

ANNUAL SUSTAINABILITY REPORT 2019



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Oak Ridge National Laboratory Annual Sustainability Report

Sustainable ORNL Program

April, 2019

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MESSAGE FROM THE DIRECTOR

Our mission at Oak Ridge National Laboratory (ORNL) is to deliver scientific discoveries and technical innovations needed to realize solutions in energy and national security and provide economic benefit to the nation. As a U.S. Department of Energy national laboratory, we conduct research and development (R&D) to support the Department in meeting America's energy, environmental, and nuclear security challenges. We are also committed to leadership in the efficiency and effectiveness of ORNL operations as a means of maximizing the impact of the nation's investment in our work.

The Sustainable ORNL program helps us to bring the outcomes of our energy-related R&D to bear on our commitment to responsible stewardship of the resources entrusted to us. By building partnerships between our R&D staff and our mission support organizations, this employee-driven program identifies opportunities to optimize energy and environmental performance, reduce waste, and cut costs. Since its initiation in 2008 as the Sustainable Campus Initiative, Sustainable ORNL has contributed to the development and efficient operation of a 21st century R&D campus supported by modern infrastructure that now includes 20 high-performance sustainable buildings, more than 300 flexible-fuel vehicles, award-winning computational facilities, and a state-of-art LEED certified guest house.

In 2018, projects initiated through Sustainable ORNL resulted in more than \$400,000 in energy and water savings, an accomplishment recognized with a 2018 Federal Energy and Water Management Award. The program's work was also the basis for a 2018 Government Green Fleet Award and the 2018 Tennessee Chamber of Commerce and Industry's Energy Excellence Award. Another 2018 project, an inventory of trees species on the ORNL campus, provides data for use in studies of the economic and environmental benefits of urban trees and will support the creation of a self-guided campus tree tour.

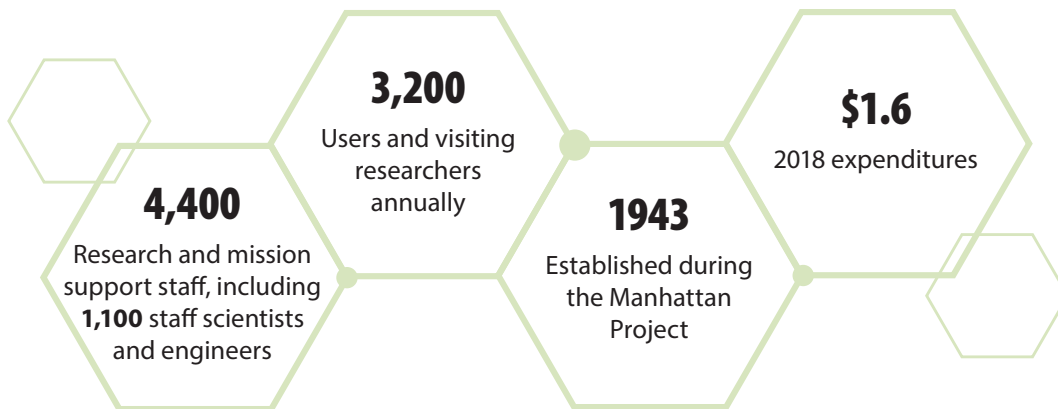
With its focus on integrating sustainability into our facilities, operations, and organizational culture, the Sustainable ORNL program is a valuable asset as we continue working to reduce our emissions, lower our operating costs, enhance the resilience of our facilities, and identify opportunities for improvement that will move us toward our goal of making ORNL the world's premier research organization. I extend my appreciation to everyone who contributed to the achievements documented in this report, and I look forward to new accomplishments as we go forward.

Thomas Zacharia

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



Today, ORNL is a leading science and energy laboratory



THIS REPORT

What is Sustainability Reporting?

A **sustainability report** is an annual document published by a company or organization about the **economic, environmental, and social impacts** that result from its everyday activities. A sustainability report also presents the organization's values and governance model, and demonstrates the link between its strategy and its commitment to a sustainable economy. Sustainability reporting enables organizations to consider their impacts of wide range of sustainability issues, enabling them to be more transparent about the risks and opportunities they face.



