

Oak Ridge National Laboratory
Annual Sustainability Report

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OAK RIDGE NATIONAL LABORATORY
ANNUAL SUSTAINABILITY REPORT
 September 2017

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ACRONYMS

AFV	alternative fuel vehicle
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
B20	6% to 20% biodiesel fuel blended with petroleum diesel
CCR	climate change resilience
CEDS	Central Energy Data System
DOE	US Department of Energy
E85 (flex fuel)	high-level ethanol-gasoline blends containing 51 to 83% ethanol
E&PS	Excessing and Property Sales (organization)
EO	executive order
EV	electric vehicle
FY	fiscal year
G/GSF	gallons per gross square feet
GHG	greenhouse gas
HEMSF	high energy mission specific facility
HPC	high performance computing
HPSB	high performance sustainable building
ITS	Information Technology Services (Division)
LDV	light-duty vehicle
LEED	Leadership in Energy and Environmental Design
LSV	low-speed vehicle
MGY	million gallons per year
MSW	municipal solid waste
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Office
OTC	once-through cooling
PEV	plug-in electric vehicle
PHEV	plug-in hybrid electric vehicle
PUE	power usage effectiveness
R&D	research and development
SCI	Sustainable Campus Initiative
SMR	small modular reactor
T&D	transmission and distribution
TDEC	Tennessee Department of Environment and Conservation
TVA	Tennessee Valley Authority
UT	University of Tennessee



Thomas Zacharia

MESSAGE FROM THE DIRECTOR

When Oak Ridge National Laboratory (ORNL) launched its Sustainable Campus Initiative (SCI) in 2008, we were in the midst of an unprecedented transformation of our physical environment. SCI has contributed to this transformation, providing a focal point for the incorporation of energy management and environmental performance into the planning, execution, and evaluation of all of our activities. SCI has also been a driver for the development of valuable partnerships between our research and development programs and our mission support organizations.

To guide our improvement initiatives, SCI uses a set of roadmaps that was expanded in 2015 to address two emerging concerns: ensuring the efficient operation of our data centers and computational research systems, and strengthening our resilience to changing conditions with the potential to disrupt our operations. As described in this report, we have made substantial progress across all 25 SCI roadmaps. While much remains to be done, it is encouraging to review the advances that have resulted from the dedication and commitment of our staff and the application of ORNL's exceptional capabilities in science and technology.

We will continue our efforts to reach our sustainability goals by working to:

- increase the energy efficiency and reduce the environmental impact of our facilities and operations;
- lower our greenhouse gas emissions;
- conserve and protect water resources;
- eliminate waste, increase recycling, and prevent pollution;
- design, construct, maintain, and operate high performance sustainable buildings in sustainable locations;
- strengthen the vitality and livability of the community around us; and
- engage our employees in the achievement of these goals.

Thank you for your interest in our efforts to achieve enduring sustainability in our facilities, operations, and organizational culture. We welcome your comments, questions, and suggestions.

Thomas Zacharia

Director, Oak Ridge National Laboratory
President and CEO, UT-Battelle, LLC

INTRODUCTION

ORNL OVERVIEW

As the largest science and energy research facility in the US Department of Energy (DOE) system, Oak Ridge National Laboratory (ORNL) conducts basic and applied research on compelling problems in energy and security.

ORNL's diverse scientific programs and world-class facilities enable scientists and researchers to find and deliver solutions to the most troubling issues facing society today. Research at ORNL supports DOE's missions to further scientific discovery, develop clean energy, and strengthen national security.

ORNL supports DOE's efforts through four major areas of science and technology: neutron scattering, high performance computing (HPC), advanced materials, and nuclear science and engineering. The laboratory is home to two of the world's leading neutron sources—the Spallation Neutron Source and the High Flux Isotope Reactor. Much in demand by researchers around the world, these facilities spur new discoveries about materials and biological systems by allowing researchers to view materials from the atomic scale to a full systems view. Home to several of the world's top supercomputers, including Titan, ORNL's high performance computing capabilities advance data-intensive science by enabling powerful modeling and simulation. The Center for Nanophase

SUSTAINABLE CAMPUS INITIATIVE

The Sustainable Campus Initiative (SCI) was organized in 2008 as a way to plan and implement sustainability at ORNL. The initiative comprises diverse areas, reflecting the multifaceted nature of both sustainability and the work conducted at ORNL. SCI is able to tap into ORNL's science and technology expertise in a way that is helping shape the future of how laboratory operations and sustainability work together. One of the responsibilities of SCI staff is to communicate campus-wide achievements to the ORNL, DOE and public communities.

SCI plays a critical role in helping ORNL meet federal sustainability requirements. From 2009-2015, SCI helped ORNL make significant progress toward the requirements outlined in Presidential Executive Order (EO) 13514, which requires government agencies to reach certain sustainability goals by 2020. SCI now guides ORNL in meeting even stricter sustainability requirements established by a replacement EO, 13693, in March 2015.

ORNL AT A GLANCE

- Established in 1943 as part of the World War II Manhattan Project
- Managed for DOE by UT-Battelle, a partnership between the University of Tennessee and Battelle Memorial Institute
- Occupies more than 5 million ft² of building space on 4,400 acres of land
- Employs 4,750 staff, including scientists and engineers from more than 100 disciplines
- Hosts 3,200 users and visiting scientists annually
- Operates on a budget of \$1.4 billion
- R&D 100 Awards: 200

Materials Sciences, the BioEnergy Science Center, and the Consortium for Advanced Simulation of Light-Water Reactors also support DOE's goals for scientific advancement and innovation. In all, ORNL operates nine user facilities that draw thousands of research scientists and visitors each year. In addition, ORNL is in collaborations with the state of Tennessee, universities, and private industry across the globe working on meeting global challenges.

Many of the mandates in EO 13693 call for higher levels of sustainability within an extended performance period (through 2025), essentially giving federal agencies more time to achieve the higher goals. For example, the original EO required agencies to use 20% renewable energy by 2020; whereas the new EO requires use of 30% renewable energy by 2025, with interim targets set during the next 8 years. Several new goals were also established, such as requiring 50% of new passenger vehicles in an agency's fleet be either zero emission or plug-in hybrid by 2025. ORNL is well on

Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*, recommits all federal agencies to leadership in sustainable practices, specifically stating that "Federal leadership in energy, environmental, water, fleet, buildings, and acquisition management will continue to drive national greenhouse gas reductions and support preparations for the impacts of climate change."

its way to meeting these new challenges through SCI’s proactive work toward each sustainability goal covered in the latest EO. In fact, avoided costs tied to SCI efforts are estimated at \$19.5 million (2016 dollars) since fiscal year (FY) 2010.

SCI organizes its efforts using a pyramid structure, consisting of four technology tiers: (1) foundational, (2) known, (3) leading edge, and (4) transformational. Populating these technology tiers are 25 focus areas, each assigned to an ORNL staff member who “owns” improvement initiatives in those areas.

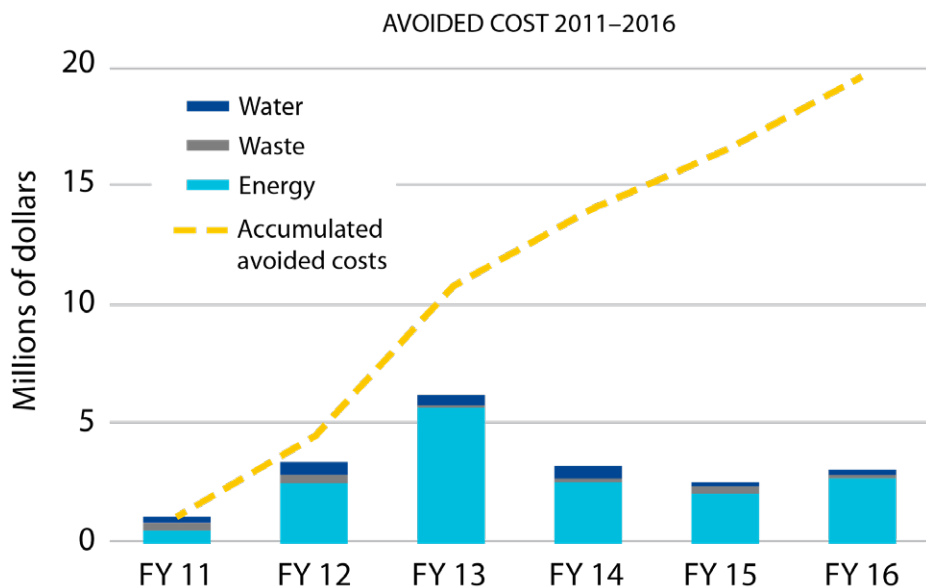
In 2015, the SCI program was expanded to include two new roadmaps in response to important and evolving national and international sustainability initiatives. The High Performance Computing Roadmap addresses the need for efficient operations for data centers and computational research systems. The Climate Change Resilience (CCR) Roadmap addresses the need to prepare for and adapt to the changing operational and mission responses needed for climate-related events.

