory (AML) (Building 3625), and the new Sewage Treatment Plant. Other highlights include the following:

- Thermography is being used to help identify issues to be addressed for reliability concerns.
- Fire alarm panels and emergency generator control panels have been upgraded for improved operations.
- The 3000 and 0901 switch houses now include bench testing for breakers and relays.
- Remote racking devices are being used for arc flash protection for increased safety.

Mechanical Utilities

Mechanical Utilities completed several projects in FY 2024 to increase energy efficiency, improve reliability, and provide more robust operations and maintenance activities.

Steam systems

- A new air compressor (#2) was installed to replace failed equipment for improved efficiency and reliability.
- Trench improvements included repairing and reinsulating approximately 815 ft of steam piping and approximately 630 ft of compressed-air piping; reducing natural gas, water, and fuel consumption; and improving electrical efficiency from leak reduction.
- The steam pit refurbishments were completed, including replacing heavy, aged steel grating with lighter aluminum grating; upgrading ladders; and adding more convenient retrieval equipment.
- Vibration monitoring is now collecting data for the boiler 7 forced draft fan for analysis and failure prediction.

Chilled water systems

- New heat exchangers were installed to subcool high-temperature water for Frontier and Room E102 to reduce chiller and cooling tower energy and improve reliability.

- Cooling tower fill replacements and drift eliminators were installed in HPC central energy plant to improve energy efficiency and reduce water loss to evaporation and leaks.
- A 1,500-ton chiller rebuild (5600-CH-4 chiller) will improve energy efficiency and reliability.
- Nine 14 in. diameter condenser water isolation valves were replaced in Building 4509 to reduce leaks on the aging infrastructure.

Water systems

- The Dosimetry Applications Research (DOSAR) Pump House was remodeled as a more energy-efficient building with LED lighting and modernized pumps and controls.
- Two new lift stations were installed to replace aging stations for more efficient and reliable operations, which include supervisory control and data acquisition monitoring.

4.5.2 Plans and Projected Performance

4.5.2.1 Initiatives and projects

ORNL will work toward pairing refrigerant migration of older systems with ECMs when possible. When looking for ECMs, ORNL will look for HVAC systems that still use older refrigerants that emit more GHGs and try to upscale to newer, more efficient systems that can use refrigerants that emit less GHGs. Currently, there is an effort to get a list of all equipment that uses the older refrigerant, which could be a starting point for ECM upgrade projects throughout the ORNL campus.

ORNL will continue to track LED installations when data are available and provided to track progress toward a fully retrofitted LED campus.

ORNL continues to isolate and demolish old, more inefficient buildings on its campus to make way for newer, more efficient and sustainable buildings.

4.5.2.2 Future utilities projects

New electric air compressors will replace vintage diesel air compressors to reduce scope 1 emissions and improve efficiency and reliability.

Additional switchgear replacements are expected as part of continued electrical distribution improvements.

The Electrical Work Center is nearly ready to be occupied for consolidation of electrical personnel.

The new Sewage Treatment Plant is expected to be in service in the second quarter of FY 2025, increasing operational efficiency and treatment flexibility. This will also replace the ozone generation system, which consumes a considerable amount of energy in the sewage treatment process.

4.6 NET-ZERO ENERGY BUILDINGS

4.6.1 Performance Status

Deployment of new nuclear generation will help ORNL to reach net-zero goals. TVA has approved up to \$200 million to prepare for the potential construction of a small modular reactor at its Nuclear Regulatory Commission-licensed site, which could provide CFE for the reservation and the region.

To further ORNL's progress toward net-zero goals, UT-Battelle has established a memorandum of understanding with TVA focused on decarbonization technologies.² Activities considered include the following:

- Point-source and direct air carbon capture
- Carbon utilization
- Hydrogen generation and utilization
- Electric vehicle (EV) charging and vehicle-to-grid interaction applications
- Light-water small modular reactors and fourth-generation advanced nuclear reactors
- Long-duration energy storage
- Electrification of parts of the economy that are currently fossil fuel based
- Grid resiliency and security

In June 2024, DOE issued the national definition of a zero emissions building: “a building that is highly energy efficient, does not emit GHG directly from energy use, and is powered solely by clean energy” (DOE 2024). Although net-zero carbon research projects will work toward new capabilities for the future of decarbonization, ORNL's first step for the strategy to support net-zero buildings will be focused on campus CFE. Net-zero carbon campus projects will require programmatic and institutional investments. Traditional ECMs such as lighting improvements, HVAC upgrades, and temperature setbacks are being investigated and implemented to reduce energy consumption and the GHG footprint.

4.6.1.1 Sustainable ORNL showcase projects that supported net-zero energy buildings in FY 2024

Each year, Sustainable ORNL makes funding available to partner with researchers at ORNL to support sustainability showcase projects that focus on creative measures that can improve ORNL's sustainability and reduce the GHG footprint. These projects are the perfect mix of mission (research) working with mission support (operations) to achieve federal goals. The projects need to be closely aligned with at least one of the Sustainable ORNL road maps, and preference is given to those that crosscut multiple roadmaps, such as net-zero emissions building projects.

In FY 2024, the program invited studies in the following areas:

1. Studies that demonstrate innovative opportunities to reduce scope 1 and scope 3 GHG emissions on campus. These studies should focus on means/methods that can be deployed at demonstration scale within 5 years.
2. Studies that demonstrate novel means to reduce scope 2 emissions on campus through reduction in electricity demand or that can improve operational resiliency in decarbonized facilities.
3. Studies and/or demonstrations of net-zero solutions for off-road vehicles and equipment used to support operations at ORNL.
4. Other topics that represent creative means to mitigate GHG emissions or further the sustainability of ORNL that are directly tied to one of the Sustainable ORNL road maps.

The showcase projects selected for FY 2024 were as follows.

² For more information, see the following ORNL news story (ORNL 2022): <https://www.ornl.gov/news/ornl-tva-partner-drive-decarbonization-explore-carbon-free-technologies>.

“Feasibility Study of Solar Generation and Resiliency Impacts on ORNL Campus”

The project proposed a feasibility study for the siting of solar energy and battery sources on the ORNL campus to offset consumption from TVA, reduce scope 2 GHG emissions, support the lab’s resiliency goals, and provide a low-carbon source for charging electric fleet vehicles.

“Review of Single-Use Products at ORNL”

The project entailed conducting a review of single-use products at ORNL for the purpose of determining their impact and examining possible alternatives. Examples included plastic cutlery and trash bags. Additionally, team members reviewed ORNL’s purchases for opportunities to increase the purchase of biobased products.

“Funding for Solar Parking Lights for the Building 2040 Parking Lot”

This project took advantage of a planned replacement of Building 2040 parking lot lights to provide support to upgrade the lights to solar-powered LED lights. The solar-powered lights will help reduce ORNL’s electricity use during the hours when fewer employees are on-site. If this installation demonstrates that the upgraded lights are a good solution, then they may be installed in additional parking areas around campus.

4.6.1.2 Mini-campus electrification AFFECT submittal

In May 2024, ORNL, in accordance with instructions from its DOE Site Office, submitted a project for funding from the Assisting Federal Facilities with Energy Conservation Technologies (AFFECT) program. AFFECT provides grants to federal agencies that they can leverage with private capital to make energy and water efficiency upgrades to federal buildings. ORNL submitted an AFFECT funding opportunity for converting a fuel-oil boiler to a rightsized electric boiler, which would create a small all-electric mini-campus at ORNL’s Experimental Gas-Cooled Reactor campus. The total project cost is estimated at \$7 million. If this project were to get funding, then this mini-campus would comprise net-zero energy buildings once ORNL achieves 100% CFE by the 2030 goal.

4.6.1.3 Net-zero energy building tables

From the showcase projects, ORNL completed the following table of projects that apply to the electrification of existing buildings (Table 5). Information on the ORNL electrification of new construction (Table 6) and deep energy retrofits (Table 7) is also outlined in tables that follow.

Table 5. ORNL electrification retrofit projects to existing buildings

FIMS real property unique ID (RPUID)	Building name	Building gross square footage	Planned electrification completion year	Project name	Funding source	Full building electrification? (Yes/No)
200843	Building 8600, Central Laboratory and Office Building	268,600	FY 2024 - FY 2025	Replace existing 250 gal natural gas water heater with a research-driven electric heat pump water heater	Lab	No
97462	Building 7603, Energy Systems Laboratory Facility	50,000	FY 2026	Replace fuel oil steam-to-hot water boiler with a new electric boiler	Direct; AFFECT potential	Yes

Table 6. ORNL planned new construction to run solely on electricity

Anticipated building name or descriptor	Estimated building square footage	Actual/anticipated construction completion year	Project details
Building 6009	Approximately 12,000	Unknown	ORNL 6000 Area support facility will be all electric
TALON	Approximately 23,000	2027	Potential research facility (no building information as of yet)

Table 7 identifies projects that affect major systems (HVAC, hot water, etc.) or infrastructure (e.g., windows) in ORNL's existing facilities and that could result in significant energy reduction (possibly within the 40% requirement for deep energy retrofits).

Table 7. ORNL building deep energy retrofits

FIMS real property unique ID	Building number	Building gross square footage	Planned retrofit completion year	Project name	Funding source (direct or lab funded [e.g., IGPP^a])
97301	4500N	363,758	FY 2026 or FY 2027 (if approval is received)	Window Upgrade to Historical Building (retrofitting single-pane windows and improving building envelope); potential to apply for windows within the historic overlay at ORNL	Lab
97248	3500	71,154	FY 2025	Feasibility Study for Major System Renovations	Lab
97301	4500N	363,758			
97302	4500S	315,595			
97303	4501	75,738			
97304	4505	41,469			
97306	4508	97,281			
97314	5500	56,857			
97320	6000	104,094			

^a Institutional General Plant Project

4.6.2 Plans and Projected Performance: ORNL Net-Zero Assessment

ORNL is waiting to hear determination on the AFFECT project submittal. If the project is awarded, then ORNL will work toward migration of a fuel-oil boiler to a rightsized electric boiler, which would result in an electric mini-campus at ORNL.

ORNL also plans to continue providing internal funding for the Sustainable ORNL showcase projects in FY 2025.

4.7 ENERGY MANAGEMENT: ENERGY INDEPENDENCE AND SECURITY ACT SECTION 432 BENCHMARKING AND EVALUATIONS

4.7.1 Performance Status

In FY 2024, ORNL started the fourth year of the 4-year energy audit cycle by conducting 21 building audits throughout the year to cover a quarter of the buildings that are qualified for audit inclusion. Most audits were done internally by using ORNL's Central Energy Data System (CEDS) data for energy benchmarking and by interviewing facility operations staff. For each facility audit, a report was drafted outlining the significant energy users, recent or impending operational changes, and potential ECMs for the facilities identified by facility personnel. Throughout the year, ORNL leveraged meter data analytics and BAS data for audits.

The Energy Efficiency and Sustainability (EE&S) program provides facility engineers with a list of information that they must be prepared to discuss before the audit. Thorough walk-downs of the facilities may be necessary moving forward, especially in mechanical and electrical rooms to identify ECMs and calculate life cycle cost-effectiveness. The EE&S program will work to establish a consistent auditing structure to ascertain the following available information before and during all building audits:

- Meter data
- BAS data

- FDD data
- Drawings needed for discussion
- Tracked LED information (to baseline and update information)
- Old audits and commissioning reports
- Old benchmarking data (for the prior year and the prior year audited on the 4-year cycle)
- Facility condition assessment (FCA) information

Energy Independence and Security Act of 2007 (EISA) benchmarking of buildings is performed by using ORNL's Resource Advisor (RA) system (addressed in Section 4.8, "Energy Management: Facility Metering") to configure building utility meters to report building utility consumption automatically to the ENERGY STAR Portfolio Manager. Once the reporting connection is set up between the two systems, the process does not require any more effort for reporting except for ensuring data quality and proper configuration within RA and the ENERGY STAR Portfolio Manager.

ORNL uses an internal high-level project tracking system, RESolution, to track all ECMs identified via the audit process or communication with facility engineers. RESolution is used to track major project core details such as time, budget, and scope. ORNL's EE&S program tracks the progress of the ECMs according to these project core details. As part of the scope, the EE&S program includes measurement and verification (M&V) when possible. If it is a more intricate project, then it may require a walk-down or analysis of the controls, but for simple projects such as installations of LEDs, project completion is the only deliverable confirmed to verify the details used in the calculation of the life cycle cost-effectiveness prior to project start. When possible, processes are also developed to embed M&V into the maintenance and operations workflow.

ORNL's M&V process for implemented ECMs aims to balance the rigor, time, and cost of M&V with the scope, scale, and data availability associated with each project. Advanced utility meter data are also used when the meter data are available and the projects are impactful enough to be seen in the building-level utility metering. M&V measures for the ORNL energy savings performance contract (ESPC) are discussed in Section 9.1.2, "Energy Savings Performance Contracts."