COMMITMENT TO SUSTAINABLE OPERATIONS

ORNL is a US Department of Energy (DOE) research facility operation, established and sustained to deliver the scientific discoveries and technological innovations needed to realize solutions in energy and national security. Established in 1943 during World War II as part of the Manhattan Project, ORNL is the largest DOE science laboratory. In 2017 we marked 75 years of continuous operations for ORNL, consisting of facilities with commissioning dates ranging from the 1940s to 2018. Located near Oak Ridge, Tennessee, ORNL occupies more than 4,400 acres of the 34,000 acre Oak Ridge Reservation (ORR). Each work day approximately 6,500 people access the laboratory to conduct research and associated activities. To support its research and development (R&D) missions, ORNL provides a wide variety of on-site services, including operation and maintenance of all ancillary utilities and infrastructure, 24/7 security, dedicated fire and emergency response, medical facilities, unique fabrication and assembly services, and other support functions.

ORNL is tasked with the management of an extraordinary set of distinctive scientific facilities and research 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 missions in energy, environment, and national security. These capabilities, each of which requires world-class equipment and operational support, reflect a combination of exceptional people, equipment, and facilities. Synergies among these core capabilities enable scientific discovery and translational research to accelerate the delivery of technology solutions and allow ORNL to respond to changing priorities and the critical needs of the nation. Among these, the Spallation Neutron Source and High Flux Isotope Reactor offer unique capabilities for understanding the structure and dynamics of materials, and robust plans for upgrades will ensure sustained US leadership in the field. The Oak Ridge Leadership Computing Facility hosts forefront computational resources, including the new Summit system (2018 deployment), and advanced data infrastructure. Other user facilities, such as the Manufacturing Demonstration Facility, provide tools for developing and testing new technologies in collaboration with industrial partnerships.

ORNL's vast portfolio of research facilities must be maintained, and carefully upgraded, in order to protect the national investment in scientific analysis. **The goal of sustainable operations is to enable more effective execution of ORNL's science and technology mission while remaining dedicated to the health of our local economy and our people.** Sustainable operational practices strive for enhanced results; at the same time we are diligent to the ideals of energy and environmental stewardship.

ORNL is **HOME** in Anderson and Roane Counties. Our sustainable operations model demonstrates the firm commitment to environmental stewardship while placing our values on the well-being of the economy and our communities.

Residents earned
\$161 million
in ORNL wages.

More than
1/3 of ORNL's
4,400
employees
live here.

Residents
received more than
\$47 million
in ORNL pension
payments.

Businesses received
\$166 million
from ORNL for goods
and services.

The City of Oak Ridge
and Roane County received
\$2.3 million
in property taxes
from UT-Battelle, their
largest taxpayer.

ORNL's Impact on the Local Economy and Our Communities

In addition to our **HOME** in Anderson and Roane Counties, ORNL's commitment to sustainability has a **LASTING IMPACT** on all of East Tennessee.



Workforce and Higher Education

ORNL supports Roane State Community College's Middle College program that allows high school students to earn their associate's degrees by taking college classes in their junior and senior years.



Mentorship

ORNL staff engage with local students to promote awareness of STEM-related career opportunities through programs such as FIRST Robotics, Lego League, and STEM Mentoring Cafés.



Economic and Industry Partnerships

Four companies, including Oak Ridge's LeMond Composites, are collaborating with ORNL to explore large-scale commercialization of new carbon fiber technology.



Science Education

The ORNL Traveling Science Fair delivers science year-round through mobile interactive exhibits at local and regional school districts and community events including the Secret City Festival.



Volunteer Spirit

ORNL encourages employees to join together through Team UT-Battelle to support the community interests that they value most. A Matching Gifts Fund is available to complement the financial generosity of employees.



Community Stewardship

ORNL has contributed more than \$8 million to Oak Ridge organizations since 2000, including a \$2 million renovation of Oak Ridge High School.

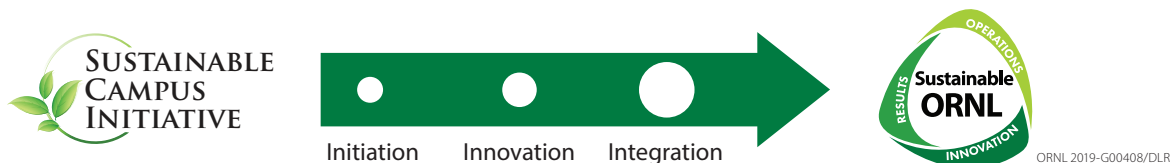
ORNL Traveling Science Fair hits the road for a lasting impact on education.