Achieving sustainability is an ongoing process. At ORNL, we leverage modernization efforts to improve sustainability—acquiring more efficient equipment that consumes less energy, identifying ways to use less paper, and repurposing objects that otherwise are destined for the landfill. As new methods and technologies are developed and put in place, new opportunities arise for reducing or preventing waste and decreasing consumption needs—edging us ever closer to our sustainability goals.

SCI is an official organization within ORNL with heart, passion, and understanding of Earth’s delicate balance. Our members care deeply about sustainability, and their passion is obvious (and often contagious) to other employees. We are proud to be a part of these very important efforts and know that changing habits are not only possible but critical for the welfare of generations to come.

Overview of avoided costs due to energy, water and waste conservation

SCI avoided costs estimated at \$19.5 million (2016 dollars) since FY 2010



“It’s no surprise that the Sustainable Campus Initiative’s [SCI] values have naturally become engrained in ORNL’s culture. SCI builds upon ORNL’s signature strengths in science and technology by integrating energy efficiency, robust and cutting-edge technologies, operational and business processes, and behavior to achieve sustainability. By holding ourselves accountable for our everyday actions, we have made tremendous progress in our achievements towards sustainability. SCI’s principles offer valuable guidance that we all seek in order to maintain our upward momentum.”

-- Moe Khaleel, Associate Laboratory Director for Energy and Environmental Sciences

Cosponsor of ORNL’s Sustainable Campus Initiative

“Over the past decade, ORNL has undergone major energy efficiency improvements throughout our facilities and operations, from reduced building energy intensity to running a cleaner fleet. To me, there is a clear correlation between these improvements and numerous efforts coordinated by SCI. The team does a phenomenal job of helping us identify ways to reduce consumption and waste, but I think their greatest impact lies in their ability to educate and engage our workforce in sustainability efforts.”

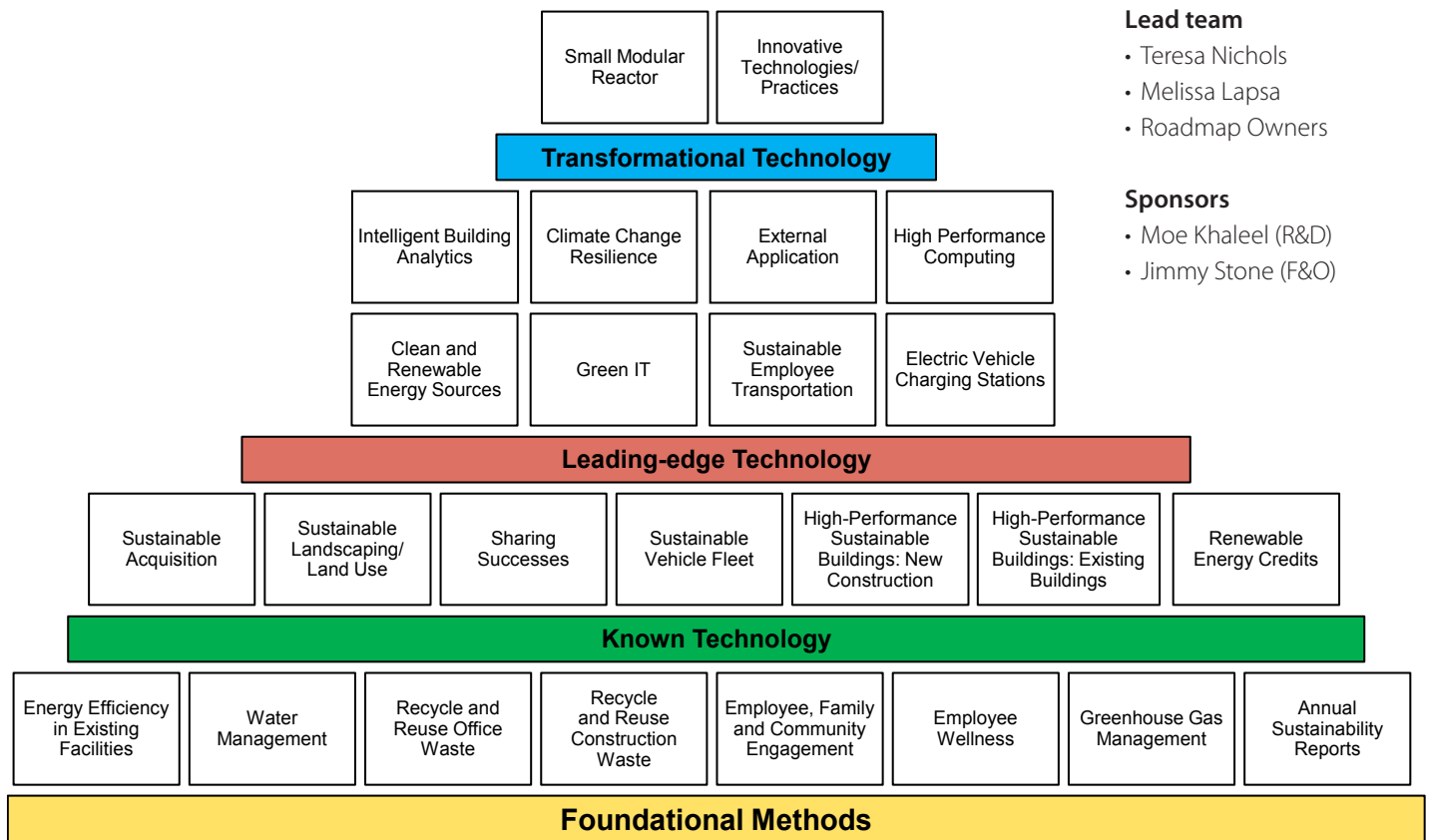
—Jimmy Stone, Director for Facilities and Operations Directorate

Cosponsor of ORNL’s Sustainable Campus Initiative



SCI plays an active role in numerous sustainability-focused organizations:

- Battelle Sustainability Working Group
- DOE Sustainability and Environment Sub-Group
- DOE Operations Improvement Committee for Sustainability Intelligent Buildings Working Group
- TN Department of Environment and Conservation Electric Vehicle Advisory Committee
- DOE Workplace Charging Challenge
- US Green Building Council
- DOE Better Buildings Campaign
- Better Building Data Center Accelerator



THIS REPORT

As DOE's largest science and energy research facility, ORNL is tasked with finding ways to reduce the consumption of fossil-based energy in today's technologies while developing alternative energy sources. This is a monumental task, but ORNL leads by example as it makes promising strides to reduce energy use and introduce cleaner fuel options on the laboratory campus, as demonstrated in this report.

In its continuous search for new ways to achieve sustainability, the SCI leaves no stone unturned. During our years as an official program, we have learned that countless methods to decrease waste, reduce pollution, and save energy are at our fingertips—we just have to creatively seek them out and implement them.

SCI supports ORNL in its goals to be a leader in sustainability best practices in all aspects of laboratory operation, from research and development (R&D) to laboratory support and maintenance functions. This, progress report (our third), reflects the efforts and strides we have made in the last fiscal year to achieve more of our goals. We hope our readers enjoy learning about and are inspired by the small steps and giant leaps we have taken to decrease ORNL's carbon footprint. Our FY 2016 achievements include the following:

- Received official notification of Leadership in Energy and Environmental Design (LEED) Gold Certifications for Buildings 8930 and 7120.
- Established a high performance sustainable building (HPSB) inventory of 20 buildings (15.5% of total applicable building portfolio).
- Achieved a 5.4% reduction in energy use intensity, exceeding the annual goal of 2.5%.
- Achieved a water use intensity of 137.9 G/GSF, a reduction of 21.8% to date, exceeding the 18% interim goal for FY 2016.
- Reached a 54.6% reduction of cumulative petroleum consumption relative to the FY 2005 baseline, exceeding the DOE target.
- Achieved a 331% increase in cumulative alternative fuel consumption relative to FY 2005 baseline, exceeding the DOE target of 160%.
- Implemented a shared print services program to update existing multifunction print devices and to provide for other shared print devices.
- Purchased two plug-in hybrid electric vehicles (PHEV) and three new government electric vehicle (EV) charging stations.
- Held the first "Battle of the Buildings" challenge between eight buildings on campus, with the winning building achieving an accumulated energy savings of 23%.
- Increased ridership on a new shuttle bus route between ORNL and two neighboring college campuses to an average of 30 daily riders, contributing to reduced fuel consumption, greenhouse gas (GHG) emissions, and personal commuting costs.



Associate Laboratory Director Jeff Nichols (left) plugs in his directorate's first EV at the newest fleet charging station on the ORNL main campus. Two fleet EV charging stations were installed at the National Transportation Research Center (right).

SUSTAINABLE BUILDINGS

HIGH PERFORMANCE SUSTAINABLE BUILDING INVENTORY

It is possible to make what's old new again, and ORNL has demonstrated that more than once by retrofitting older buildings across campus to obtain HPSB status by complying with the revised *Guiding Principles for Sustainable Federal Buildings* (FEMP 2016). HPSB compliance applies to all new construction, major renovations, and alterations of buildings larger than 5,000 GSF.