ORNL complies with the 5-year FCA cycle to identify and document maintenance that is needed within designated facilities throughout the ORNL campus. During FCAs, various SMEs are contacted to perform the FCA for each building. Meeting with the different individuals creates a bridge of knowledge with respect to equipment repairs, repair costs, and energy improvements. The knowledge transfer and documentation of these FCAs provide those responsible with helpful resources and necessary information for identifying and prioritizing maintenance issues, including some that may have energy efficiency impacts on buildings. ORNL's FCA program has a custom system programmed for tracking assessments. This program tracks the date and assessment details, allows for the upload of information to create a formal assessment report, and tracks actionable deferred maintenance.

In FY 2023, ORNL's EE&S program worked with the FCA system programmers to integrate tracking energy and water audits within the same FCA tracking system shown in Figure 10. This building energy evaluation tracking system could be set up to track and report the data needed for the EISA reporting file that ORNL must submit each year to DOE. The building energy evaluation tracking system can also generate evaluation reports based on the data input into the system. ORNL also worked with programmers to incorporate an ECM tracking system for all identified ECMs discussed in Section 9.1.1, "Energy Act of 2020."

Edit Building Energy Evaluation		FIC	FUA	ESC
Facility Information				
Evaluation Status:	Complete	(Evaluation Cycle: 2021-2024)		
Site:	332 - Oak Ridge National Laboratory - SC			
Property Name:	Central Research & Administration North			
Property ID:	4500N			
Real Property Unique ID:	97301			
Ownership:	DOE Owned (O)			
FUA Description:	Import Text from FUA			
EISA S432 Covered Characteristics				
Covered Facility?:	Covered			
Covered Changed Justification:				
Benchmarked with Portfolio Manager:	No			
Energy Consuming Sq. Ft.:	363758.00			
Prior FY Energy Use (10*6 x Btu/Yr):	74881.10739000			
Prior FY Water Use (10*3 x Gal/Yr):	499.61900000			
EISA S432 Evaluation Status (Combined)				
Previous 4-Year Evaluation Cycle Date:	09/30/2017			
Current 4-Year Evaluation Cycle Date:	04/15/2021			
Evaluation Type/Level:	ASHRAE Level 1			
EISA S432 Cx & Notes				
Retro/Re-Commissioning Assessment:	Yes			
Notes:				
Additional ORNL Information				
Building LED Coverage:				
Lighting Controls:	(Select)	Comments:		
HVAC Setbacks:	(Select)	Comments:		
Re-Commission Date:				
SkySpark Integration:	(Select)	Comments:		
Save & Close Apply Changes Cancel				

Figure 10. Building energy evaluation tool input screen.

4.7.2 Plans and Projected Performance

In FY 2025, ORNL will start the first year of the new 4-year energy audit cycle. This will be the second year that all building audits will be completed using the newly developed building energy audit evaluation tool shown in Figure 10. This tool is a major first step in ORNL's planned approach to enhance the documentation of energy audits and ECMs. The new application will streamline ORNL's ECM and project funding decision matrix by compiling all decision criteria in one central location, thus aiding in compliance with the Energy Act of 2020 (EAct 20). The new tool will be used to assist in determining ECM project selections for FY 2025 using information collected during the FY 2023 and FY 2024 audit cycle.

The vision is for programmers to incorporate a screen that combines the two reporting needs, FCAs and EISA audits, to show all the needed projects within a single building collectively. A combined system of actionable projects that could accomplish two designated requirements could improve decision-making data for funding moving forward. ORNL will also include general and deferred maintenance as factors to consider when prioritizing ECMs each year, along with considerations for safety and environmental benefits.

4.8 ENERGY MANAGEMENT: FACILITY METERING

4.8.1 Performance Status

In FY 2024, ORNL added 27 new advanced utility meters (including computational metering and electrical utility distribution metering), migrated one new data stream from other systems across the lab, and replaced seven meters. ORNL meter installations include electrical, steam/hot water, natural gas, chilled water, and potable water. The meters were connected to ORNL's CEDS, which is a network of systems used for data archiving and analysis. CEDS serves to securely collect, archive, and display advanced utility meter data from the network of utility meters installed throughout the laboratory. CEDS logs multiple parameters from each meter on a standard 15 min interval. This system also enables meter data trend analysis, report consumption, energy awareness dashboard deployment, and data export for use in other analyses.

One of the tools used in CEDS is Resource Advisor (RA). RA's advanced configuration capabilities have been used to easily calculate and quickly display total building energy consumption using data from the advanced utility meters. RA provides comprehensive dashboard and energy analysis capabilities that align with ORNL's continued maturation in energy data utilization. RA also directly feeds metered energy data into ENERGY STAR for benchmarking.

Meters are also used in the following ways:

- ORNL uses its robust meter network to establish a process for continuous energy monitoring using a meter alert capability within CEDS. Alerts are placed on real-time readings for mechanical utility meters, including steam, chilled water, natural gas, and potable water for all buildings that have mechanical meters. Alert parameters are determined by reviewing meter trend history and analyzing as many prior months or years as possible to obtain an accurate representative trend for each building's utility baseline use. Meter alerts have been used to identify and prevent unnecessary waste.
- Metering at service entrances to ORNL is used to validate services for utility provider payments (electricity, natural gas, and water).
- The service-level meters are used along with building-level metering to distribute utility service costs among programs at ORNL for cost recovery.
- Meters are used to track the use of energy, fuel, and water for various data-reporting requirements and to help identify problems and potential conservation opportunities.
- Metering is used in the review of the M&V report for the ESPC with Johnson Controls Inc. (JCI).
- Metering assists with measurements of on-site electrical generation at the solar arrays.

All facility metering is presently documented and updated in ORNL's work management and enterprise asset management system, Hexagon EAM. Using the capabilities of Esri ArcGIS at ORNL, asset information is joined with utility distribution system information into a site utilities metering dashboard in Esri ArcGIS. This dashboard provides insight into the facility utility connections that are currently metered across every utility and facility on campus. With this dashboard, which serves as a master meter report, ORNL can identify unmetered facility connections and then prioritize resources toward the installation of additional metering. The metering dashboard serves as a comprehensive document that charts a course for ORNL's continued advanced metering deployment, supporting ORNL's alignment with the October 2022 *Federal Metering Guidance* (DOE EERE and FEMP 2022) and with current DOE directives focused on advanced utility metering where cost-effective and appropriate. In using ArcGIS, the metering plan and meter implementation process become institutionalized in ORNL's systems so that once a meter is added as an asset, it can be tracked and reported in the meter network (Figure 11).

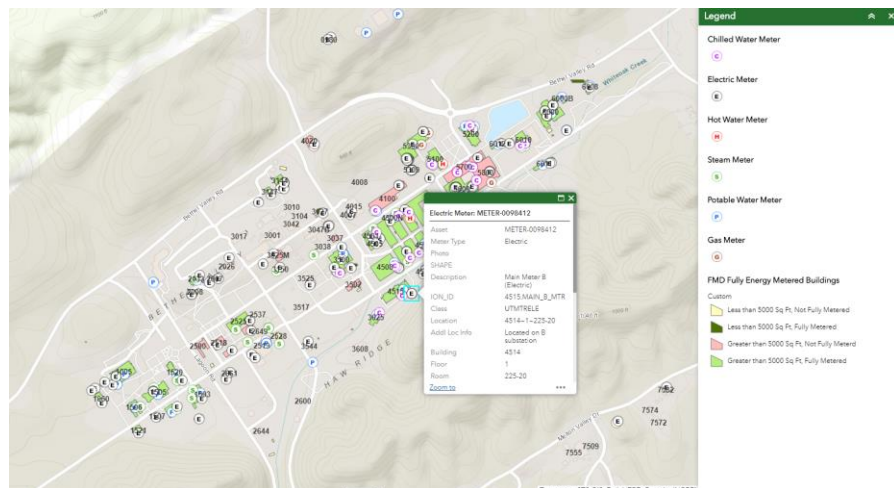


Figure 11. ArcGIS map of the meter network across ORNL.
An electric meter is selected to show the information tracked for each meter.

The total number of facility and distribution meters, the connection points to facilities, the number of facilities that are fully or partially metered, and where these meters are located are now tracked and interconnected between Hexagon EAM and ArcGIS (Figure 12). All mechanical meters are integrated into this process for inclusion in the meter plan report, and the integration of electrical metering into this process was completed in FY 2023.

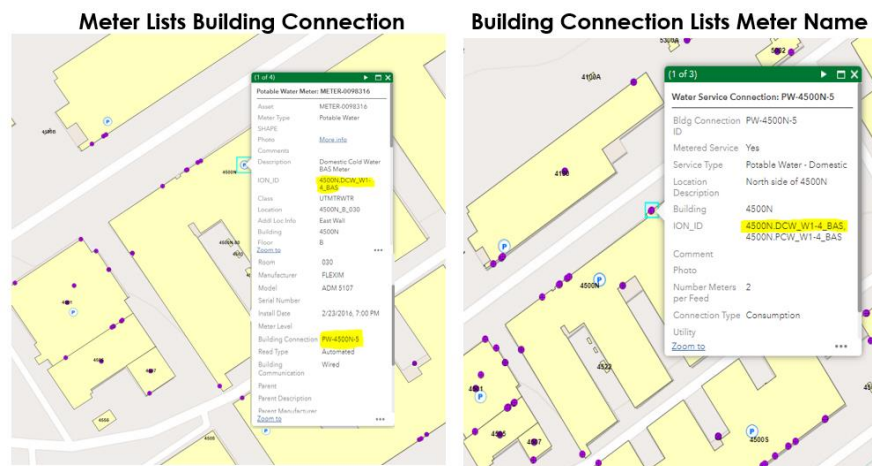


Figure 12. ArcGIS map showing meters connected to utility building connection feeds. Once a meter is linked to connection points (purple dots), a meter plan (as well as meter gap analysis) can be developed.

As with any project of this scale, continued meter deployment will not be without barriers. These barriers may include installation funding limitations, alternative prioritizations of the installation labor force, utility outages or service interruptions required to accommodate installations, and other technical challenges.

4.8.2 Plans and Projected Performance

ORNL is not 100% metered (energy and water) for all buildings defined by the 2022 *Federal Metering Guidance*. ORNL is currently working on establishing a plan for achieving fully metered status per the *Federal Metering Guidance* based on the metering requirements defined in the DOE Order 436.1A

contractor requirements document. ORNL will continue to add metering each year, when feasible, to SC-owned buildings that are required to be metered as designated by the DOE Sustainability Dashboard (based on the 2022 *Federal Metering Guidance*).

The asset management and geographic information system mapping of the utility services and the associated advanced utility meters will continue to be documented, maintained, and expanded upon into the future. The institutionalized meter plan report will be a valuable asset that will help maintain and document the meter network into the future. ORNL will continue to use the metering plan for guidance in installing additional advanced utility meters, where cost-effective and appropriate, on all utilities. All utility meters installed for this endeavor will be connected to ORNL's CEDS for data analysis and archiving.

RA can be used to expand energy awareness with more robust dashboards and analyses for facility managers, facility engineers, and eventually the greater laboratory population. RA is currently being developed to track energy reporting throughout the year using meter data and allocation data when building-level meters are not available for improved reporting and tracking of sustainability metrics (such as EUI) throughout the year. Additional metering will expand building-level EUI and water use intensity (WUI) tracking for potential project opportunities and reporting metrics and will enhance cost recovery efforts.

4.9 ENERGY MANAGEMENT: NON-FLEET VEHICLES AND EQUIPMENT

4.9.1 Performance Status

At only a fraction of 1% of all facility energy, non-fleet fuels (for facility vehicles and equipment) are a comparatively minor source of energy usage and emissions at ORNL. ORNL remains in compliance with reporting and tracking the use of these fuels (diesel, biodiesel, gasoline, and oils) for DOE SSP reporting and performance.

For FY 2024, the combined fuel consumption of generators, landscaping equipment, and heavy machinery increased by approximately 26% from FY 2023. Further improvements in the methodology for collecting fuel information and better categorization of utility vehicles and equipment resulted in additional fuel consumption for non-fleet vehicles and equipment to support a growing mission and service activities.

4.9.2 Plans and Projected Performance

ORNL will continue to upgrade equipment with more energy-efficient options. Sustainable ORNL and the Fleet Management team will continue to look for opportunities to upgrade existing non-fleet vehicles. ORNL will consider fuel-efficiency and improved emissions specifications for future generator purchases.

4.10 ENERGY MANAGEMENT: EUI FACILITY IDENTIFICATION

Figure 13 shows the FY 2024 EUI of 250,387 Btu/GSF and identifies the EUIs of 40 buildings in the Goal Subject category that are greater than 5,000 GSF with EUIs of 250,387 Btu/GSF or greater. Buildings in excess of the current EUI will be the focus of energy conservation activities in the future because improvements in EUI are necessary to meet several of the DOE energy management and sustainability objectives. As expected, buildings with the greatest EUIs are associated with HEMSF research systems (Excluded category) but are not included in this figure.