THE SUSTAINABLE ORNL PROGRAM

The beginning of 2018 marked a significant transition for energy and water management at ORNL. Originally, the ORNL Sustainable Campus Initiative (SCI) was formally chartered in 2008 during a time when federal governance in efficient and sustainable operations was moving to the forefront in facilities management. ORNL leadership considered the SCI charter to be a logical extension of the remarkable national laboratory transformation that launched in the very first year of the twenty-first century.

Beginning in 2000, through a creative mix of facility development funding, construction, and renovation, ORNL's World War II-era infrastructure became home to state-of-the-art facilities hosting major new research programs in areas such as high-performance computing (HPC). Advanced building technologies—many developed, tested, and proven at ORNL—were incorporated into new construction and renovation to further advance the laboratory's goal of efficient, sustainable operations.

It was recognized that continuous improvements in operational and business processes must be integrated into the fabric of the ORNL culture to maximize the return from the investment made in modernizing facilities and equipment. For 10 years, SCI played a critical role in the advancement of innovations in sustainable and efficient facility operations. In 2018 we recognized that SCI had indeed been successful in utilizing innovation in equipment and processes to advance resource efficiencies and that an integrated, Sustainable ORNL had evolved as envisioned.



Development of the Project Roadmap concept was a key to the success of SCI, so as we evolved to the Sustainable ORNL program the roadmap structure was streamlined (reduced from 25 to 12 vital projects). The new design indicates how each project contributes to the well-being of the whole. Continuous engagements with ORNL associates and regular status reports to the ORNL Leadership Team are still a measure of the success of the program. Cosponsorship of Sustainable ORNL is championed by Moe Khaleel, Associate Laboratory Director for Energy and Environmental Sciences and Jimmy Stone, Director of Facilities and Operations (F&O).

Sustainable ORNL Roadmaps



Project Highlight: Sustainable ORNL Transition

The transition to an integrated Sustainable ORNL program is accomplished through announcements, promotions, and numerous activities, including the following:

- Article submissions to ORNL Today, a web-based newsletter
- Article submissions to the DOE Sustainability SPOTlight Newsletter
- Posting of public relations information on SCALA screens throughout the campus
- Launch and promotion of a new web site (<http://www.ornl.gov/sustainable-ornl>)
- Quarterly workshops with Sustainable ORNL Roadmap owners
- Quarterly updates to the ORNL Leadership Team
- Planning and delivery of the annual ORNL Earth Day Campaign
- Manage and promote the ORNL Electric Vehicle (EV) Owners Club (for use of EV charging stations)
- Manage and promote bus service between the University of Tennessee (UT), Knoxville; Pellissippi State Community College (PSCC), and the ORNL main campus
- **Sustainable ORNL is uniquely positioned to bridge research capabilities with the commitment to sustainable operations, now and in the future.**



Jimmy Stone,
Director for Facilities and
Operations Directorate
Cosponsor of Sustainable ORNL

"The Sustainable ORNL team developed a pilot project with the University of Tennessee Knoxville and Pellissippi State Community College to help students working at ORNL get from UT to PSCC to ORNL and back each day. The pilot was a huge success and now runs year round with a 30-passenger bus moving on average 45 riders everyday (more than 9,000 riders last year)! This bus is extremely helpful during the summer time when we have an influx of students and not an influx of parking spaces!"