In FY 2016, ORNL's HPSB inventory consisted of 20 buildings, or 15.5% of total applicable site buildings. To meet DOE's goal, at least 17% of ORNL's total applicable site buildings must comply with HPSB guiding principles by FY 2025, with progression to 100% thereafter.

HPSB and LEED certification criteria overlap substantially, and ORNL prevails as one of the largest sites of LEED-certified buildings on a single campus in the entire Southeast, with a total of 18 LEED facilities, including 8 LEED Gold and 3 LEED Silver facilities.

Most recently added to ORNL's LEED-certified building list is the Gold-certified ORNL Shipping and Receiving Building (7120), which replaced a 58-year-old building (7018) with poor energy performance and inefficiencies. The new building incorporates customized pre-engineered structures, as well as advanced electricity and water monitoring. The building was designed with LEED criteria in mind, including maximization of open space while maintaining functionality, minimized heating, ventilating, and air-conditioning and refrigeration system emissions, high-performance building envelopes, high solar reflectance roof surfaces, waste diversion through on- and off-site recycling, LEED innovation credits, and more. Additionally, the building won the US Green Building Council Tennessee 2015 Green Light Award.

ENERGY INTENSITY REDUCTION

In addition to setting goals for Scope 1, 2, and 3 GHG emissions, DOE also set a goal to reduce building energy intensity (Btu/ft²). With implementation of EO 13693, the new goal for federal facilities is to continuously reduce energy intensity by 2.5% each year by FY 2025 compared to a FY 2015 baseline. In FY 2016, ORNL exceeded the annual goal with a 5.4% reduction in site energy intensity, dropping from 265,326 to 250,994 Btu/GSF.

At ORNL, energy reductions are achieved using a multifaceted approach that includes construction of new energy-efficient facilities, repurposing existing facilities, and demolishing inefficient legacy facilities. In addition, aggressive energy conservation activities in existing facilities include energy data analysis, energy performance benchmarking, energy audits, targeted energy conservation measures, and retro-commissioning. ORNL has a continuous

improvement philosophy for energy management and continues to strive for sustaining and improving performance.

Recent upgrades to the ORNL Steam Plant will go a long way toward achieving energy intensity reductions. Two vintage boilers and the Biomass Gasification System were replaced with three new, more efficient dual-fuel natural gas/fuel oil boilers, commissioned in September 2015, achieving reductions in natural gas and fuel oil consumption. Steam distribution decentralization and steam production efficiency improvements further enhance ORNL's steam service and reliability.

Other modernization efforts across campus included equipment upgrades and a building management system with modernized heating, ventilating, and air-conditioning systems, which enabled significant reduction or elimination of energy-intensive, simultaneous heating and cooling loads in several large air-handling units.

AUTOMATED MONITORING FOR ENERGY EFFICIENCY

The ORNL Central Energy Data System (CEDS) maintains 838 smart meters and devices. These utility meters collect data on electric power, water, natural gas, steam, chilled water, photovoltaic arrays, and electric vehicles and report energy consumption data to the system. CEDS contributes to the laboratory's smart grid and energy management capabilities, including the collection of power usage effectiveness data for the Titan supercomputer.

All advanced meters included in ORNL's site-wide metering plan will be connected to CEDS for data archiving and analysis. CEDS has the ability to log multiple parameters from each meter on a standard 15-minute interval. The system also enables trend analysis, report generation, energy awareness dashboard deployment, normalization for weather and other factors, and data export for use in other analyses. A utility cost analysis and allocation module within the CEDS called "EnergyCAP" will be used to automate



Building 7120 gained LEED Gold status in May 2016.



New dual-fuel boilers enhance steam system efficiency.

utility cost distribution, generate management reports, and push monthly energy data to the US Environmental Protection Agency's ENERGY STAR® Portfolio Manager for benchmarking.

As ORNL's CEDS and individual Building Automations Systems continue to grow in size and operational significance, we are working

BATTLE OF THE BUILDINGS CHALLENGE

The Battle of the Buildings is a building electricity conservation challenge that was held for the first time on the ORNL campus. Eight buildings with similar sizes and missions were selected for the competition, which took place from July 5 to September 30, 2016. The occupants' electricity use was recorded and shown in comparison to the electricity use for the previous year through real-time data analytics and visualization that was meant to drive team competitiveness. The winning building, which was awarded with a certificate and celebration lunch for its occupants, accumulated energy savings of

DATA CENTER EFFICIENCY INITIATIVE

High Performance Computing (HPC) done at ORNL as part of the Oak Ridge Leadership Computing Facility has several areas of increased efficiency associated with the HPC hardware, software, and programming for its new cornerstone system called Summit. The current HPC system, Titan, can produce more than 2 billion calculations using a single watt. Summit is expected to consume less than one-sixth of that energy for the same amount of work, producing more than 12 billion floating point calculations per watt. In addition, the system will utilize a burst buffer which absorbs bulk data a hundred times faster than its predecessor. When combined with NVLINK, which expedites the transfer of memory between CPUs and GPUs, jobs finish quicker, minimizing compute time and overall energy consumption. DOE encourages federal agencies to establish a power usage effectiveness (PUE) target in the range of 1.2–1.4 for new data centers and less than 1.5 for existing data centers. PUE is a metric used to show the efficiency of a facility's data center support infrastructure. In FY 2016, ORNL's Computational Facilities Complex met this goal by reporting a data center portfolio PUE of 1.28.

To achieve and maintain DOE's PUE goal, we have launched initiatives to reduce energy consumption in our HPC facilities. For example, we installed a high-voltage entry point in the data center, bypassing an estimated two miles of transmission lines for HPC loads. We also raised air supply temperature inset points on strategic air handlers in the high performance data center by 9°F.

ORNL's partnership with the University of Tennessee (UT) Reliability and Maintainability Center, currently in its fifth year, also provides a highly reliable infrastructure that results in less wasted energy. This

to keep cybersecurity in lockstep by building a more secure industrial controls system network. This is a purpose-built network with security measures specific to the sensitivity of facility and energy management systems. This new network will ensure that industrial control systems' functionality and data are protected for years to come.

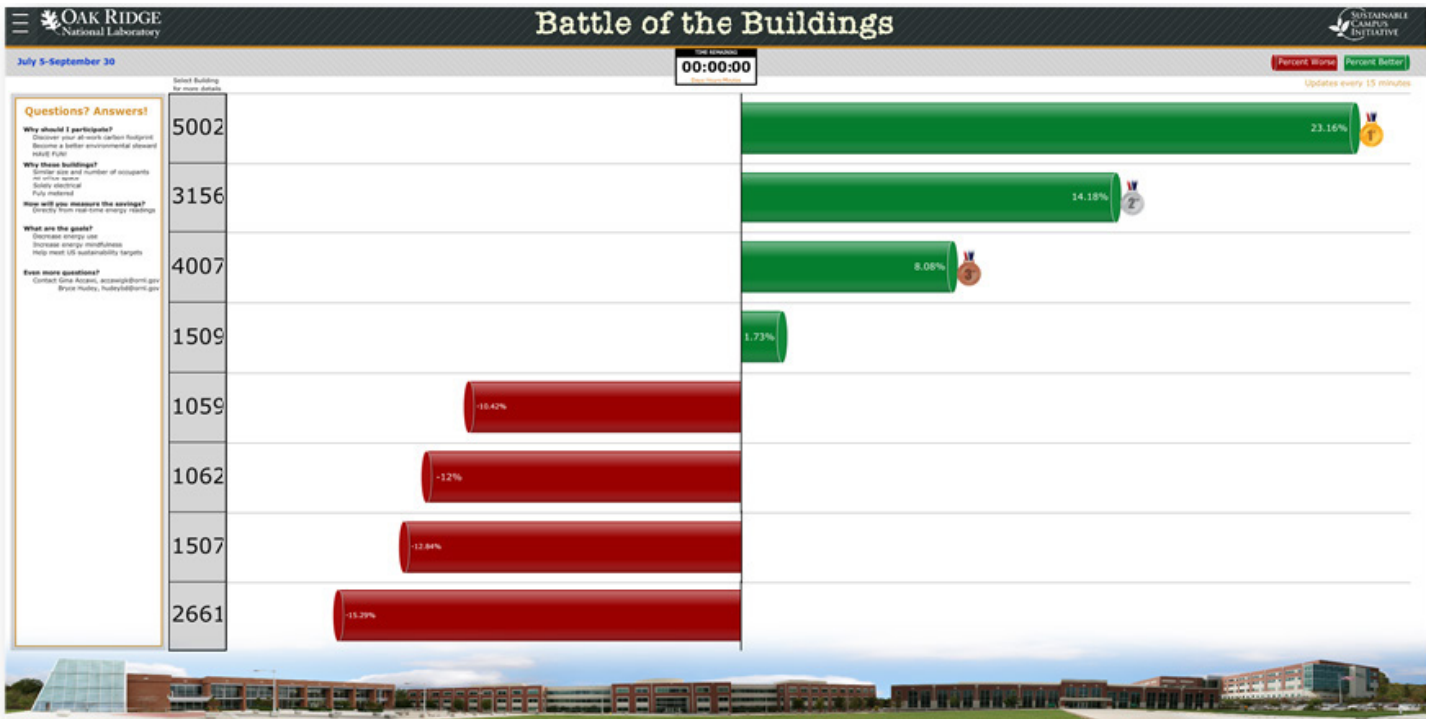
23%. The second- and third-place contestants followed with savings of 14% and 8%, respectively. Over the two-month competition, an impressive 9,700 kWh were saved.