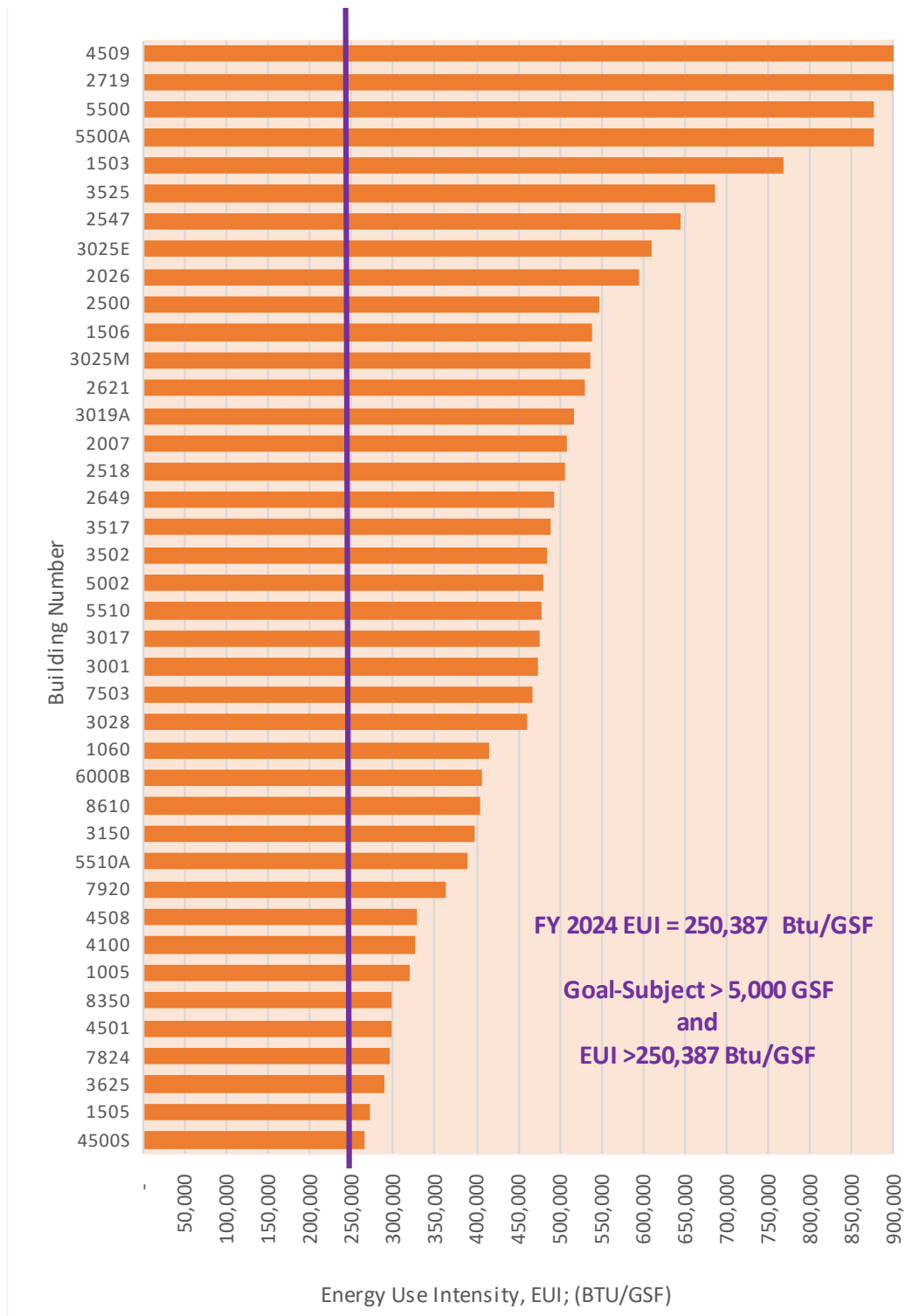


Figure 13. FY 2024 EUIs for buildings that exceeded the FY 2024 EUI (excluding HEMSFs).

5. WATER MANAGEMENT

5.1 WATER MANAGEMENT: WATER USE INTENSITY

5.1.1 Performance Status

ORNL procures potable water from the City of Oak Ridge for domestic use (e.g., handwashing, flushing), cooling (e.g., cooling towers, chillers), heating (e.g., steam generation, hot water generation), limited landscape irrigation, laboratories, and special research processes. ORNL does not use gray water or industrial, landscaping, and agricultural water.

ORNL has long been aware of the benefits of effective water management, having already experienced a 61.2% reduction in water use compared with its highest level of water use in FY 1985. Numerous strategies are engaged to reduce water consumption, including repairing leaks, replacing old lines in the site water distribution system, and eliminating once-through cooling (OTC) where possible. FY 2024 water consumption increased by 4.0% from FY 2023, partially because of increased operations at HFIR and the increased HPC mission. ORNL's total water consumption has decreased by 21.0% from the FY 2007 baseline (Figure 14). As the SNS mission increases along with the increased HPC mission, ORNL's water consumption is projected to increase by 12.6% by FY 2030.

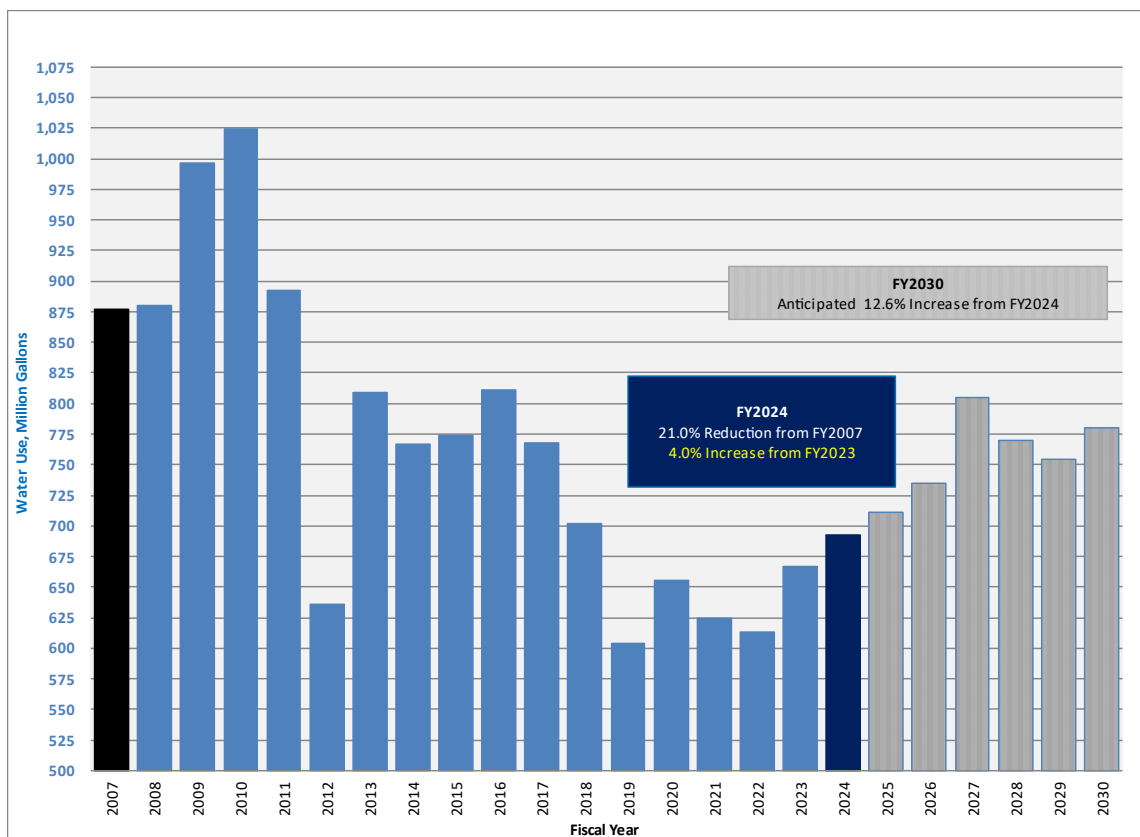


Figure 14. Historical, current (FY 2024), and projected water use at ORNL.

The FY 2024 water consumption yields a WUI of 155.7 Gal/GSF, which is an increase of 5.0% from FY 2023 (Figure 15). The FY 2024 WUI is a 15.0% increase from the FY 2021 baseline, and the target is a 50% reduction by FY 2030.

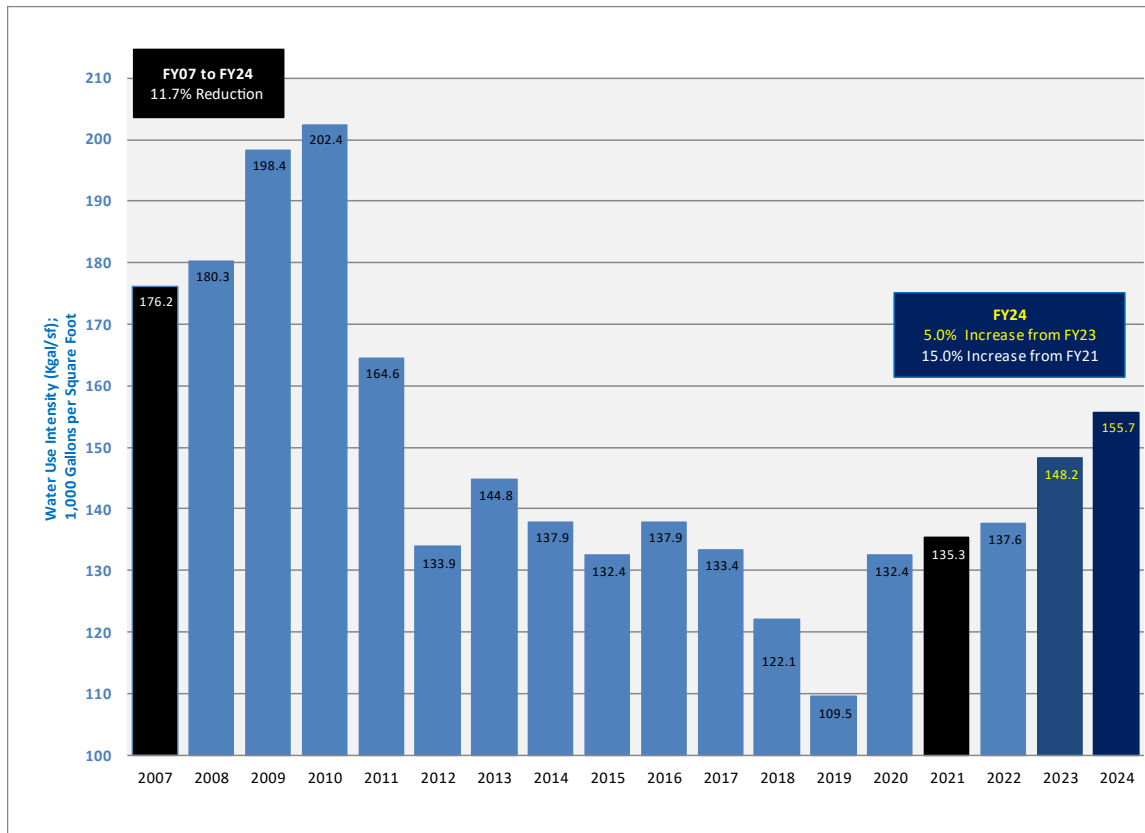


Figure 15. Historic Baseline (FY 2007) to current (FY 2024) WUI at ORNL.

5.1.1.1 ORNL's end-use water consumption

Typical site services such as chilled water and steam/heating production share water use across the facilities that receive those services (Figure 16). Base water use (37% of total water use) is considered more typical in conventional offices and standard laboratories for traditional handwashing/flushing and some research-related water use. Base water is a prime target for energy conservation opportunities. OTC processes have been significantly reduced at ORNL.

Although DOE does not permit excluding water consumption for high-intensity processes for WUI calculations, Figure 16 shows that 10% of ORNL's end-use water consumption is dedicated to research and process activities. This includes dedicated water for cooling tower makeup for HPC (such as Summit and Frontier), SNS processes, and HFIR.

ORNL will continue to improve the water balance calculations to better discern the categories and consumption so more water conservation measures can be identified.

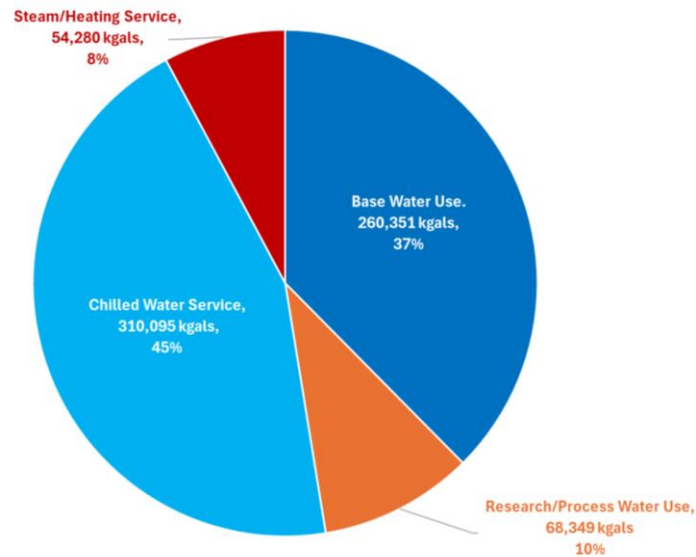


Figure 16. ORNL's detailed end-use water consumption for FY 2024.