Bus Schedule	
From UT to PSCC to ORNL	
Starting August 22, 2018–May 7, 2019	
ARRIVAL	DEPARTURE
UT Cumberland Avenue at James Agee Street	
—	6:54 a.m.
—	12:00 p.m.
—	3:44 p.m.
8:51 a.m.	—
1:52 p.m.	—
5:36 p.m.	—
PSCC Clayton Performing Arts Center	
7:14 a.m.	7:19 a.m.
*8:26 a.m.	*8:31 a.m.
12:20 p.m.	12:25 p.m.
*1:27 p.m.	*1:32 p.m.
4:04 p.m.	4:09 p.m.
*5:11 p.m.	*5:16 p.m.
ORNL Visitor's Center	
7:50 a.m.	*8:00 a.m.
12:56 p.m.	*1:01 p.m.
4:40 p.m.	*4:45 p.m.
Service available every Monday through Friday exceptions on back	
(* Return to UT Campus)	

BUS STOP LOCATIONS
<ul style="list-style-type: none"> • UT Main Campus: Westbound Cumberland Ave at James Agee St. Proper ID required for all passengers. • Pellissippi State Community College: Clayton Performing Arts Center • ORNL: Visitor's Center.
Valid ORNL ID badges required for all trips to ORNL—no exceptions
ORNL Onsite Taxi Service Number 865-680-2303 or 865-680-9800
NO SERVICE DATES (2018–2019)
<ul style="list-style-type: none"> • September 3 (Labor Day) • October 4–5 (Fall Break) • November 22–23 (Thanksgiving) • December 14, 2018–January 9, 2019 (Commencement/Holiday) • January 21 (MLK Holiday) • March 18–22 (Spring Break) • April 19 (ORNL Good Friday Holiday) • May 9 (Commencement/Summer Break)
ORNL Contact: Melissa Lapsa (576-8620)



Recent ORNL Sustainability Awards

- **2018 Federal Energy Management Program (FEMP) Federal Energy and Water Management Award for Outstanding Program**, "ORNL Sustainable Campus Initiative: From Initiation to Integration"
- **2018 Government Green Fleet Award**, recognized in 2017 and again in 2018 with improved standing
- **DOE Sustainability Honorable Mention for Outstanding Sustainability Program/Project Award**, "ORNL's HPC Summit Facility — Designed for Success"
- **Tennessee Chamber of Commerce & Industry Energy Excellence Award**, "ORNL's HPC Summit Facility— Designed for Success"
- **US Green Building Council LEED GOLD and LEED ARC certification for Building 5200, Research Support Center**. Awarded Impact Benchmarking Challenge 'Most Improved Water' category for USGBC, Tennessee.

The new Summit supercomputer is super in more ways than just processing speed, thanks to the help of some engineers from F&O's Modernization Project Office who participated on the design team. Summit's systems have the ability to utilize moderate water temperature (70°F.) for cooling. Normally, water for ORNL's supercomputers needs to be chilled to 45°F. This primary design feature resulted in savings of approximately \$3.7 million in construction costs by eliminating the need for a larger chilled water plant. Other construction capital was eliminated by innovations in electrical power configuration design for the servers resulting in an estimated \$500,000 in project savings.

And best of all, for long-term sustainable operations, Summit is designed to use medium temperature cooling water for long-term utility cost savings and improved energy efficiency. Water at temperatures of 64-70 oF is provided direct to each computer rack. Water returns at 85-100°F and is cooled by a tower water heat exchanger, and when needed, a chilled water exchanger in series. Bypass of chilled water exchange will be possible much of the year. This unique design will result in an estimated cost reduction of \$1million each year. Facility management is working with the HPC operations staff to optimize cooling system by tying computer run scheduler and computer diagnostic system to mechanical controls to further reduce operational cost. **Now that's SUPER!**

in



ORNL's high-performance Summit facility; Designed for success. 2018 DOE Outstanding Sustainability Program - Project, August 17, 2018. Left to right - Rick Griffin, Bart Hammontree, James Abston, David Grant, Bryce Hudey, Melissa Lapsa, James Rogers

ENERGY AND WATER USE EFFICIENCY

Energy Use Intensity (EUI) Reduction

To maintain steady progress toward EUI reductions, ORNL focuses on energy-efficient and sustainable design in new construction projects, smart repurposing of existing facilities, and a drive for continuous improvement in facility and utility operations. ORNL continues to modernize by demolishing old, unsafe, and inefficient buildings to make way for the construction of new, high-performance buildings that better serve the ORNL mission.