As expressed by the occupants of the winning team, "Brainstorming made us all get together, share ideas, and look at how to conserve energy. The brainstorm and collective thinking helped us to attain full engagement in the competition." The Battle of the Buildings demonstrates how competitiveness, collective behavioral change, and mindfulness can influence energy use to a great degree.

partnership is of great value because problems with facility infrastructure that stop HPC systems not only delay the science mission but also keep power usage at high levels relative to the lack of data production. The ORNL Computational Facilities Complex Reliability Program increases equipment life, keeping the overall complex operating as efficiently as possible.

ORNL also shares industry best practices and lessons learned with the Energy Efficient High Performance Computing Working Group (LLNL 2017), comprised of counterparts at other national laboratories and individuals from industry (i.e., HPC system integrators and facilities hosting HPC). Subgroups include Infrastructure (Liquid Cooling, Controls, and Energy Reuse Effectiveness); Computing Systems (Procurement Considerations, HPC Grid Integration, and System Workload Power Measurement), and Conferences (industry engagement).

Several measures have been taken to ensure staff are trained and knowledgeable in the best practices of HPC efficiency. Certain staff members completed the DOE Data Center Energy Practitioner Training and were certified for the generalist and specialist levels. ORNL's subject matter experts enrolled in the UT "Introduction to Data Centers" course, which covers infrastructure, operations, and management of many aspects of data facilities, including cooling, power, and efficiency. To ensure we remain aware of the industry's direction and aggregate knowledge, and to share lessons learned with others, a staff member is serving on the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Technical Committee and will attend the upcoming ASHRAE Annual Conference.



Live energy-performance dashboard for competition standings and energy-consumption trends.



Certificate presentation to Building 5002 occupants, winners of the ORNL Battle of the Buildings.

The Titan supercomputer will be succeeded by Summit—an IBM POWER9 system. Plans for the new world-class computing facility will be economized for warmer water using a combination of cooling towers and chillers, which will reduce both electricity and

water over conventional chilled water systems. As a participant in the DOE Better Buildings Challenge and the Data Center Accelerator program, ORNL will realize more than 20% improvement in PUE by the year 2020, in part because of this transition.

WATER USE INTENSITY

ORNL has a unique responsibility and opportunity to lead in water management strategies and, by proactively undertaking a variety of operational initiatives, has demonstrated astounding results. Through a few simple programs, ORNL has reduced its water consumption by 57.2% compared with its highest water use (in FY 1985).

DOE's goal of a 36% potable water intensity (G/GSF) reduction by the FY 2025 target year relative to a FY 2007 baseline will be challenging. The lab has exceeded the 18% interim goal for FY 2016 with a 37.9 G/GSF water use intensity, a reduction of 21.8% from FY 2007. However, as demand increases for cooling tower makeup water to support growth of HPC systems, ORNL will need to be aggressive in pursuing additional water-savings opportunities to offset mission-specific demands.

ORNL organizes its water conservation efforts into three main areas: domestic use in buildings, water distribution systems, and once-through cooling (OTC). Achievements in each of these areas include the following:

- Installing low-flow devices on sinks, toilets, and showers across campus will save 12 million gallons per year (MGY).
- Repairing leaks in the water distribution system in buildings and in main distribution lines is an ongoing activity, but repair work conducted last year has already saved 70 MGY.

- Initiating several projects to reduce or eliminate OTC water, including the installation of new closed-loop equipment, will save 170 MGY.

ORNL continues to operate an aggressive plan to reduce water consumption, including repairing leaks, replacing old lines in the site water distribution system, and eliminating OTC where possible.

Some of the achievements in water use intensity in FY 2016:

- ORNL was highlighted in *Tennessee Utility News*, Second Quarter 2016, for its rapid response to repairing a 20-in. water main. The rupture released 50–75 gallons per minute of potable water during a very cold, wet, and snowy February day. With help from area utilities and dedicated, multidiscipline craft personnel, ORNL utilities completed the repair and mission-critical operations were not impacted.
- ORNL continues to repair and replace a very old and leaky water distribution system with new backflow preventers in several buildings, along with piping reconfigurations to correct plumbing problems. Fire hydrants and post-indicator valves in the distribution systems have also been replaced as needed.
- Rain sensors have been installed and connected to irrigation controllers to temporarily discontinue irrigation after recent rainfalls.

To better understand water use at ORNL, a water-metering plan is being implemented in accordance with DOE's goal to meter all individual buildings where cost effective and appropriate. As a part of this plan, assessments identified the 33 facilities that account for 90% of water use at ORNL. To date, 21 of these 33 facilities have been equipped with advanced meters, which are connected to CEDS and are collecting interval data. In addition, all of ORNL's cooling tower makeup water supplies are metered, and most of the metering devices are advanced meters. An advanced meter was installed on one of the site's water distribution supply mains, establishing a foundation for additional distribution-side meters in the coming years. In FY 2016, another advanced meter with wireless connectivity was installed in a key location on ORNL's water distribution system, expanding the foundation for additional distribution-side meters in the future.



*Photo taken by Jessica Langstaff,
Oak Ridge National Laboratory.*

TRANSPORTATION

ORNL and the SCI Employee Transportation Roadmap contributors actively engage in regional and local planning for sustainable transportation, as well as in outreach activities for its enhancement across the entire Southeast region. In 2016, SCI coordinated with state and regional transportation programs to help create more effective, efficient, and affordable regional transportation and commuting options. ORNL staff were active participants in local and regional organizations, such as the Board of Directors for the East Tennessee Clean Fuels Coalition, which focuses on regional sustainable transportation options. Attendance at board meetings allows for important interaction with regional stakeholders, including Knoxville Area Transit, the City of Knoxville, Smart Trips™, and others. ORNL remains committed to coordinating with local,

state, and federal stakeholders to advance telecommute and ride-share initiatives.

Specific efforts, some detailed subsequently, include the following:

- Participation in the new bus route linking the UT Knoxville, Pellissippi State Community College (PSCC), and ORNL campuses.
- Participation in the Tennessee Workplace Charging Challenge.
- Encouragement of Smart Trips™ participation by ORNL employees.
- Collaboration with the local DOE Clean Cities Coalition and regional stakeholders.
- Participation in the Southeast Alternative Fuels Conference.

FLEET PETROLEUM CONSUMPTION

By FY 2016, ORNL and other federal facilities were challenged to reduce annual petroleum consumption by 20% relative to an FY 2005 baseline and then maintain a 20% reduction thereafter. Fuel data for FY 2016 shows that ORNL nearly tripled the cumulative target of 20% decrease in petroleum consumption by achieving a cumulative decrease of 54.6% compared with the baseline. To help with sustainability goals, including the reduction of fleet vehicle use, ORNL has strategically placed 100 bicycles throughout the campus for staff use. Of the low-speed vehicles (LSVs) used on campus, 22% are EVs. Under the auspices of the SCI, two diesel-powered LSVs from the ORNL fleet were evaluated on the vehicle dynamometer in the Fuels, Engines, and Emissions Research Center to benchmark their fuel economy and emissions. Results show excellent fuel economy of 22 to 36 miles per gallon, much higher than expected for this type of nonroad vehicle and much higher than would be expected from light-duty sedans or pickup trucks used in similar service.

As funding is provided, appropriate approvals are granted, and the mission dictates, ORNL will continue to replace inefficient vehicles with alternative-fuel vehicles (AFV) and hybrids; replace heavy-duty vehicles with units that have smaller gross vehicle weight ratings; and, when possible, replace gasoline LSVs with electric LSVs. Other planned fleet measures include the following:

- Zero waivers for using petroleum fuel in AFVs.
- Promotion of lab-wide E85 alternative fuel use.
- Zero missed opportunities for fueling AFVs with alternative fuels.
- Replacement of older vehicles with AFVs and hybrids as funding allows.
- Continued emphasis of initiatives that will decrease idling practices by personnel.
- Procurement of hybrid vehicles to provide the on-site taxi/shuttle activity with fuel-efficient vehicles.
- Continued reduction of vehicle use (e.g., through teleconferencing, trip consolidation, use of mass transportation).

FLEET ALTERNATIVE FUEL CONSUMPTION

Contributing to reduced petroleum consumption at ORNL is the continued introduction of alternative vehicles and fuels, including the gasoline-ethanol blend E85 and biodiesel blend B20. DOE's goal for federal facilities is to increase annual alternative fuel consumption by 10% by 2015 relative to an FY 2005 baseline and to maintain 10% thereafter. ORNL not only reached the 10% with ease by FY 2007 but also recently achieved a 331% increase over the 2005 baseline in FY 2016.