5.1.1.2 Water management ECMs and initiatives in FY 2024

In the past few years, ORNL has reduced OTC processes throughout the campus. Mechanical utilities personnel have been working on water consumption reduction through utilities repairs and upgrades. On occasion, ORNL engineering groups review the feasibility of alternative water options. If there is a potential option for alternative water to be cost-effective in new construction, then it can be included as one of the noncore Guiding Principles. However, factors such as cost and complexity of water treatment for some of these alternatives make them difficult to implement. ORNL will continue to explore alternative water sources when cost-effective and feasible, but in the meantime, ORNL is focused on overall water consumption reduction when possible.

Environmental compliance specialists have agreed to inform the EE&S program when/if water use variances are requested to see whether these needs can be engineered to avoid OTC.

Efforts to maintain WUI-improving measures were initiated in FY 2008 upon the award of an ESPC. Year 12 contract performance indicates water savings of 197 Mgal/year.

To gain a better understanding of water use at ORNL, a water-metering plan is being implemented. Many of ORNL's most significant water-consuming facilities and utility processes, such as cooling tower makeup water, have been updated with advanced meters that are connected to CEDS and are collecting interval data. These data are used to understand water end uses, consumption patterns, and potential opportunities for WUI reduction.

The aggressive campaign to repair leaks and to replace failed components in the vintage water distribution system continued in FY 2024.

Design and construction support for the new Sewage Treatment Plant project is ongoing, with commissioning planned for 2025. Tie-in points were completed to interface existing utility systems to the new facility. Support was provided to the contractor for excavation of contaminated soils to maintain the project's schedule.

Utilities support was provided for the design and procurement team to initiate the replacement of the 3501 lift station, underway. The project will improve the reliability of the sewage collection system and is expected to be complete in FY 2025.

The DOSAR Pump House has been updated with new pumps, a control system, and metering.

A water balance is in development to better identify facilities with water connections and estimate/meter their water consumption as an improved methodology to collect and project water consumption and highlight water conservation opportunities.

5.1.1.3 Stormwater management

Section 438 of EISA stipulates that any development or redevelopment project involving a federal facility with a footprint that exceeds 5,000 ft² shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow.

Facilities and Operations' (F&O's) Laboratory Modernization Division, through the division's environmental compliance representative, evaluates any development or redevelopment project that exceeds the net 5,000 ft² footprint of new impervious area. ORNL's approach to addressing EISA Section 438 requirements for stormwater management was revised. Because of the soil types (low permeability) and karst geology, conditions exist at ORNL that would allow for claiming technical infeasibility as per technical guidance from the US Environmental Protection Agency (EPA). Clay soils have low infiltrative capacities, and the introduction of more water to the subsurface in a karst geology can accelerate the formation of sinkholes. As a result of these two geological conditions at ORNL, the use of subsurface infiltration to address EISA Section 438 is being pursued only on a limited basis. Instead, mitigation strategies (e.g., improvement of streams and their associated buffer zones, installation of water quality systems and devices to improve water quality, and strategies that would allow for additional evapotranspiration) are being pursued. Implementing this revised approach to EISA Section 438 compliance as opposed to claiming technical infeasibility demonstrates ORNL's commitment to environmental stewardship. If projects take place in existing contaminated areas or where an area approach is not feasible, then technical infeasibility is claimed to prevent potential movement of contamination within soil or groundwater.

When possible, this environmental stewardship approach is implemented on an area basis at ORNL. Addressing EISA Section 438 on an area basis instead of a project-by-project basis allows for the following:

- Stormwater runoff from adjacent areas can be diverted around developed areas to keep water quality high.
- Water quality structures/devices can be installed to handle runoff from developed areas, thus reducing the number of water quality structures/devices to be installed and maintained.
- Individual projects are not burdened with the costs associated with addressing EISA Section 438 requirements.

In FY 2024, no EISA Section 438 projects were completed.

The ORNL Utilities Division provided a conditions statement for current stormwater systems in use on the campus. The stormwater collection system consists of drainage ditches, catch basins, manholes, and collection pipes that convey stormwater, condensate, and cooling water flows to the receiving streams.

White Oak Creek traverses the ORNL site and ultimately receives all the discharges from ORNL as well as normal flows from the four tributaries that feed it. Rainfall, snowmelt, and other authorized flows are directed to the gravity-drainage system that conveys the water from buildings, parking lots, streets, and roofs to specific outfalls. The collection system was installed in an unplanned manner over the years as ORNL developed and matured, which has resulted in the existence of 155 National Pollutant Discharge Elimination System (NPDES)–permitted stormwater outfalls discharging into the receiving streams. To comply with current stormwater regulations and ORNL’s NPDES permit, each of these outfalls must be periodically sampled and characterized to determine the makeup of the discharge stream and to ensure that it complies with permit requirements. The condition and performance of the stormwater collection system are very good. Under all but the worst of conditions, the system removes storm flows from the laboratory grounds without flooding or other damage.

5.1.2 Plans and Projected Performance

ORNL is working with a third party to perform a site-wide utility infrastructure assessment. The assessment’s anticipated upgrades to the water distribution system will be identified for water efficiency, maintenance reductions, and reliability improvements.

Current performance and projections indicate that ORNL’s WUI is subject to rise because of increased demands for cooling tower makeup water to support the growth of HPC systems. Therefore, ORNL must aggressively pursue additional water-savings opportunities to offset mission-specific demands to continue to reduce overall water consumption. With continued modernization activities that include the elimination of old facilities and the addition of new facilities, ORNL must consider more water-efficient systems and maintain a focus on water management best practices to meet future WUI reduction goals.

Planned growth to support ORNL’s HPC mission is projected to result in additional water consumption for cooling towers. Current plans indicate that water use is expected to peak in FY 2030 at 176 Mgal/year.

Building-specific locations and other strategic points across the site’s water distribution system will continue to be evaluated for the installation of advanced metering in accordance with EAct 20. A thorough analysis of accumulated water meter interval data will be a priority in the pursuit of reducing consumption. ORNL is putting a large emphasis on building-level water metering in the next few years because of the EAct 20 metering requirement that now includes water metering. Compared with metering for other energy utilities at ORNL, water metering will need to be a focus to catch up to 100% metered. Water metering will be a priority for ORNL EE&S metering efforts going forward.

Distribution meters for various areas throughout the campus were obtained in FY 2021 with the intent to install them in the near term using a cost-effective approach. Some distribution meters were installed in FY 2022, and more will be installed in the coming years.

Distribution and building-level water meters, facility audits, site-wide water crosstie connection surveys, and ArcGIS water distribution maps help ORNL further understand on-site water usage, which will aid in identifying new water conservation opportunities.

ORNL will continue to identify and repair leaks and replace failed components in the vintage water distribution system.

5.2 WATER MANAGEMENT: WATER CONSUMPTION AND HEMSF RESEARCH

ORNL’s HEMSF systems accounted for 40% of ORNL’s water use in FY 2024 and are expected to account for around 35% in FY 2030. HPC activities were responsible for 20% of ORNL’s water

consumption in FY 2024; that amount is expected to remain around 18% in FY 2030 despite projected increases from FY 2025 to FY 2028 (Figure 17).

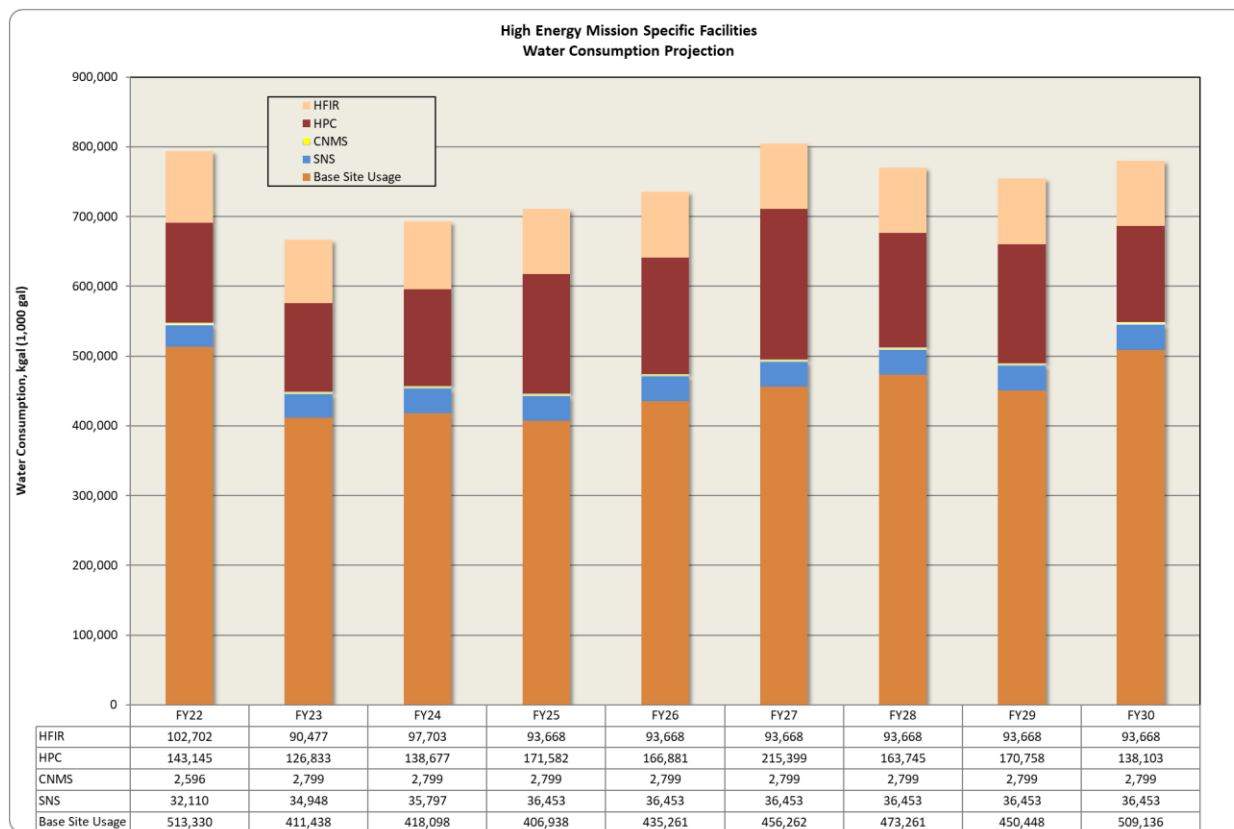


Figure 17. Current (FY 2024) and projected HEMSF water consumption at ORNL.

CNMS stands for Center for Nanophase Materials Sciences and is the small yellow line between the blue and red.

5.3 WATER MANAGEMENT: WUI FACILITY IDENTIFICATION

ORNL's mission requires the use of water for processes and cooling services. The facilities identified in Figure 18, several of which are associated with chilled water and steam production, had the highest WUIs at ORNL in FY 2024. As with energy, ORNL's water consumption is directly tied to mission-critical research growth and is expected to increase in the next 10 years.

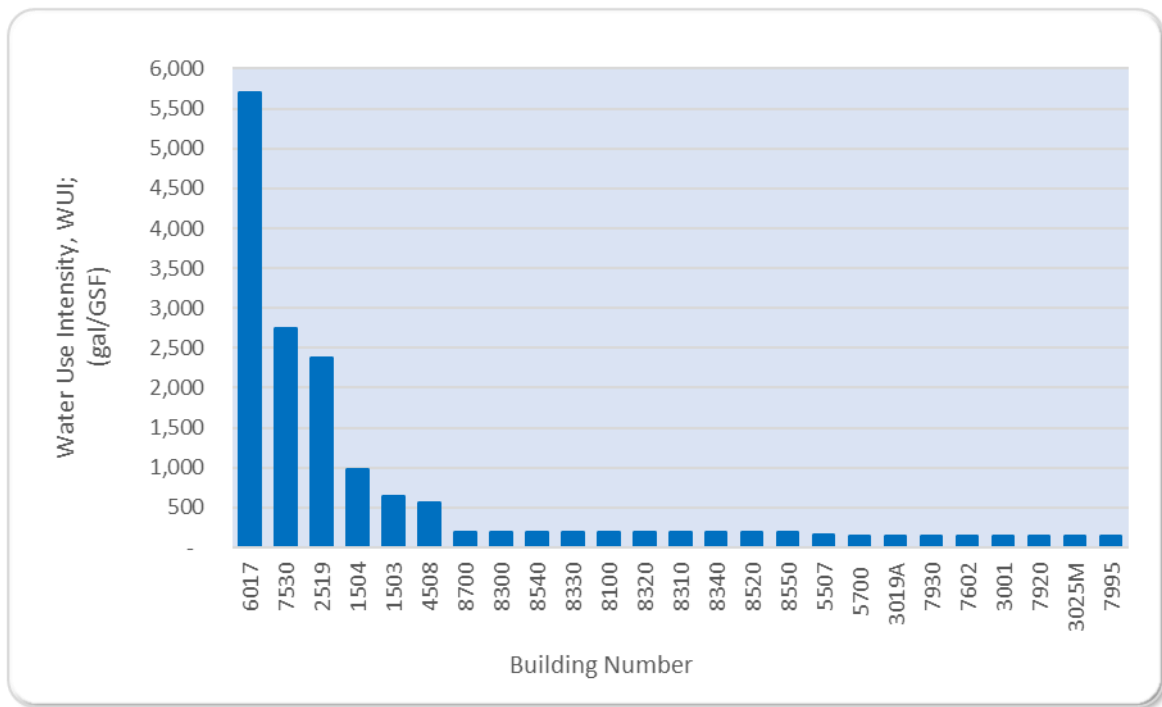


Figure 18. ORNL facilities with the highest WUIs in FY 2024.