EUI reduction in existing ORNL facilities is data-driven, and we endeavor to quantify and bring awareness to building energy performance so that operations staff can make informed decisions. Initiatives in 2018 included new approaches to energy consumption awareness using data visualization and reporting. Building data analytics, including fault detection and diagnostics, are also being added to ORNL's energy conservation tools. To bolster this effort, we have elected to participate in the DOE Better Buildings Smart Energy Analytics Campaign. New and innovative methods were accompanied by time-tested approaches to energy conservation, including LED lighting upgrades, existing building commissioning, and HVAC control system improvements.

Steam System improvements include steam trap repairs and replacement and commissioning of a new deaerator. We have installed additional steam flow metering for better monitoring of how the steam is distributed throughout the laboratory and to help identify future energy projections and new facility locations. A new natural gas boiler was installed for direct heating to reduce distribution losses.

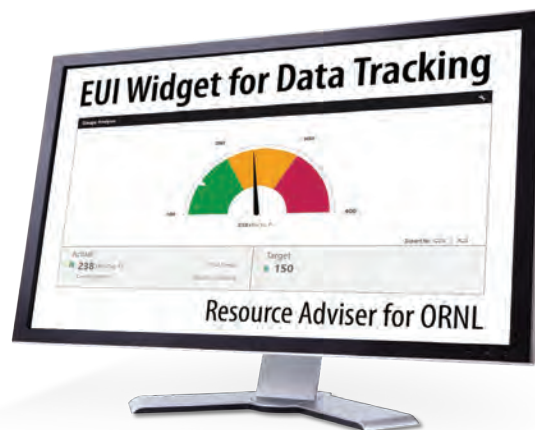
Chilled Water System improvements include initial operations of the Medium Temperature Water System for select High Performance Computing processes, utilizing more cooling tower exchange than chiller operations for energy savings. Other improvements include new chiller control panels for improved reliability and continuous flow of chemical treatment as well as heat tracing and insulation upgrades.

Electrical Distribution System upgrades included installation of additional switchgear to optimize existing loads and to allow improved capacity as ORNL expands its mission. Intelligent reclosers were installed for better power conditioning. More efficient transformers were installed. In addition to being more efficient, they improve reliability and reduce maintenance.

Life-Cycle Cost Analysis at ORNL utilizes building, system, and equipment data, engineering principles, and personnel expertise to perform multiple analyses and validate efficiency measures. We strive for consistency in life cycle cost analysis calculations, procedures, and methods to manage the wide range of projects throughout the campus. In 2018, ORNL began utilizing a project planning and tracking tool that includes steps to measure and validate efficiency conservation measures and utilizes a custom designed project life-cycle dashboard.

Improvement in Energy Metering and Analysis

As the key to the measure-to-manage philosophy, ORNL has developed the Central Energy Data System (CEDs) which currently comprises more than 800 smart meters and devices. These utility meters collect data on electric power, water, natural gas, steam, chilled water, and electric vehicle charging stations; then reports energy consumption utility data to the system. All new advanced meters are connected to ORNL's CEDs for data archiving and analysis. This system has the ability to log multiple parameters from each meter on a standard 15-minute interval. CEDs supports meter data trend analysis, report generation, energy awareness dashboard deployment, normalization for weather and other factors as well as data export for use in other analyses. An advanced meter data analysis module within CEDs called "Resource Advisor" is being designed and implemented for a variety of uses including automated utility cost distribution, Resource Advisor will be used to compile complex utility data, generate custom and ad hoc management reports, and push monthly energy data to EPA's ENERGY STAR Portfolio Manager for benchmarking analysis.



THE ENERGY EFFICIENCY & SUSTAINABILITY PROGRAM

EE\$P

WHERE SUSTAINABILITY MEANS SAVINGS

Amy Albaugh, EESP Engineer and Certified Energy Manager, is part of an ORNL team working with CEDS and Resource Advisor to further develop energy dashboards and other customized tools.



As CEDS and the Building Automations Systems continue to grow in size and operational significance, we are working to keep cyber security 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 ensures that our industrial controls systems functionality and data will be protected for years to come.

Meters at service entrances to ORNL are also used to validate service volumes for utility provider payments (electricity, natural gas, and water). This service-level meter system, along with building-level metering is used to distribute utility costs among programs at ORNL for cost recovery among research and operational divisions. CEDS performs energy/fuel/water tracking and trend analyses for reporting and can be used to identify problems and potential conservation opportunities.