ORNL currently has on-site three alternative fuel pumps and a fueling truck that dispenses B20 biodiesel fuel to equipment and vehicles. An outside fuel test laboratory frequently tests the E85 fuel to determine the ethanol content. Any interruptions in the availability or quality of alternative fuels could quickly lead to reduced alternative fuel use and increased petroleum use, which would set back our progress toward DOE goals. After the vehicle purchases were made for FY 2016, 63% of the ORNL fleet is made up of flexible-fuel vehicles. In addition, 86% of the vehicles, including recently purchased PHEVs, can use alternative fuel.

ORNL continues to be a leader in the Southeast for alternative-fuel fleet use and remains involved in alternative fuel outreach through partnerships with the local DOE Clean Cities program (East Tennessee Clean Fuels) and by providing experts at local public

outreach and education events. Such events highlight ORNL's experience and expertise in alternative fuel use. ORNL's educational outreach efforts help the public make informed decisions regarding both the benefits and challenges of alternative fuel use.



Future Fuels: E85 Pump Upgrades

Since FY 2005, ORNL has cumulatively decreased its petroleum consumption by 48.6% and has enhanced its alternative fuel use by 331%, exceeding DOE targets and demonstrating early commitment to sustainable transportation. This commitment persists for further development of vehicles and fuels. In September 2016, for example, a project called "Right at the Pumps" was carried out to promote E85 fuel use. The project incorporated a makeover of the fuel station and pumps on campus with improved signage, including brightly colored "Fuel up with E85" graphics for heightened awareness.

AFV FLEET AND INFRASTRUCTURE EXPANSION

ORNL remains a leader in the Southeast and among national labs in the use of alternative fuels and advanced vehicle technologies. In 2017, ORNL was awarded honorable mention by *The 100 Best Fleets in the Americas* (Johnson 2016). The lab is expanding use of AFVs, including plug-in electric vehicles (PEV), to help meet ORNL goals and those set forth in the EO for reduced use of petroleum-based fuels and increased fleet fuel economy. One goal was that 75% of light-duty vehicle (LDV) acquisitions must be for AFVs by 2016 and ORNL exceeded this goal with 100% of ORNL LDV acquisitions being AFVs. Another goal was that 20% of newly acquired passenger vehicles must either be PHEVs or produce zero emissions by FY 2020, working towards a goal of 50% by FY 2025. ORNL supported both of these DOE goals by adding one Ford C-Max Energi and two Ford Fusion Energi PHEVs to its fleet, bringing the number of PEVs to five.

Via telematics, ORNL collects data on use, battery charging, and fuel economy of one fleet PHEV and one fleet non-PHEV. In FY 2016, ORNL purchased four additional telematics devices with advanced capabilities. By applying ORNL's expertise in PHEV data analysis, the laboratory can monitor for problems and quickly provide solutions. It can also aid in decisions of where to best use PHEV and charging infrastructure as more PHEVs are added to the fleet.

Makeup of ORNL's fleet of 439 vehicles:

- 40 Sedans: 5 PHEVs, 35 hybrid/FF^a
- 23 SUVs: 10 UG,^b 13 FF
- 92 Medium-size pickups: 14 UG, 42 FF, 36 DSL^c
- 152 Light-duty pickups: 3 UG, 149 FF
- 70 Vans (cargo and passenger): 2 UG, 67 FF, 1 DSL
- 52 Heavy-duty vehicles: 1 UG, 51 DSL
- 5 Emergency vehicles: All DSL
- 5 Buses: 2 FF, 3 DSL

^aFlex fuel

^bUnleaded gas

^cDiesel

A total of 47 electric vehicle supply equipment parking spots are now available between the main campus and Hardin Valley campus. The total includes 25 solar-assisted charging stations, 1 DC fast charger, and 21 Level-2 charging stations. Staff interest in EVs has increased so much that an Owner's Club was established in October 2016. The club currently has 55 active members, who can access campus charging stations for a flat annual fee.

EMPLOYEE COMMUTING

ORNL and UT partnered on a new bus route that provides service between the UT Knoxville campus, Pellissippi State Community College campus, and ORNL that would help ORNL contribute to meeting its carbon emissions goal under EO 13693. The new service provides three daily round-trip routes at no charge to its riders. UT's campus transit service, "The T," which carries more than 1 million passengers annually, launched the new route on August 19, 2015. The route was requested by UT and ORNL leadership and ORNL employees who frequently attend meetings at the three locations. Ridership is at an all-time high of about 30 riders per day on a 36-passenger bus. The round trip to all three destinations takes approximately 48 minutes.

"Our numbers of joint faculty, shared graduate students, and undergraduates doing internships at ORNL is constantly increasing," said Dr. Taylor Eighmy, vice chancellor for UT Research & Engagement 2012–2017. "This [transit] will benefit both communities—the Bredesen Center, our joint institutes, and all of our active collaborations. It will also support our Bridge Program with Pellissippi State."

"One of our laboratory initiatives is to reduce Scope 3 emissions, and Scope 3 encompasses employee travel, carpooling, and reductions in business travel," she said. "This transit route shows a strong, good-faith effort in how we're trying to address that goal."

—SCI Co-Lead Teresa Nichols



SCI team members welcome the "shuttle pioneers" on the bus's first day of service, August 19, 2015.

ELECTRONIC STEWARDSHIP/GREEN IT

As ORNL staff continue to expand their technical and scientific pursuits, they will require more computing power and electronic capabilities. Office equipment is estimated to account for 15% of all electricity used by office buildings in the United States and

presents a challenge for reduced energy consumption at the laboratory as well. However, ORNL is always on the lookout for ways to improve its electronic stewardship, not only for the laboratory, but for other federal facilities and private organizations.

POWER MANAGEMENT OF ELECTRONIC EQUIPMENT

After a highly successful pilot program in 2009, Verdiem Surveyor software was rolled out to the entire campus the following year. This software allows central management of the energy consumption of networked computers and monitors by powering down idle units into sleep and standby modes to save energy. Today the system includes more than 7,700 desktop computers that are

actively power managed, and cumulative savings since 2009 have totaled more than \$1.8 million. Not only has this initiative resulted in significant cost savings for the lab but also it has helped ORNL meet the DOE goal of 100% of eligible desktops, laptops, and monitors being power management enabled.

NETWORK PRINTING AND VIRTUAL SERVERS

Since the 2013 rollout of a shared network print services model, multiple one-function devices have been replaced with a single-multifunction device to reduce the use of electricity and space. The new print services model provides equipment with additional print features (e.g., automatic duplexing set as a default), improves service and operation, helps standardize equipment, and reduces landfill waste. It will also save the laboratory up to \$500K per year when adopted across the entire complex.

The Information Technology Services (ITS) Division continues to pilot technologies that will allow us to replace typical desktop configurations with virtual systems and applications such as thin clients and zero clients. These devices replace the typical desktop unit with a network connection to a remote server that hosts the user operating system. Such configurations are more cost effective than typical desktop systems, use significantly less energy, and are easier to manage and more secure.

Although these improvements target desktop computing, ITS is also continuing to expand the use of virtual servers. By running multiple virtual servers on a single physical server, the costs of administration, power consumption, and space use can all be reduced. Any server or application that is able to run in a virtual environment will be migrated to a centrally managed virtual server cluster. As current servers reach their end-of-service life, they will be examined to determine eligibility for movement to a virtual platform, possibly increasing energy savings and improving space use.

Out with the Old, In with the New: Library Reduces Floor Footprint by Going Digital

ORNL's Research Library reduced the number of older paper journals in favor of perpetual digital access. The paper-reduction

initiative allowed ORNL to reduce the amount of space needed for the library and improve access to digital documents without research personnel losing access to any of the journals.

With support from the Facilities Strategic Planning and Information Technology Services divisions, the librarians transitioned 535 linear feet of paper journals and 281 microfilm cartridges to electronic format. "That equates to an impressive 4,280 cumulative years of new electronic journal archives that are available to the ORNL staff," said library manager Bob Conrad.

During the digitization process ORNL recycling experts assisted by coordinating the removal of an estimated 16,000 lb of paper. The Library plans to continue this sustainability practice by diverting waste to the appropriate recycle stream whenever and wherever possible. Other groups across campus are beginning to transfer their old reference materials to recycling bins, and SCI expects more to follow.



ORNL librarian and UT intern recycle paper journals from the research library

POLLUTION PREVENTION AND WASTE REDUCTION

Through the Pollution Prevention Program, ORNL staff continue efforts to conserve resources and reduce the cost of R&D activities by developing and implementing techniques, technologies, and programs that minimize waste and pollution. First and foremost in preventing waste is source reduction, such as reducing the amount of paper used, since generating and using these and other materials must eventually be managed as waste. Therefore, the program presents staff with alternatives that use less paper and that rely on electronic records instead of hard copies. In addition to reducing the use of valuable resources, ORNL provides facilities where materials that otherwise are deemed waste can be reused or recycled.