Twenty-five facilities are responsible for 80% of ORNL’s total water consumption, as shown in Figure 19. Again, chilled water and steam production, HFIR, SNS and HPC are the largest consumers of water.

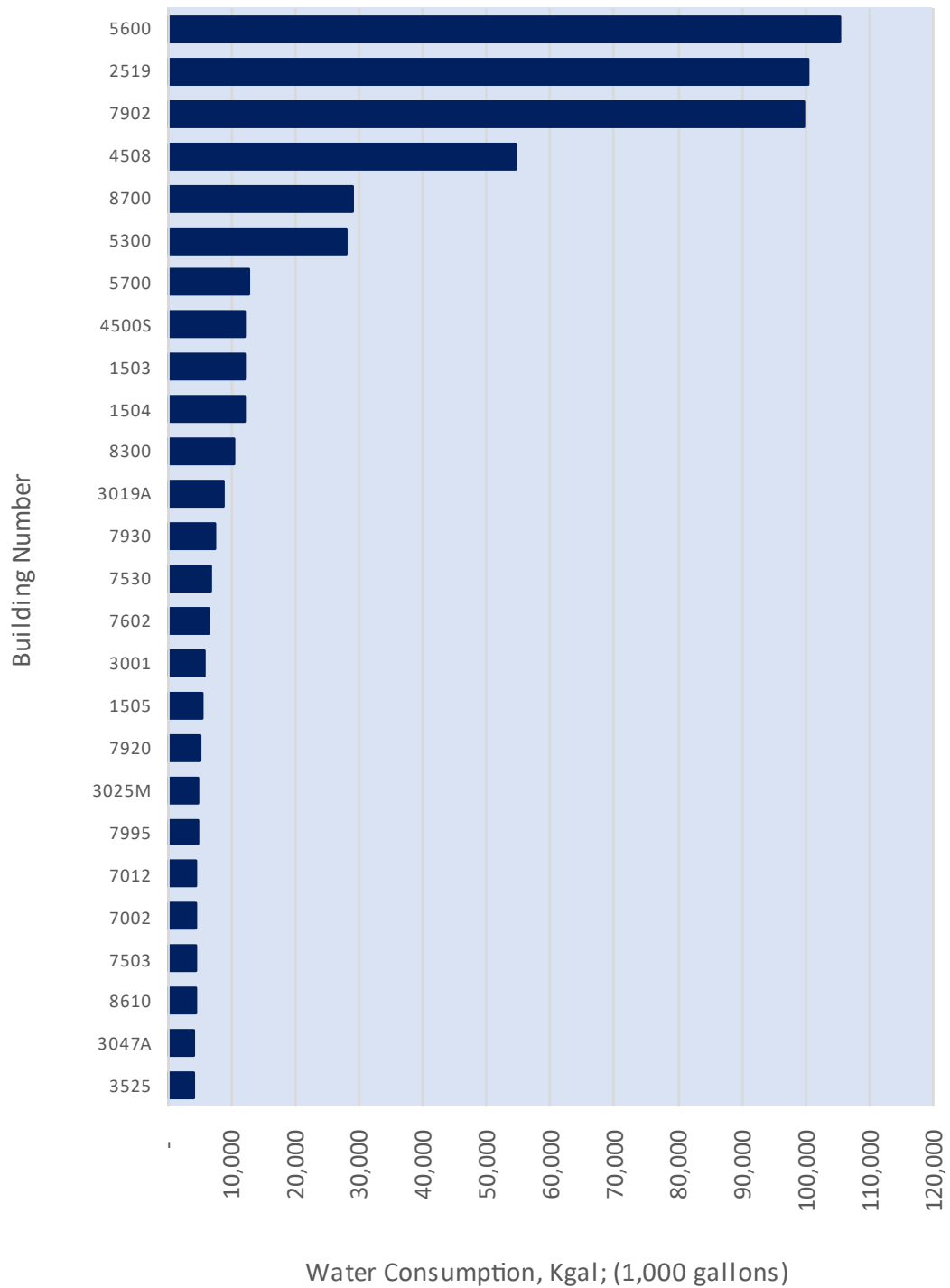


Figure 19. Largest water-consuming facilities at ORNL in FY 2024.

6. FLEET MANAGEMENT

6.1 PERFORMANCE STATUS

ORNL has continued to increase the number of alternative-fuel vehicles (AFVs), hybrid vehicles, and plug-in hybrid electric vehicles (PHEVs) when options have been available. Currently, 80% of all ORNL fleet vehicles are AFVs. Since FY 2020, ORNL has replaced 372 vehicles, of which 319, or 86%, have been AFVs, hybrid vehicles, or PHEVs.

Fleet managers continued coordination with vehicle custodians during FY 2024 acquisitions to ensure vehicle rightsizing while also meeting mission-critical needs. This effort also allowed the fleet managers to place custodians in more fuel-efficient vehicles such as AFVs and EVs when applicable, lowering the emissions impact and overall GHG produced by ORNL.

ORNL uses internal operating procedures, including home-to-work, and follows all applicable parts of the *Code of Federal Regulations* that govern procurement, utilization, disposition, and mission support while working closely with federal oversight.

The fleet office has coordinated with the ORNL Laboratory Modernization Division to locate optimal locations for current and future vehicle charging stations. There are plans to include them in the pooling program project.

ORNL uses an in-house-developed fleet management information system. This system is called the Facility Services Center (FSC), and Fleet Management uses it for internal tracking, recordkeeping, and work orders generated on vehicles. Agency-owned vehicles' annual maintenance is also tracked in FSC. However, General Services Administration (GSA)-leased vehicles' annual maintenance is tracked through GSA Drive-Thru.

ORNL currently uses ChargePoint to monitor the energy consumption of its electric vehicle supply equipment (EVSE) units and is assessing the reporting capabilities to gather detailed insights.

The ORNL Fleet Management organization structure is shown in Figure 20.

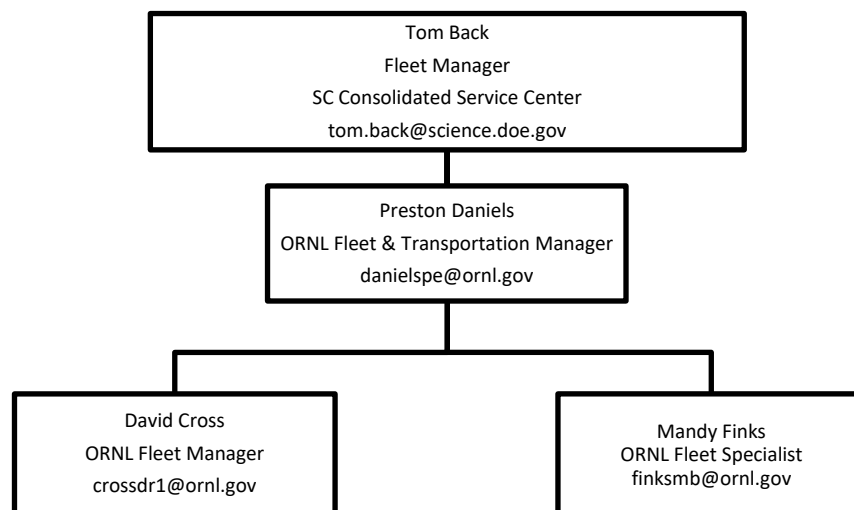


Figure 20. ORNL Fleet Management organizational structure.

6.1.1 Alternative Fuel Use and Infrastructure

In accordance with DOE guidance, ORNL Fleet Management continues to stress the use of alternative fuels. The alternative fuel available on-site is E-80. Fleet Management continues to examine available technologies to upgrade ORNL's on-site fueling station.

6.1.2 Zero-Emissions Vehicles (ZEVs)

The ORNL fleet currently has 15 zero-emissions vehicles (ZEVs) and 7 PHEVs.

In FY 2024, developing a pooling program has been an ongoing effort to increase the fuel efficiency of its fleet to maximize utilization, and move toward a net-zero fleet. Fleet management launched a passenger-carrying vehicle pool at the start of FY 2025. ORNL will utilize the capabilities of the telematics systems that were deployed into ORNL vehicles in FY 2022. ORNL will use data from telematics for reporting and analysis functions within the pooling program. This addition to the software will allow ORNL to track utilization in real-time, ensuring that vehicles are used appropriately.

By pooling ORNL's passenger-carrying fleet, ORNL plans to use the program as a tool to do the following:

- Optimize vehicle utilization
- Expand vehicle options and accessibility for ORNL staff
- Right size or Redistribute the ORNL fleet
- Align government-owned vehicle parking spaces for future EV charging station deployment
- Ensure vehicle keys and WEX cards are secured
- The pooling locations should also be able to align the parking structure needed to align EV chargers for government spaces.

6.2 PLANS AND PROJECTED PERFORMANCE

ORNL will continue to invest in improved technology and updated management practices to reduce fuel consumption. ORNL continues to structure a solid foundation for ZEVs and EVSE. Goals are based on progress toward implementing EO 14057 and DOE Order 436.1A.

In FY 2025, ORNL plans to establish twenty level 2 and two level 3 EVSE on-site. ORNL received the first fifteen ZEVs in FY 2024, but most vehicles are planned to be delivered around FY 2027.

When no AFV/EV models are available as replacement options, ORNL will select vehicles with the best possible fuel economy.

Projected light-duty EV acquisitions are as follows: 12 vehicles in FY 2025, 5 vehicles in FY 2026, and 23 vehicles in FY 2027.

Currently, ORNL is developing a plan for dual-use EVSE that supports both government-owned vehicle and privately owned vehicle (POV) charging. However, several challenges are associated with POV charging, including the following:

- Accurately estimating all associated costs so they can be incorporated into ORNL's hourly rate, as ORNL is unable to resell power
- Preventing the misuse of EV parking spaces
- Establishing a clear process for managing and allocating the funds generated from POV charging

As EVSE deployment has continued around the site, site-specific challenges have affected implementation, such as having sufficient space to accommodate EVSE infrastructure. Upon receiving ZEVs and/or EVSE, employees will receive training and communication on operations.

ORNL has not used any EVSE tools to plan, improve, or implement deployment. ORNL will continue to investigate the tools that are available to improve EVSE and ZEV deployment.

7. CLEAN AND RENEWABLE ENERGY

7.1 PERFORMANCE STATUS

In FY 2024, ORNL purchased renewable energy credits (RECs) to supplement on-site renewable energy generation, representing 9.20% of the laboratory's electrical energy consumption, as shown in Figure 21. ORNL on-site renewable energy and REC purchases resulted in a calculated renewable electricity usage of 52,133 MWh for the year. The result is a total renewable offset performance of 9.21%, including RECs and on-site generation, exceeding DOE's 7.5% requirement as identified in EPA Act of 2005.

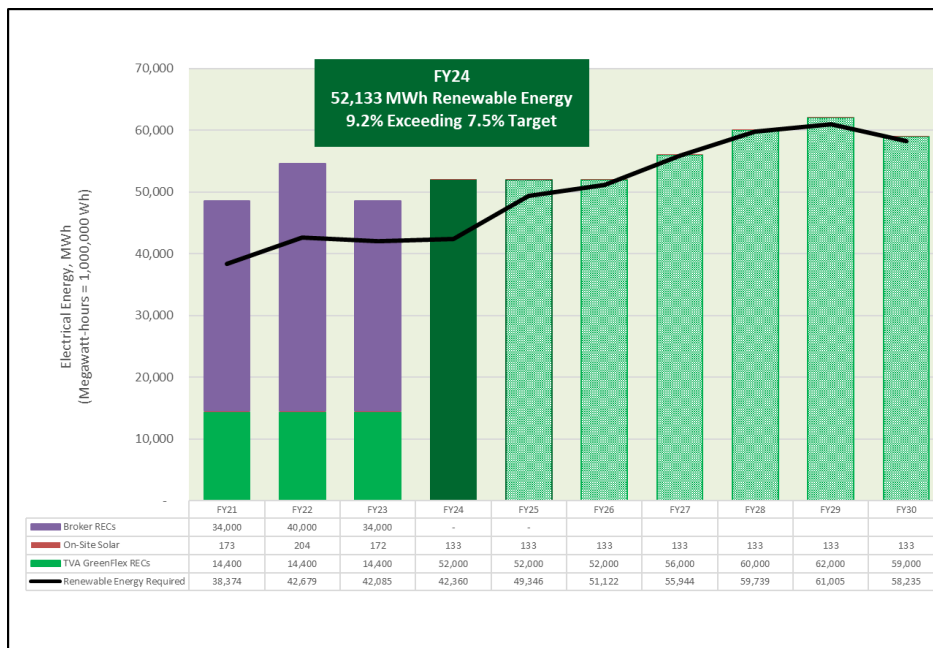


Figure 21. FY 2024 ORNL REC purchase details and projections.

The on-site generation and the purchased RECs shown in Figure 21 are outlined below.

- The 66 MWh of electricity produced on-site by two of the five solar arrays accounted for 0.023% of ORNL electricity, which includes the double bonus allowed for on-site generation at federal facilities. Associated RECs are retained for use by the site.
- ORNL increased participation in TVA's Green Flex program by purchasing 52,000 MWh of renewable energy in FY 2024 to meet/exceed the renewable energy target.

7.2 PLANS AND PROJECTED PERFORMANCE

In the near term, ORNL will continue with recent strategies to purchase sufficient RECs to meet the EPA Act 2005 renewable energy goal of 7.5% electrical energy.

ORNL will continue to investigate on-site economically feasible renewable energy projects to minimize annual REC purchases. Strategies used to meet renewable energy goals will also result in progress toward GHG emissions reduction. Specific plans include the following:

- Sustainable ORNL will take the lead in the continued investigation for a potential large-scale solar project at the main campus or a remote campus location. ORNL would like to encourage a project

development plan that would combine research opportunities, such as microgrid research, with large solar installations for renewable credit. ORNL will continue to evaluate project concepts that include financial benefits such as investment tax credits and research grant opportunities.

- Life cycle cost analysis and project payback are critical when investing public funds; sustainable solutions must include financial considerations. Until renewable projects are identified and implemented to meet on-site renewable objectives, RECs and energy attribute certificates (EACs), when available, will be the primary cost-effective means to meet DOE goals. ORNL will prioritize a strategy to develop on-site capabilities, ideally incorporating research possibilities, before considering other options.

ORNL REC purchase strategy options include the following:

- Looking into bundled RECs and EACs to count as credit for both CFE and EPCAct of 2005
- Periodically monitoring the REC and EAC open market and considering purchasing opportunities as they arise
- Seeking options to engage in a multiyear purchasing agreement that will provide a more streamlined and flexible procurement process
- Considering increasing participation in TVA's Green Flex program to purchase additional RECs through the utility if cost/benefit analysis is favorable
- Developing specific REC strategic purchasing guidance and incorporating this guidance into a viable document to help determine the best value for the long term; guidance should encourage brokers to provide better tribal options
- Further evaluating opportunities to partner with the Defense Logistics Agency or the Western Area Power Administration to identify tribal RECs for purchase

7.3 CARBON POLLUTION-FREE ELECTRICITY

7.3.1 Performance Status

ORNL had 39.61% CFE in FY 2024 based on Emissions and Generation Resource Integrated Database (eGRID) 2022 data. Of this CFE, 39.60% was largely due to the grid-supplied CFE from ORNL's supplied electricity region, or eGRID Subregion SRTV (SERC Tennessee Valley). The remaining 0.01% CFE resulted from ORNL's on-site generation from two solar arrays.

Figure 22 shows the calculation formula and the specific numbers used to calculate ORNL's percentage of CFE.

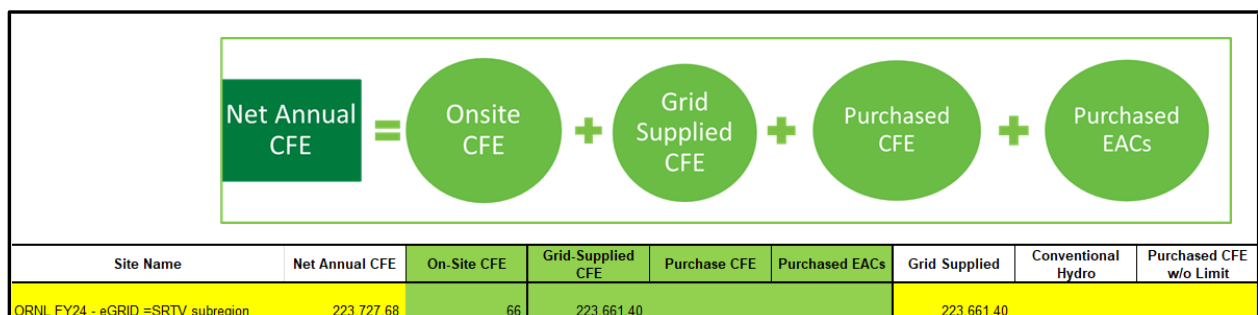


Figure 22. ORNL FY 2024 CFE calculation (MWh).

DOE and TVA signed a memorandum of understanding in December 2023.³ The purpose of the memorandum is to document a shared intention of the parties to collaboratively and expeditiously explore power supply options that permit DOE and the National Nuclear Security Administration, a separately organized agency within DOE, as consumers of TVA power in Oak Ridge, Tennessee, to have access to electricity (1) that on a net annual basis is 100% CFE resources that are either owned or contracted for by TVA and (2) of which at least 50% meets the federal government’s requirements on a 24/7 hourly match basis as outlined in EO 14057. DOE’s Oak Ridge National Laboratory Site Office, ORNL, and TVA are continuing to explore potential pathways to bring 100% CFE to ORNL. ORNL anticipates that collaborative efforts with TVA will be the primary means of identifying a solution that will enable ORNL to meet the directive to use 100% CFE by 2030.

7.3.2 Plans and Projected Performance

ORNL’s annual projections or targets for percentage of CFE through FY 2030 are listed in Table 8.

Table 8. ORNL’s baseline CFE and annual CFE performance targets

Metric	FY 2024 MWh	FY 2025 MWh	FY 2026 MWh	FY 2027 MWh	FY 2028 MWh	FY 2029 MWh	FY 2030 MWh
Total CFE (a + b + c + d)	223,748	276,403	299,979	343,187	382,398	398,634	776,465
a. Grid-supplied CFE	223,661	276,337	299,913	343,121	382,331	398,567	388,233
b. On-site CFE	86	66	66	66	66	66	66
c. Purchased CFE							388,166
d. Legacy CFE from EPA 7.5%							
Total electricity use	564,802	657,945	681,621	745,915	796,523	813,403	776,465
Total % CFE	40%	42%	44%	46%	48%	49%	100%

TVA and DOE are discussing TVA self-attestation documentation because the TVA-specific CFE percentage delivered to ORNL is expected to be higher than the SRTV eGRID subregion CFE percentage. However, until the self-attestation documentation is resolved, ORNL will report CFE percentage based on the eGRID CFE percentage.

For FY 2024, ORNL’s CFE percentage was 39.6%. TVA is expected to increase its CFE generation portfolio to 50% CFE by FY 2030. TVA has projected that it will reach approximately 70% CFE by 2030.

ORNL will not count the EPA 2005 RECs as legacy CFE because per guidance, these RECs are not part of a long-term contract to be considered legacy.

ORNL projects to achieve 100% CFE through grid-supplied CFE, on-site renewable energy generation, and purchased CFE (considering the memorandum with TVA) by FY 2030. ORNL’s projected energy consumption and the percentage CFE (either eGRID or TVA self-attestation) will determine the remaining CFE to be purchased or to be generated by on-site projects or other partnerships for CFE projects.

The CFE projects selected moving forward depend on further investigation, identification of the most effective strategy, verified project efficiencies, leadership approval, and capital funding. ORNL will

³ More information is available in the following article (DOE 2023): <https://www.energy.gov/articles/doe-partners-tennessee-valley-authority-power-oak-ridge-facilities-100-carbon-pollution>.

continuously investigate changing technologies and aim for capital projects with the best probabilities of achieving and maintaining energy-efficient performance over time.

In FY 2024, Sustainable ORNL selected a showcase project to install solar outdoor parking lights in one of ORNL’s many parking lots. Outdoor solar lighting was installed within the main parking lot for Building 2040 by ORNL Utilities. This project will be used as a pilot installation to investigate the potential to install more solar lighting for outdoor parking in the future. Details about the project are included in Table 9.

Table 9. Onsite CFE Projects at ORNL

On-site CFE system type (solar, wind, etc.)	Nameplate capacity (MW)	Funding source(s) (appropriations, performance contract, AFECT, etc.)	Estimated year of completion
Solar parking lights pilot project	15 lights (9 single and 6 double lamps) in total at 65 W luminaires	Lab	Beginning of FY 2025

ORNL must balance progress toward 100% CFE for existing electricity consumption and predicted electricity consumption growth due to mission needs. Electricity consumption is expected to increase because of the SNS Second Target Station and the next high-performance supercomputer launching in the coming years.

8. ACQUISITION AND PROCUREMENT

8.1 PERFORMANCE STATUS

All applicable contracts in FY 2024 contained terms and conditions that invoked requirements for sustainable acquisitions (SAs) defined in the UT-Battelle prime contract as flow-down requirements. Standard contract terms and conditions, which are made part of all procurement actions for commercial items and services, invoke the pertinent federal acquisition regulation (FAR) subcontract sustainability requirements:

52.223-2	Affirmative Procurement of Biobased Products under Service and Construction Contracts
52.223-13	Acquisition of EPEAT®-Registered Imaging Equipment
52.223-14	Acquisition of EPEAT®-Registered Televisions
52.223-15	Energy Efficiency in Energy-Consuming Products
52.223-16	Acquisition of EPEAT-Registered Personal Computer Products
52.223-17	Affirmative Procurement of EPA-Designated Items in Service and Construction Contracts

Neither FAR 52.223-4 nor 52.223-9 as referenced in the SSP guidance definition table is included in the prime contract as a flow-down requirement. Because ORNL includes both of these in each subcontract or purchase order, the required information can be found in the multi-statutory column of Table 10.

Table 10. Types of sustainable acquisition clauses in contracts

	Recycled	Energy efficient	Biobased	Multi-statutory	Environmentally preferable	Statutory+
Number of contract actions with SA clauses	—	—	—	12,004	—	—
Total contract dollars with SA clauses	—	—	—	\$2,941,775,076.69	—	—

Each of the ORNL Marketplace catalog/punch-out vendors' basic ordering agreements requires the submission of a quarterly environmentally preferable procurement report that highlights commodities that fall into the Environmentally Preferable, Recycled, Postconsumer, Waste Prevention, Pollution Prevention, and Biobased categories. The vendor sends four reports per year to recycle@ornl.gov highlighting all efforts. These reports are analyzed by the pollution prevention program coordinator. Any efforts to track data for the new initiative "Phasing Out Single-Use Plastics" as mentioned in the current SSP guidance document will be undertaken through a similar process (DOE SPO 2024).

No new janitorial contracts were issued in FY 2024. Kelsan, ORNL's janitor contract vendor, recognizes the lab's interest in sustainability and has made sustainable acquisition products a point of emphasis in its product line for ORNL, including biobased products. Kelsan offers more than 100 sustainable items, including bio-preferred, post-consumer recycled content, and Green Seal-certified items. These items include janitorial products such as paper, hand care, and cleaning products. This product line provided by Kelsan helps support ORNL's sustainability goals. In FY 2024, \$265,789.35 of \$840,806.82, or 31.61%,

of Kelsan's contract spend was for bio-preferred products alone. Additionally, ORNL strives to buy bio-preferred dielectric fluids when technically feasible and synthetic ester-based dielectric fluids in other appropriate applications because both are biodegradable and more environmentally friendly than conventional mineral oil-based dielectric fluids.

Office supply vendor A&W offers remanufactured ink cartridges and provides a rebate to ORNL on printer cartridges that are recycled back to A&W through central receiving. In addition, they offer a variety of recycled-content office supplies like paper, binders, notebooks, and planners.

ORNL Digital Services Infrastructure and Operations Division administers the IT managed hardware program, which pushes administrative controls for all requisitions for IT equipment. Both IT Operations and the Contracts Division are responsible for 100% compliance for all eligible equipment.

The Transportation and Waste Management Division supports reporting on the procurement of the biobased preferred products and sustainable disposition of federal property, including electronics.

The Contracts Division uses subcontract language in communications with key commodity suppliers requiring that the vendors provide detailed reports on purchases of electronics products designated as ENERGY STAR and listed in EPEAT (Electronic Product Environmental Assessment Tool).

8.2 PLANS AND PROJECTED PERFORMANCE

The ORNL Contracts Division includes several working groups aimed at sustainable acquisition. The Contracts Compliance group is responsible for policies, procedures, records, reports, and compliance with all prime contract terms and conditions. Advances and improvements in these processes to promote sustainable acquisitions and procurement are among the division's highest priorities because the division remains committed to maintaining 100% compliance with DOE Order 436.1A SSP goals. FY 2024 initiatives include the following:

- Per DOE Order 436.1A, sites are to complete supply chain risk assessments to determine the reliability and vulnerability of critical supply chains. SPO is currently developing guidance for the supply chain risk assessments and will work with programs to set the due dates. SC will work with the science laboratories to issue this guidance, including due dates, when available.
- ORNL is open to attending training sessions that will address the requirements and logistics needed to access and report laboratory procurement data in the Federal Procurement Data System – Next Generation.
- The Environmental Protection Services Division will work with procurement toward progress on minimizing products that contain perfluoroalkyl and polyfluoroalkyl substances.
- The ORNL pollution prevention program will work with Procurement to determine whether the Procurement organization can play a meaningful role in ORNL efforts to phase out single-use plastics.
- The ORNL Contracts Division will continue to work through DOE Order 436.1A implementation plan deliverables in the coming years.