ORNL's aggressive pursuit of both source reduction and reuse/recycling opportunities has reaped the benefits. From FYs 2009 through 2014, new pollution prevention initiatives precluded production of about 2.7 billion lb (1.35 million metric tons) of waste, with an associated cost avoidance of more than \$31M.

MUNICIPAL SOLID WASTE REDUCTION

ORNL continually strives to meet DOE's goal of diverting at least 50% of nonhazardous municipal solid waste (MSW), excluding construction and demolition waste, that would otherwise be sent to a landfill. ORNL's diversion rate for MSW in FY 2016 reached an impressive 46%. Although slightly below the target, this rate represents continued improvement. In fact, through a series of coordinated efforts we achieved a significant increase compared in the last two years compared with prior years, in which the MSW diversion rate averaged 34%.

ORNL has continued its initiatives and best management practices to reduce the amount of material going to the landfill. During the last five years, we periodically conducted extensive, targeted assessments of on-site waste characteristics and employee waste disposal and recycling practices and worked to identify additional diversion opportunities. These assessments, along with awareness activities, resulted in easier ways for employees to reduce waste and recycle and helped engrain these practices into the ORNL culture.



PT staff member recycling a used paper bed roll.

How ORNL's Physical Therapy Clinic Upped Their Recycling Efforts

ORNL's Physical Therapy (PT) Clinic uses a large amount of paper bed rolls, which fill up approximately four full trash bins per week, accumulating to 70 lb/year. PT has upped their sustainability efforts with two new recycling bins exclusively for used paper bed rolls. The PT team says working with the SCI to come up with and implement this solution was a win-win. The team is happy to recycle as sustainability is an important issue to them. PT's janitor was also more than willing to manage the pickup and recycling of the paper bed roll bins.

The Fresh Seasons Cafe Offers
Refillable Mugs

The Sustainable Campus Initiative has partnered with Taher to reduce paper waste by offering refillable mugs.

\$5.76 for a 16 oz. mug and \$0.42 (plus tax) for each refill

Purchase your refillable mug today!
 (Previously purchased refillable mugs honored.)

One small, but very practical, incentive that has had a big impact is offering employees refillable 16 oz. mugs at the Fresh Seasons Cafe, the employee dining concessionaire. After a one-time purchase price of \$5.76 for the mug, subsequent drinks are only \$0.42. Over time, employees can save significant lunch costs while using far fewer disposable cups.

CONSTRUCTION AND DEMOLITION WASTE REDUCTION

ORNL has always addressed the recycling of excess building materials in new construction, but before 2011, waste generated from the remodeling of existing structures went to a landfill. A contract was subsequently put in place to recycle a large portion of waste materials resulting from remodeling. In FY 2016, 66% of the construction and demolition waste was diverted from the landfill, thus exceeding the 50% annual waste diversion goal.

SCI efforts to reduce construction and demolition waste include:

- Hosted an introductory meeting to discuss a potential regional composting program. Attendees included Y-12 National Security Complex, the State of Tennessee—Department of Environment

& Conservation, Roane County Government, Roane County Schools, and Sevier Solid Waste, Inc.

- Implemented recycling of wooden pallets, resulting in approximately 4,000 pallets diverted from the landfill. An external vendor picks up pallets on a regular basis and pays ORNL an annual fee for this arrangement.
- Introduced a lab-wide initiative to recycle carpet (transitioning away from a project-by-project activity). One carpet-recycling project totaled 670 yd² (2,631 tons).
- Reused and recycled 998 metric tons of asphalt milling from a paving project and 103 yd³ of soil as clean cover at the DOE Oak Ridge Office (ORO) landfill.

RECYCLING BATTERIES

In FY 2016, ORNL recycled 14,903 kg (32,856 lb) of batteries. Batteries are collected in more than 175 locations across the lab. Because batteries are common, the hazards associated with them are often not recognized. Batteries are managed as what is called a universal waste under the hazardous waste regulations to ensure they do not adversely affect human health or the environment. To minimize the risk of a fire started by sparking batteries, ORNL suggests taping the terminals of all types of batteries (except

alkaline AAA, AA, C and D cells) while they are being collected. One regulatory requirement is that the batteries must be shipped offsite for recycle within one year of generation. Therefore, at ORNL, collected batteries must be turned over to the Transportation and Waste Management Division within nine months of generation to then be shipped offsite for recycle, which ensures this requirement is met.



Paper Reduction Pilot

SCI teamed with Facilities Management, Environmental Protection, and the Waste Services Division on a pilot program to reduce ORNL waste being sent to a landfill. The six-week pilot program included evaluating the value of collecting paper towels used in restrooms from five major buildings. After six weeks more than 1,350 lb of paper towels were collected and successfully diverted, providing metrics that can be used to calculate the value-added versus effort if the pilot program is expanded campus wide.

SCI Team Members stand behind one week's worth of collected paper towels.

CLIMATE CHANGE RESILIENCE

EO 13693 requires federal agencies to address and plan for climate-related impacts to their facilities, thereby, improving their climate change resilience (CCR). The EO defines “resilience” as the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions. By including climate-resilient design and management elements in the operation and renovation of existing agency buildings and the design of new federal buildings, ORNL can strengthen its resilience to events brought about by changing conditions.

Taking an integrated and proactive approach to include sustainability efforts and CCR into the operational planning process, in FY 2014 ORNL chartered a CCR team comprised of representatives from Facilities and Operations and various research programs. The team is responsible for reviewing climate change risk elements and event categories and their potential effects on critical missions and operations while considering our specific geographic location and associated risk for climate-change events. The team has worked to increase awareness regarding climate change risks to better understand their roles in facility operations, emergency planning and response, environmental protection, and natural resource management. The CCR team will have input in all future planning activities to ensure risk elements and risk events are considered.

ORNL is committed to incorporating climate-resilient design and management elements into the planning process and to determining the specific risks and level of resiliency required. In addition to updating the ORNL CCR Risk Table on an annual basis, the team’s planning steps for future activities include the following:

- Continue to develop knowledge of the possible effects of climate change risks on ORNL.
- Apply this knowledge to missions and operations.
- Develop and prioritize actions based on site-specific risks and threats.
- Build awareness and improve skills to respond to potential events.

ORNL already has numerous agreements in place with state, local counties, communities, and regional agencies to address emergency response and preparedness. These include the Tennessee

Department of Environment and Conservation, the City of Oak Ridge and Roane County fire departments, emergency medical services, and first responders.

ORNL has recently completed the following actions:

- Replaced the existing internal notification system with Laboratory Shift Superintendent Alerts (LSS-Alerts), an improved notification system for advising staff of local emergencies, traffic and road conditions, inclement weather, protective actions and security situations, and other important information about the ORNL area.
- LSS is deploying a new computer desktop alert system for protective actions such as shelter in place, evacuate and take cover. The system will also be used for the drills associated with these alert actions.
- Instituted a more formalized system of identifying priority areas for snow removal.
- Reviewed the impact of regional events that have occurred, such as the Gatlinburg, Tennessee, wildfires in 2016 and how to mitigate the risk of a similar event happening in the ORNL area.



Removal of debris from creeks and streams can help control flooding.



Improved notification system at ORNL helps minimize the impact of winter conditions.

SUSTAINABLE CAMPUS INITIATIVE

Earth Day Seminar

Sponsored by Sustainable Campus Initiative

The Gatlinburg Firestorm— Can it Happen Here?

Wednesday
April 19
10:00 a.m.

Wigner Auditorium
(Building 4500N, Room 250)

Bruce Miller

Greg Byrd

OAK RIDGE
National Laboratory

SCI sponsored a seminar on the Gatlinburg, Tennessee, wildfires of 2016.

GREENHOUSE GAS MANAGEMENT

Even before DOE established GHG emission goals, ORNL compiled a GHG inventory reduction and management plan. For Scope 1 (direct emissions), Scope 2 (indirect emissions from purchased electricity), and Scope 3 (all other indirect emissions such as those from employee commutes and transmission and distribution [T&D] losses), ORNL has evaluated GHG inventories annually and used this data to quantify improvements of projects designed to meet or exceed federal GHG reduction targets.

Recent improvements in steam plant efficiency, in collaboration with Johnson Controls, Inc. (see Sustainable Buildings), are excellent examples of this commitment to reducing GHG emissions. As a result of the more efficient process at the steam plant, the use of natural gas and the resulting GHG emissions have declined significantly. This and other efforts helped to exceed DOE's incremental Scope 1 reduction target of 22% below the FY 2008 baseline by

2016, with Scope 1 GHG emissions down 35%. As a result, Scope 1 reductions are on target for meeting the DOE goal.

Reduction of Scope 2 and Scope 3 emissions at ORNL has proven more challenging because of the limited control over operations at our high energy mission specific facilities (HEMSF). In FY 2016, for example, it was estimated that HEMSF operations consumed 71% of ORNL's electrical energy and 50% of its water use. However, DOE acknowledges that HEMSFs at national laboratories are crucial for R&D since they enable strides toward our energy independence and national security. Overall, in FY 2016, Scope 2 emissions increased 10% from the FY 2008 baseline once renewable energy credits were purchased.