9. INVESTMENTS: IMPROVEMENT MEASURES, WORKFORCE, AND COMMUNITY

9.1 PERFORMANCE STATUS

9.1.1 Energy Act of 2020

ORNL develops an annual ECM list from the following two primary information sources throughout the year:

- The EE&S program meets early each new fiscal year with FMD managers and facility engineers to identify ECMs and funding requests. Most annual ORNL ECMs are identified through this process.
- EISA building audits also provide ECMs. ECMs can be identified through a walk-down of the facility and/or directly from the facility representative who is interviewed during their respective audits.

In the past, ORNL has found that building facility engineers and supervisors are the most knowledgeable about facility conditions and can provide valuable information and suggestions concerning ECMs. ECM project identification, evaluation, funding, and execution are mutually beneficial for those requesting the funds and for the EE&S program to document and track information properly. The facility owners are provided with funds and made responsible for performing the projects on schedule and within budget. The facilities are turned over with new energy-efficient and reliable systems and/or equipment, and the EE&S program benefits from being able to report the resultant energy savings. In the past few years, the ORNL EE&S program on average has provided over \$500,000/year in funding for ECMs. The EE&S program analyzes the preliminary list and funds the ones that have the shortest payback periods and best benefits for the building owners and occupants while still working within the limitations of the program budget.

In FY 2024, the ORNL EE&S program provided approximately \$500,000 in funding to projects for ECMs or energy-efficient equipment such as LEDs (not including metering and FDD). EE&S representatives met with facility engineers and managers from across the various ORNL complexes and brainstormed ECM ideas. Facility engineers formally submitted their top ideas to the EE&S program, a comprehensive prioritized list was developed, and then ECM projects were funded accordingly. Life cycle cost analysis, annual energy savings, or a combination of both was used to rank ECMs. Life cycle cost analysis uses building, system, or equipment data; engineering principles; and employee expertise to perform the calculations and validate efficiency measures.

The following eight energy reduction projects were funded in FY 2024:

- Building 1061 LED conversion
- Building 3587 LED conversion
- Building 7003 LED conversion
- Building 7009 LED conversion
- Building 7605 LED conversion
- Building 7606B LED conversion
- Building 7625 LED conversion
- Building 8600 LED conversion

The ORNL EE&S program recognized that the passing of EAct 20 would mean more substantive reporting and funding changes to the EISA auditing process, especially because ORNL averages more than 20 building audits per year to meet the requirements. The passing of EAct 20 strongly emphasized the importance of finding ECM projects via the EISA auditing process that will increase operational and organizational performance while reducing energy and water consumption.

As EAct 20 requirements are implemented, ORNL is maintaining a limited list of past ECM ideas that were not funded. Existing FY 2023 and the new FY 2024 ECMs on the ECM reporting module list will be looked at for funding in the next year. The revised list will then be evaluated to determine whether the ECMs are life cycle cost-effective, and if they are found to be so, then ORNL will determine the funding process and begin installation to the maximum level of funding available.

ORNL's current understanding of life cycle cost-effectiveness is as follows:

- ECMs that prove to have simple paybacks of 10 years or less should be funded internally.
- ECMs with paybacks between 10 and 25 years should be funded internally, or performance contracting should be considered/pursued.

Because ORNL has many buildings to audit each year (approximately 20 to 25 meet the one-fourth annual EISA requirement), ORNL plans to investigate a reasonably acceptable number of ECMs per audited building. The number of ECMs for a given building is heavily reliant on building design and size, so the number of ECMs per building will vary across a diverse portfolio like ORNL's. With this approach, ORNL anticipates that an ample number of ECMs will be identified. After the audit cycle has been executed for several 4-year iterations, ORNL expects that the list will shorten as most of the ECMs are addressed through the cyclical process.

ORNL has developed an ECM project tool as a sub-application to the newly developed building energy audit tool (see Figure 23 for an example). This app will allow the auditing team to record required information for potential ECMs as part of building audits. Additionally, the tool will aid in the funding decision process by presenting the required information in one easy-to-interpret format.

Add Building Energy ECM Project		EC	EIA	ESC
Building/Complex:	1061 / WF			
Identified Year:				
Description:				
Site Assigned Project ID:				
WBS Element:	(Select) ▼			
WBS Breakdown:	(Select) ▼			
Equipment Asset Number:				
Location Description:				
Quantity:				
Unit of Measure:	(Select) ▼			
Notes:				
Estimated Implementation Cost (\$):				
Anticipated Completion Year:				
Estimated Service Life (Year):				
Simple Payback with O&M (Years):				
Simple Payback without O&M (Years):				
Estimated Annual Energy Cost Savings (\$):				
Estimated Annual O&M Cost Savings (\$):				
Estimated Annual Electricity Savings (Kwh/Yr):				
Estimated Annual Other Savings (BTU/Yr):				
Estimated Annual Potable Water Savings (Gall/Yr):				
ECM Status:	(Select) ▼			
Save Cancel				

Figure 23. ECM input screen.

9.1.2 Energy Savings Performance Contracts

ORNL's ESPC with JCI was the primary mechanism for achieving the goals established to meet EAct of 2005 directives. A delivery order with JCI was awarded in July 2008 and was accepted in July 2012. This ESPC is creating opportunities for ORNL to improve its depth of experience in performance contracting and to develop an understanding of the most effective use of this funding mechanism. The ESPC is currently in the middle of year 13 of the 21-year contract term. As a result of the ESPC, year 12 of the contract realized savings of \$13,696,000, which includes \$10,507,000 (762 million Btu) of electricity,

natural gas, and fuel oil savings; \$449,000 (197 million gal) of water savings; and \$2,740,000 of operations and maintenance savings.

A dual-fuel natural gas/fuel oil boiler replaced the biomass gasification system, which had experienced operational difficulties. The new boiler has been in operation since FY 2016, and natural gas and fuel oil consumption have been reduced, complementing two similar dual-fuel natural gas/fuel oil boilers that replaced a vintage boiler installed under a separate activity. Steam distribution decentralization, including the new Melton Valley steam plant and steam production efficiency improvements, further increase ORNL's steam service and reliability.

Other ESPC improvements include lighting upgrades and water conservation measures. Equipment upgrades, a building management system, and modernized HVAC control systems provide the means to significantly reduce or eliminate energy-intensive simultaneous heating and cooling in several large air-handling units.

M&V of the ECMs completed under the ORNL ESPC is ongoing per the contract between JCI and DOE. JCI employs an on-site performance assurance engineer who leads the M&V effort. M&V activities are reviewed by the ORNL DOE Site Office contracting officer's representative with the engagement of UT-Battelle's EE&S program and Utilities Division staff. Monthly ESPC performance reviews are held by JCI with ORNL DOE Site Office personnel and ORNL personnel. An annual M&V report review and comment resolution process is conducted with the same group.

ORNL is not currently pursuing any other performance contract options. Further discussion and planning are underway for how to proceed with the EAct 20 performance contracting requirements and carbon net-zero initiatives. ORNL will be better informed to develop funding plans, whether via performance contracting or internal funding, after implementing and integrating the new approaches to ECM identification and life cycle cost-effective funding strategies per EAct 20.

9.1.3 Funding

ORNL assesses the environmental, economic, and social benefits of proposed activities on an individual, project-specific basis. Through the mission readiness process, ORNL gauges the abilities of its facilities and infrastructure to accomplish mission objectives now and in the future. Projects are identified to safely, compliantly, and efficiently accomplish mission objectives, including sustainable operations. Funding sources for projects are evaluated and established by considering all available and appropriate funding venues, including private sector financing, cost sharing, institutional investment, and programmatic appropriations. Allocation of funds is based on multiple considerations, including mission impact, sustainability, and return on investment (Table 11).

Table 11. FY 2024 budget and future funding for sustainability funding categories

ORNL sustainability funding category	FY 2024 actual (\$)	FY 2025 planned/ requested (\$)	FY 2026 projected (\$)
Sustainability projects (including ECMs and metering)	640,000	670,000	700,000
Sustainability activities other than projects	490,000	500,000	500,000
Sustainability program division-funded projects (SPO funding portion only)	0	0	0
SLI GPP ECM funding	0	0	0
ESPC	12,568,000	12,981,000	13,408,000
REC purchase costs	130,000	162,000	181,000
Total	13,828,000	14,313,000	14,789,000

In FY 2024, the ORNL EE&S program allocated a large portion of the budget to sustainability projects, which included ECMs, metering, and FDD. The remaining sustainability activities supported the overall Sustainable ORNL function. The Sustainable ORNL program invests in sustainability activities in support of the 15 road maps that correlate with the main reporting and implementation needs of the SSP requirements and goals. Sustainability activities also include showcase projects that consist of partnerships with research to move the needle on sustainability at ORNL.

9.1.4 Training and Education

ORNL EE&S engineers take opportunities, when offered, to participate in facility and operations training that is offered to facility and utility engineers at ORNL. When possible, ORNL uses facility and maintenance training to glean more energy-efficient methods for operations and improved system performance. ORNL also takes opportunities to attend DOE trainings. In FY 2024, ORNL EE&S engineers took the DOE Climate Change 101 course. ORNL is currently working with training personnel to bring the DOE Climate Change 101 course into the internal training system so that it is available to any interested personnel to take. ORNL had five F&O personnel attended the FY 2024 Energy Exchange in Pittsburgh, Pennsylvania, as a training event to learn, network, and collaborate on sustainability throughout the federal government. ORNL EE&S program personnel also participated in periodically scheduled webinars in FY 2024 for the Energy Facility Contractors Group Sustainability and Environmental Subgroup.

At least nine ORNL F&O personnel across various positions and fields throughout the campus hold and maintain Association of Energy Engineers' (AEE's) Certified Energy Manager (CEM) credentials. The local chapter of the AEE has held two local CEM trainings in the past. ORNL in partnership with the local AEE chapter has agreed to host the next local CEM training in February 2025. ORNL is currently working on internal communication to allow all interested ORNL employees the opportunity to attend the training to earn their CEM credentials and keep energy management in mind in their day-to-day work.

9.1.5 Environmental Justice, Workforce, and Community

9.1.5.1 Environmental justice

In FY 2024, ORNL evaluated and documented the impacts of its significant environmental aspects on the disadvantaged community that is closest to the lab. Based on this evaluation, no disproportionately high impacts were identified.

9.1.5.2 Workforce, community, and stakeholder engagement initiatives

Earth Day

Each year, Sustainable ORNL hosts an Earth Week celebration with engagement activities for staff and the community. FY 2024's Earth Day event was titled "Sustainable ORNL 2024 Earth Day—Planet vs. Plastics." This was the second year since the COVID-19 pandemic that ORNL was able to hold this event in person with a huge turnout. The event was a huge success, with two seminars (details listed below), 33 vendors on Main Street, an EV ride-and-drive event, and food trucks.

"An Introduction to Foothills Land Conservancy—Preserving, Protecting, and Enhancing Our Region's Natural Areas, Scenic Views, and Rural Character" was presented on April 23, 2024, by Foothills Land Conservancy's (FLC's) outreach director, Elise Eustace. The abstract for this presentation is as follows:

For almost 40 years Foothills Land Conservancy has partnered with landowners across Tennessee and surrounding states, providing conservation tools for landowners. To date, their efforts have assisted in the protection of 200,000 acres that includes [sic] both public and private lands. This presentation included an overview of Foothill's regional land conservation programs, recent projects, and highlights from the Harris Farm, a 300-acre working farm in Blount County, TN, that is also the site of FLC's office headquarters.

"Bridging Science, Technology and Community: Discover Life in America's Collaborative Efforts in Biodiversity Research in the Smokies" was presented on April 26, 2024, by Discover Life in America's executive director, Todd Witcher. The abstract for this presentation is as follows:

Discover Life in America (DLiA), led by Executive Director Todd Witcher, is a local nonprofit organization committed to studying and conserving biodiversity, with a focus on their flagship project, the All Taxa Biodiversity Inventory (ATBI) in Great Smoky Mountains National Park. Through their dedicated work, DLiA has successfully doubled the number of known species in the park and identified 1,079 species that are new to science. Despite these accomplishments, there is still a vast amount of biodiversity that remains to be discovered in the park. To further their research and exploration, DLiA leverages new technologies, engages in community science projects, and collaborates with scientists from around the world.

9.1.5.3 Annual Site Environmental Report for Stakeholder Engagement

Each September, DOE publishes an annual site environmental report (ASER) for the Oak Ridge Reservation. The ASER contains detailed information on ORNL's environmental performance in the areas of compliance and sustainability. The ASER is accessible to ORNL stakeholders through an external DOE website. DOE solicits stakeholder comments on the ASER through the DOE ASER website.

9.1.5.4 University of Tennessee/Pellissippi State Community College/ORNL transportation route

In August 2015, ORNL and the University of Tennessee partnered on a new bus route that connected the University of Tennessee, Knoxville, campus; Pellissippi State Community College in west Knox County; and ORNL, providing transportation to staff, students, and faculty. Three round-trip routes were offered each day to all three sites based on the University of Tennessee's semester schedules. The transportation route has grown with stops at ORNL's National Transportation Research Center and SNS campuses, and service has expanded to year-round except federal holidays and the week of Christmas. Ridership grew in the summer months of FY 2024 with the influx of ORNL summer interns (1,749 riders in June and 1,934

riders in July). With this ongoing initiative, ORNL and the University of Tennessee continue to support alternative commuting.

9.2 PLANS AND PROJECTED PERFORMANCE

ORNL will continue to develop and define the plans and action items necessary to meet EAct 20 requirements, including funding strategies. ORNL will continue integrating its new ECM project tool to better document and track the statuses of projects identified by audit evaluations and to align this process with the projects identified via FCAs.

ORNL will continue life-of-contract activities associated with its current ESPC. These include participation in regular project performance review meetings, review of the annual M&V report, and other support as requested by DOE. All funding paths for ECMs, including performance contracting, will be considered as ORNL works to meet sustainability goals.

ORNL plans to host the local AEE CEM training in early 2025 for all interested parties in the area to attend. ORNL's EE&S program plans to continue promoting this on-site CEM training internally for all interested parties.

ORNL employees from several research and operations divisions plan to attend the 2025 Energy Exchange.

In FY 2025, DOE will publish an ASER, which will be accessible to ORNL stakeholders, and stakeholder comments will be solicited.

ORNL will continue to promote Sustainable ORNL showcase projects (as outlined in Section 4.6, "Net-Zero Energy Buildings") and will engage the workforce in Earth Week FY 2025 activities to promote environmental justice, resiliency, and net-zero efforts at ORNL and within the community.

10. FUGITIVE EMISSIONS AND REFRIGERANTS

10.1 PERFORMANCE STATUS

Fugitive emissions (unintentional releases such as leaks) from refrigerants and industrial gases are included in federal GHG inventories to track and reduce scope 1 GHG emissions. Commonly used materials in this category contain substances that can disproportionately influence the climate because of exceptionally high global warming potential (GWP) values. Fugitive emissions from refrigerants and laboratory gases contain substances that have GWPs hundreds of times to several thousand times more potent than released CO₂. A common but very potent gas used for industrial processes is SF₆, which is estimated to be 22,800 times more threatening to the climate than CO₂.

Direct emissions from purchased industrial gases for standard processes such as testing and laboratory applications are included and tracked by DOE in this category to help identify the need for alternative substances. In FY 2024, ORNL's environmental management systems resulted in GHG emissions of 2,554.73 MTCO₂e, approximately 1% of all emissions from lab operations. Releases are measured using complex materials-handling procedures, balances, and resultant calculations using the individual GWP of each type and volume of gas released. Since the final decommissioning of a large SF₆ process in 2018, this category has remained less than 5% of total emissions at ORNL and is expected to remain at a minimum over the coming years.

Fugitive emissions decreased in 2024 because of a site-wide effort to reduce GHG emissions based on the directives in EO 14057 and the facility's sustainability road map. In 2024, ORNL expanded the site's refrigerant management program to address DOE's GHG reduction goals and the comprehensive changes to the refrigeration industry due to the continued phasedown of hydrofluorocarbons. This phasedown will be factored into asset replacement decisions. Compliance specialists, researchers, and other SMEs track inventories and ensure proper storage by using a complex materials management system. Special leak detection equipment is generally available for deployment when needed to monitor large quantities of refrigerants. Environmental staff also encourage researchers to consider refrigerants with lower GWPs when conducting investigations, referencing the SNAP (Significant New Alternatives Policy) list. Compliance with National Environmental Policy Act (NEPA) reviews will also reveal whether new materials or large quantities of material are defined as high GWP. Processes and procedures within science research projects are also reviewed any time there is a new circumstance. Compliance specialists will work with F&O moving forward to identify aging equipment with high GWPs to be considered for replacement and to follow new projects through to completion, ensuring that requests during the NEPA phase are properly implemented.

New federal regulations have begun to limit the amounts of high-GWP refrigerants being produced by manufacturers. Laboratory staff will naturally decrease use of these materials in favor of lower GWP refrigerants.

10.2 PLANS AND PROJECTED PERFORMANCE

No on-site process at ORNL used SF₆ in FY 2024, and no process use of SF₆ is expected in the future.

Site-wide fugitive emissions should continue to decline as research scientists are made aware of less potent alternatives for tracer gases and are introduced to more compelling gases for use in experiments and research projects. Project costs will also favor less potent (and less expensive) gases.

Site-wide fugitive and refrigerant GHG emissions will continue to have a minor impact on the GHG emission estimates across ORNL.

11. ADAPTATION AND RESILIENCE

11.1 PERFORMANCE STATUS

Following the release of DOE’s vulnerability assessment and resilience plan (VARP) guidance and associated timelines (DOE SPO 2022), ORNL added operational resilience to the Sustainable ORNL road map structure and established a core team to develop a site-specific plan to meet VARP requirements. At ORNL, the VARP is centered on mission-essential facilities and utility infrastructure to ensure that the physical assets will be prepared to exhibit a high degree of resilience in response to extreme weather events. Operations stakeholders including building engineers, utility engineers, and their management are included in the broader VARP team. Division- and directorate-level leadership in operations continues to provide support for VARP team activities. A portfolio of solutions to address resiliency projects was created and uploaded to the DOE Sustainability Dashboard in 2022. Portfolio solutions included newly developed project ideas resulting from VARP discussions and evaluations as well as projects from other lab infrastructure enhancement efforts, such as SLI-funded projects and reliability improvements.

In FY 2024, EE&S energy engineers coordinated with facility stakeholders to update the project statuses of identified portfolio solutions. ORNL continues to measure implementation milestones against the resilience plan and gather feedback from various site organizations implementing the resilience solutions. EESP takes the lead on periodic communications with asset owners, including reporting on project costs.

Highlights from updating the implementation statuses of resilience solutions in FY 2024 include confirmation that three portfolio solutions became operational in FY 2024. One of these solutions was to upgrade the emergency diesel generator system at the HFIR site. This solution is effective because prior emergency diesel generators were old and maintenance intensive, with some components no longer available for replacement. Another solution reported as operational in FY 2024 is the completion of a study by the Mechanical Utilities group to identify areas of concern for stormwater and sanitary sewer system, which is also effective because the study helped to identify high-risk areas. This assessment was completed in FY 2024, and copies were provided to the VARP team. Additionally, two new resilience solutions were identified and began being reported in FY 2024.

The VARP team is always looking for ways to fund resilience solutions. A few solutions identified by ORNL’s Mechanical Utilities group are larger scale efforts that require additional funding from outside sources. Two of the resilience solutions identified are now being submitted for Institutional General Plant Project (IGPP) funding, and one is being submitted as a line item.

ORNL continues to coordinate VARP solutions with other priorities to reach a number of agency objectives. Throughout the ORNL campus, projects are evaluated on several sustainability priorities, including energy, water, and cost savings from ECMs, net-zero initiatives, and operational resilience.

11.2 PLANS AND PROJECTED PERFORMANCE

The implementation statuses of ORNL’s resilience solutions will continue to be updated each year during the annual SSP process. Additional resilience solutions will be identified and added to the DOE Sustainability Dashboard for tracking as appropriate. In recognition of the important goal of addressing operational and climate resiliency solutions for critical missions and operations, ORNL will ensure that continued collaboration and focus on this topic are maintained. Clear communication and timely responsiveness will be required as this initiative is built upon and improved annually going forward. VARP goals in FY 2025 include a plan to better document resilience solutions and lessons learned during implementation and completion. Meetings are being planned to work with stakeholders to develop cost estimates and life cycle cost-effectiveness analyses.

EESP energy engineers are working in FY 2025 to review current processes related to documentation of weather impacts on operations by developing a system-wide method to observe and report weather hazards and building service interruptions. The current process to quantify damages from extreme weather events involves meeting with operations stakeholders to inquire about disruption events. Additional efforts to document weather events and climate impacts include the electrical utilities disruption logs and regular emails from the ORNL lab shift superintendent that document site outages.

EESP energy engineers are also working with ORNL instructional designers (Office of Technical Training) in FY 2025 to develop the scope of content for climate literacy training that will align with themes covered in SPO's Climate Change 101 (CLI101) course. This training is intended to be issued as an ORNL online employee learning assignment and provided to those who want to take it.

12. REFERENCES

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APPENDIX A. PROGRAM INFORMATION FOR ORNL HEMSFS

Program Information for ORNL HEMSFS

ORNL's unique research mission results in energy efficiency challenges not typically experienced in conventional office and laboratory buildings. DOE and SC have designated a unique facility category for facilities housing exceptional operations: HEMSFS. ORNL currently designates and tracks four unique facility/research systems as HEMSFS. The following contains brief program information for ORNL HEMSFS and is included to better document the associated energy efficiency challenges in terms of energy and water performance improvement efforts.



High Flux Isotope Reactor

The neutron scattering research facilities at [High Flux Isotope Reactor \(HFIR\)](#) allow scientists to study the molecular and magnetic structures and behaviors of a variety of materials, including high-temperature superconductors, polymers, metals, and biological samples. These studies are leading to scientific and technical advances in a wide range of fields, such as physics, chemistry, materials science, engineering, and biology. The reactor is also used for isotope production, materials irradiation, and neutron activation analysis. Recent discoveries made possible by neutrons at HFIR are helping to unravel the secrets of materials and energy. This new knowledge also leads to improvements in everyday products like solar cells, hard drives, drugs, and bio-fuels. Isotopes produced at HFIR are fueling the discovery of new elements and space flight.



Computational Sciences Building

The HPC mission includes the [Computational Sciences Building](#), part of the Oak Ridge Leadership Computing Facility, which gives the world's most advanced computational researchers an opportunity to tackle problems that would be unthinkable on other systems.

To date, the Oak Ridge Leadership Computing Facility has produced four supercomputers, each bearing the title "world's fastest computer" in its time. In May 2022, Frontier came online as the first exascale machine in the world. Exascale is the next level of computing performance. By solving calculations more than five times faster than today's top supercomputers—exceeding a quintillion, or a billion billion, calculations per second—exascale systems will enable scientists to develop critically needed technologies for energy, medicine, materials, and more. As supercomputing strategy continues to evolve, the design features championed at ORNL will ensure that DOE remains positioned at the forefront of HPC on the international stage.

The ORNL Computing and Computational Sciences Directorate mission is to provide the world's most powerful open advanced computing ecosystem for scalable computing and simulation, data and analytics, and scalable cyber-secure infrastructure for science. ORNL also has a rich tradition of artificial intelligence (AI) research dating back more than four decades and garnering more than 10 patents. The laboratory's AI initiative is dedicated to ensuring safe, trustworthy, and energy-efficient AI in the service of scientific research and national security.



Spallation Neutron Source

[SNS](#) produces neutrons with an accelerator-based system that delivers short (microsecond) proton pulses to a steel target filled with liquid mercury through a process called spallation. Those neutrons are then directed toward state-of-the-art instruments that provide a variety of capabilities to researchers across a broad range of disciplines, such as physics, chemistry, biology, and materials science.

SNS is available to researchers around the world with varying degrees of experience. Submitted research proposals are reviewed by independent scientists from within the neutron scattering community to ensure the most promising ones are chosen.

With its more intense, brighter source of neutrons and world-class instrument suite, SNS provides the neutron scattering community with unprecedented research opportunities. The facility allows for measurements of greater sensitivity, higher speed, and higher resolution and in more complex sample environments than have been possible at existing neutron facilities. Each year, more than 1,000 scientists from around the world compete for valuable research time at the SNS facility. A series of power and equipment upgrades at SNS will enable the commissioning of a second target station in the coming years, delivering a world-leading source of pulsed long-wavelength (cold) neutrons for research into complex materials.



Center for Nanophase Materials Sciences

The [Center for Nanophase Materials Sciences \(CNMS\)](#) is one of five DOE Nanoscale Science Research Centers. The centers provide leading-edge tools and scientific expertise for synthesis, characterization, and computation for interdisciplinary research at the nanoscale. CNMS's unique capabilities enable scientists worldwide to "see," make, control, and understand nanoscale matter. Nanoscience aims to understand advantageous yet sometimes strange physical and chemical behaviors that arise in structures 1 to 100 nanometers (nm) wide that do not occur in larger structures. The CNMS program offers the national and international user community access to staff expertise and state-of-the-art equipment for a broad range of nanoscience research, including nanomaterials synthesis; nanofabrication; imaging, microscopy, and characterization; and theory, modeling, and simulation. The facility is equipped with a wide range of specialized tools for synthesis, characterization, and fabrication of nanoscale materials and assemblies, including tools for the integration of hard and soft materials.