While great strides were made in reducing business travel and commute-related GHG emissions, Scope 3 emissions still increased by 1% compared with the FY 2008 baseline because of increased T&D losses tied to electricity purchased for HEMSF activities.

GOAL SETTING WITH OUR POWER PROVIDERS

Since ORNL is dependent upon our power provider, the Tennessee Valley Authority (TVA), to reduce GHG emissions from purchased electricity and the related T&D losses (Scope 3), the two entities established mutually beneficial goals for clean power production and upgrades to the T&D infrastructure. The Debban-Bruce Bethel Valley substation, commissioned on-site in 2015, helps reduce T&D losses and improve the reliability of medium-voltage distribution. ORNL continues to be proactive and influential in decisions that will result in improved operations, such as including TVA as a member of our solutions team for Scope 2 GHG reductions and working with the agency to influence lower carbon content in transmitted electricity in our region.

AVOIDING TRAVEL EMISSIONS THROUGH TECHNOLOGY

SCI supports other projects aimed at employee engagement that will result in lower indirect GHG emissions. Initiative targets, described subsequently, are designed to reduce business travel whenever possible, making for more efficient use of employee time, as well as saving organizational costs and avoiding GHG emissions.

Alternative Commuting Options. ORNL continues its partnership with SmartTrips™, a program of the Knoxville Transportation Planning Organization. As a result of the outreach and promotional efforts, over 90 ORNL employees



Herb Debban and Charles Bruce at substation dedication.

currently use SmartTrips™ to log their environmentally friendly commuting practices. ORNL continues to promote sustainable employee commuting practices. Examples include the provision of solar-assisted electric charging parking spots available for employee vehicles as well as ORNL fleet PEVs and preferred parking spaces for registered employee carpools. Thirteen carpools that involve three or more riders were registered in FY 2016.

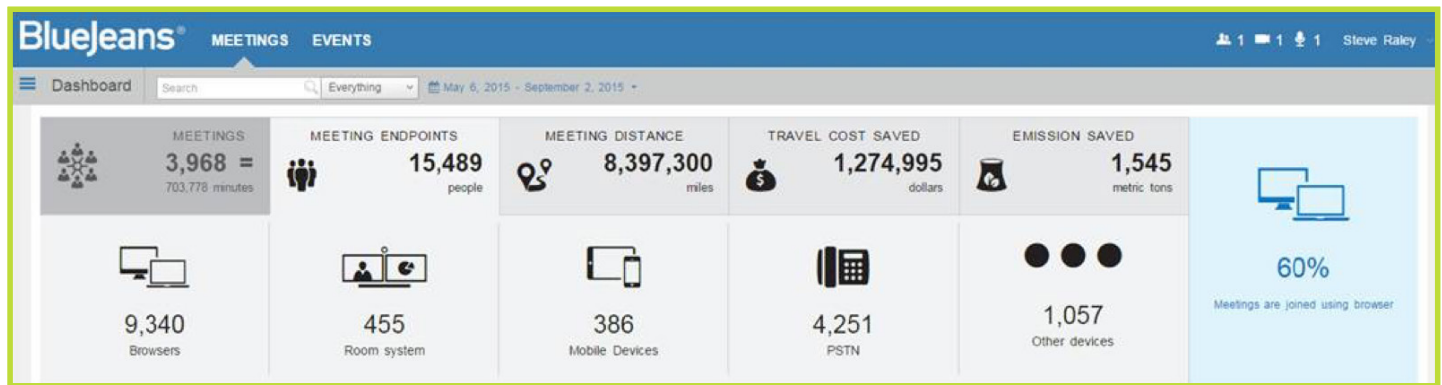
Alternative Work Schedules. Human Resources reported that 135 employees were on compressed work week schedules:

- 69 work a 9/80 shift (80 hours in 9 working days as opposed to the typical 10 days)
- 34 work a 4/10 shift (four 10-hour days each week as opposed to the typical five 8-hour day week)
- 32 work under formal telework agreements (working one or more days from home each week).

Business Travel. ORNL has experienced a reduction in business air and ground travel because of better awareness of the benefits of reduced travel and improved teleconferencing tools. ORNL continues to emphasize the benefits of conservative conference

travel, environmentally friendly practices such as carpooling or taking public transportation while on business travel, and the added benefits of the use of teleconferencing tools whenever practical. Implementation of the Blue Jeans videoconferencing system has proven effective in managing business travel. Results data from 12 months of operation reflected 16,066 teleconference meetings were held involving 65,299 participants, resulting in the avoidance of the financial and environmental costs of traditional business travel.

Regional Clean Power. For additional GHG Scope 1 and 2 reductions needed to meet EO 13693 mandates, ORNL is interested in using energy from a small modular reactor (SMR) technologies that could be built by TVA with prospective financial support (possibly clean energy certificates) provided by DOE, DOE-ORO, and/or ORNL. TVA has submitted its Early Site Permit Application to the Nuclear Regulatory Commission to assess the potential for construction and operation of SMR units at its Clinch River site near Oak Ridge (TVA 2016). Such SMRs would result in cleaner power production for the entire region.



Cloud Technology Saves Fuel for Business Travel

After a pilot period ORNL offered the videoconference service Blue Jeans to all ORNL users on a 24/7 basis. Use of the cloud-based video service has grown tremendously and is returning great value in the form of expanded collaboration opportunities, avoided travel expense, and reduced Scope 3 GHG emissions through avoided travel. In the first nine months of operation, a total of 3,977 meetings were held involving more than a half million participant minutes, 504 cities, and 28 countries, all while avoiding the financial and environmental costs of traditional business travel.

SAFETY, HEALTH, AND WELLNESS

NEW BLOOD PRESSURE MACHINES

An ongoing partnership between SCI and the ORNL Wellness Program resulted in a total of eight blood pressure machines being distributed across campus to help employees keep a close check on their blood pressure. According to the American Heart Association, blood pressure is known as the “silent killer” because most of the time high blood pressure has no obvious symptoms to indicate something is wrong.

The blood pressure machines are strategically located in eight buildings across campus as well as external building locations. The blood pressure machines have proven to be very popular among ORNL staff, allowing them to be mindful of their health during the work day.



Employees take turns reading their blood pressure with the new self-service machine recently installed at Building 2040.

SUSTAINABLE LANDSCAPING/LAND USE

Ecological landscaping at ORNL is done with using sustainable practices to improve habitat, protect water quality, minimize erosion, and enhance native wildlife. Use of local plant species highlights the lab’s uniqueness, strengthens its role in the natural surroundings, and demonstrates staff dedication to conserving and showcasing the environment. An integrated pest management program controls potential infestations of insects, rodents, fungi, and invasive plant species.

Over the years, ORNL staff have greatly reduced mowed turf areas by incorporating native plant beds, planting fields of native grasses, and allowing the beauty of the surrounding Oak Ridge Reservation to provide a natural backdrop to the campus. Minimizing turf reduces the need for frequent mowing and maintenance, thus reducing fuel consumption, pollution, and emissions associated with mowing.

Staff have incorporated education and awareness into the use of native landscaping by placing name tags near plants to help guests and other laboratory staff identify regional vegetation. Educational signs

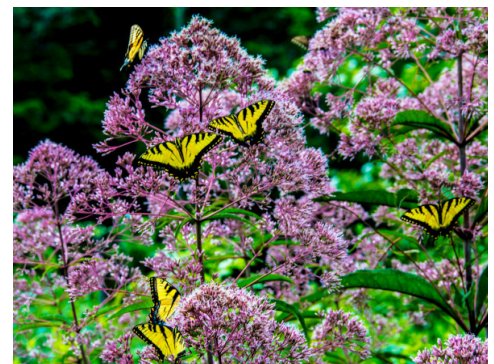


Onsite signage—ORNL’s landscape master plan.

around campus explain the benefits of sustainable landscaping with native species.

Projects completed by ORNL staff in 2016:

- Removal of 74 ash trees with Emerald Ash Borer infestation to avoid safety hazards.
- Implementation of bird exclusion practices using mesh netting and sheet metal.
- Removal of invasive plants along portions of White Oak Creek and First Creek.
- Inspection of newly purchased landscaping plants for fire ants.



Onsite pollinator plants.

COMMUNITY ENGAGEMENT

EARTH DAYS AT ORNL

ORNL's highly anticipated annual Earth Day event is designed to engage the ORNL community and involves a series of activities meant to spread awareness and trigger further reflection on environmental protection and sustainability.

Activities at Earth Day 2016, "The Science of Earth Day," included a tour of the Additive Manufacturing Integrated Energy demonstration project (www.ornl.gov/amie), where a natural-gas-powered

hybrid EV was on display; multiple seminars; an organized bike ride and 5K run/walk; and the opportunity to view displays and speak with representatives of various SCI projects. At Earth Day 2017, "Seeds of Progress," the Tennessee Wildlife Resources Agency gave out more than 400 tree seedlings, and local master gardeners were on hand to answer questions. A planting and recycling relay also helped promote awareness.

Monday, April 18:
Seminar: *Butterfly Gardens and Pollinator Habitats: on campus and in your own yard.*
Jamie Herold, ORNL Plant Ecologist and SCI Landscaping and Land Use Roadmap Owner
10:30 AM, JICS Auditorium, 5100

Thursday, April 21:
Seminar: *Climate Change in This Region: What It Looks Like Now, and What It Will Look Like in the Future*
Dr. Jack D. Fellows
10:30-11:30 a.m.
JICS Auditorium (Building 5100, Room 428)

Monday, April 18:
11:00 AM to 1:00 PM
Tours located on or near the Quad:
• Additive Manufacturing Integrated Energy (AMIE) Demonstration project and plug-in electric vehicle
• Science Trailers
– EESD Research Trailer
– Joint Facilities & Operations/Environmental Safety & Health "Supporting Research" Trailer
– PSD Research Trailer
• Electric Vehicles from ORNL's Fleet

Thursday, April 21:
Seminar: *Climate Change: What does it look like now, and what will it look like in the future.*
Dr. Jack Fellows, Director, ORNL's Climate Change Science Institute
10:30 AM, JICS Auditorium, 5100

Friday, April 22:
Get Out and Move: Health and Wellness Program
3k, 5k, 10k Run/Walk
Meet at 11:00 AM, Quad

Wednesday, April 19:
Seminar: *The Gatlinburg Firestorm – Can it happen here?*
Bruce Miller, Tennessee Division of Forestry
Greg Byrd, Forest Stewardship and Wildland Fire Management Programs
ORNL's Natural Resources Program
10:00 AM, Wigner Auditorium, 4500N

ORNL – Earth Day: The Seeds of Progress Main Event 11:00 AM to 1:00 PM
Relay Competition Schedule: 11:20 AM to 12:20 PM (First 12 teams to register by April 12 are in)
-Planting for Pollinators Relay: Know Your Seeds (4 person/12 teams needed)
-Recycle Relay: Know Your Trash (4 person/12 teams needed)

Earth Day: The Seeds of Progress – Representatives and Displays:
Come Ask the Experts
Sustainable Campus Initiative partnering with:
• Pollution Prevention Program – Recycling (e.g., old cell phones, eye glasses, aluminum can tabs, and new this year, old/expired prescription drugs)
• Health and Wellness
• Green IT – Thermocopy
• Energy Management
– Stokes Lighting
– Johnstone Supply
– TVA
• Sustainable Transportation
– Tommy's Motorsports
– Oak Ridge Bicycle Center
• Landscaping Committee
– Beckkeepers
– ORNL Natural Resources/TWRA
– Tennessee Extension Master Gardener Program
– Tennessee Division of Forestry
• Smart Trips
• Taher Fresh Seasons Café
• Staples

Friday, April 21:
Get Out and Move: Health and Wellness Program
3k, 5k, 10k Run/Walk and Bike Ride
Meet at 11:00AM, Quad (between Bldgs 5200 and 5700)
**Will be rescheduled if weather does not cooperate*

COMING IN JUNE 2016:
ORNL's First Sustainability Scavenger Hunt.
Get a team together or work individually for the scavenger hunt scheduled for June 2016.

Staff dress the part for competing in the planting relay.



Earth days at ORNL are filled with interactive seminars, exhibits, and activities that educate and engage visitors interested in a better understanding of sustainability best practices for work, home, and community.

RECOGNIZING SUSTAINABILITY EFFORTS

Many ORNL employees go above and beyond the call of duty when it comes to sustainability, and SCI is committed to recognizing these efforts that might otherwise go unnoticed. One way

of acknowledging employees is through the “ORNL Sustainability Champion” Award, presented annually during Earth Day events.



Kathye Settles received the 2016 ORNL Sustainability Champion award for her exemplary contributions and dedicated support to SCI’s Sustainable Vehicle Fleet—2008-2016 (Award presented by Teresa Nichols and Melissa Lapsa).



Bryce Hudey was awarded the 2017 Sustainability Champion for exemplary leadership with ORNL’s first “Battle of the Buildings” Challenge. Bryce is congratulated by his manager, Ann Weaver.

SUSTAINABLE PHILANTHROPY

SCI supported ORNL's contributions to the Keep Anderson County Beautiful campaign by collecting shoes at the 2016 Earth Day event. This event served as one of several drop-off locations across campus where staff could leave donations. Shoes collected were

available not only for those in need or for recycling but also were kept out of landfills. More than 450 pairs of shoes were collected throughout the entire campaign.

EDUCATIONAL OUTREACH

Just as we have benefited from lessons learned at other campuses, ORNL is well positioned to share its own success stories with universities facing similar sustainability challenges. For example, the SCI team provided posters with project highlights to Southern University, New Orleans, and the Ohio State University for their Earth Day event and Sustainability Fair, respectively.

SCI colead Melissa Lapsa has provided an SCI overview presentation to students, faculty, and staff at nearby Pellissippi State Community College.



ORNL's SCI poster sent to Earth Day/Sustainability Festivals held in 2017 at PSCC, Knoxville, TN and Ohio State University, Columbus, OH

AWARDS

Sustainability efforts and achievements are recognized through numerous awards from a variety of industry organizations as well as DOE. These awards span the numerous facets of SCI, from

strides in clean transportation to data center efficiency, demonstrating the widespread participation required for lab-wide sustainability success.

EXTERNAL AWARDS

From FY 2014 to 2017, ORNL teams received a series of awards recognizing progress toward laboratory sustainability.

ORNL was awarded “East Tennessee Clean Fuels Coalition’s Volunteer Leadership–Davy Crockett Award” for leadership in alternative fuel use in the Southeast and among national labs. The award was presented as part of the coalition’s special 10th anniversary celebration.

Pictured from left to right are Jonathan Overly, executive director of the East Tennessee Clean Fuels Coalition, ORNL’s Scott Curran, who accepted the award, and “Davy Crockett.”



The Tennessee Department of Environment and Conservation (TDEC) awarded ORNL the Sustainable Transportation Award for its work on the Electric Vehicle Project. Pictured from left to right are Deputy TDEC Commissioner Shari Meghreblian, TDEC Commissioner Bob Martineau, SCI colead Teresa Nichols, and Tennessee Department of Transportation Assistant Commissioner Toks Omishakin. [Photo provided by TDEC.]



DOE AWARDS

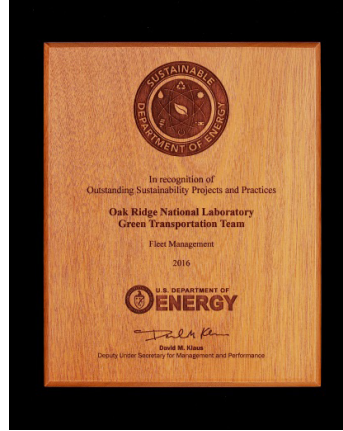
SCI colead Melissa Lapsa was named DOE’s 2014 Sustainability Champion Award winner. Lapsa won the prestigious award for her success in establishing ORNL’s Sustainable Campus Initiative in 2008 and developing it into 25 core teams from across the laboratory.

ORNL was recognized by DOE’s Office of Energy Efficiency and Renewable Energy for supporting the development of the national PEV charging infrastructure and meeting the voluntary requirements of the Workplace Charging Challenge in December 2015. The challenge was launched by DOE in 2013 with the goal of having 500 US employers commit to installing workplace PEV charging stations and joining the challenge by 2018. ORNL was one of the fewer than 30% of all Workplace Charging Challenge partners to receive this “Leading the Charge” recognition.



ORNL was the recipient of two 2016 DOE Sustainability Awards:

- Green IT Team: Among the team’s achievements is a 1.28 portfolio average PUE rating for ORNL’s data centers in FY 2015, which is well below the DOE goal of less than 1.5 PUE for existing centers. The award also cites gains in supercomputing energy efficiency: Titan performs calculations 10 times faster than its predecessor, Jaguar, but uses only 20% more energy. Furthermore, Titan’s replacement, Summit, will be at least six times more efficient than Titan while maintaining a similar carbon footprint.
- Green Transportation Team: The team’s efforts and commitment to sustainability are essential to ensuring DOE is a government-wide leader in sustainability. ORNL has realized significant results and achievements because of its commitment to and implementation of short-term and long-term fleet management efforts. ORNL alternative fuel use increased by 227% in FY 2015 compared with the 2005 baseline, exceeding the 160% cumulative target. Fleet petroleum consumption decreased by 57% in FY 2015 compared with the 2005 baseline, exceeding DOE’s 20% decrease target. Additionally, 100% of ORNL’s 2015 LDV purchases were AFVs, exceeding the 75% target.
- In 2017, ORNL Fleet received the *“Honorable Mention”* for *100 Best Fleets in the Americas*.



Fleet Management



GreenIT



Fleet Honorable Mention



SCI Team

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