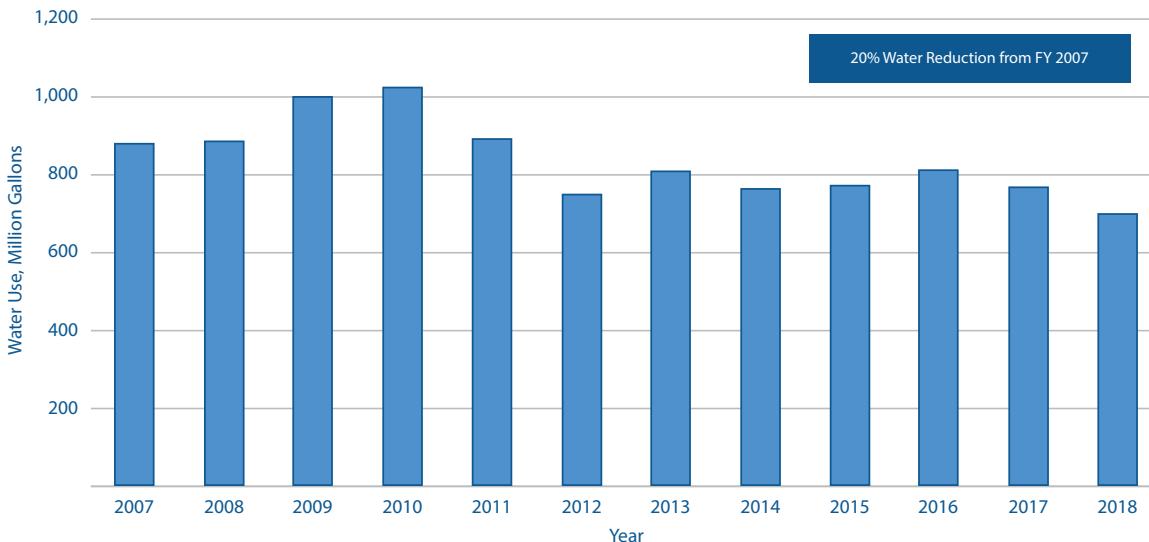


ORNL is using the robust network of building-level utility metering to establish a system for continuous energy monitoring using a meter alert capability in the CEDS system. **Alerts** are placed on real-time mechanical utility meters including steam, chilled water, natural gas, and potable water for all buildings that have these mechanical meters in CEDS. Alert parameters are determined by reviewing meter trend history, analyzing as many months or years prior as possible to obtain an accurate representation of each building utility “base” or “normal” trend usage. Meter alerts result in **Actions** as they are sent out through email or text to the designated person responsible for investigating and, if needed, correcting the issue. Meter alert are custom designed to identify and prevent unnecessary waste. Some examples of successful utilization of these alerts include: preventing steam waste (e.g. a steam valve failing open or a pressure regulator valve failure) and water waste (a make-up water valve being left open to a chiller during maintenance, or the float for a tower sump periodically sticking and flooding the sump, leading to unnecessary water use).

Water Use Reduction

ORNL procures potable water from the City of Oak Ridge for domestic use (handwashing, flushing), cooling (cooling towers, chillers), heating (steam generation, hot water generation), limited landscape irrigation, laboratories, and special research processes. We have long been aware of the benefits of effective water management, having already established conservations measures that resulted in a 60% reduction in water use compared with the highest level of water use (experienced in 1985). A firmly established aggressive water management plan continues to be deployed. Numerous strategies are engaged to reduce water consumption including leak repair, replacing old lines in the site water distribution system, and eliminating once-through cooling where possible; resulting in a 20% reduction in annual total water use since 2007 as shown in the graph below. ORNL’s history of water use reductions shows our commitment to the sustainable practices of less resource waste and better economic stewardship.

ORNL's Water Consumption History



EXAMPLES of ACTIONS in Water Use Management

- Building on prior successes, the ORNL Utilities Division identified and repaired twelve significant leaks in the water distribution system in 2018. The project replaced over 230 feet of pipe sections, six valves/isolation points and five hydrants. Several leaks appeared to have been active for some time; underground and undiscovered until the project was underway!
- Research support in the Building 4508 was redesigned to utilize a closed-loop process cooling system, conserving more than 34 million gallons of water in 2018, the first year.



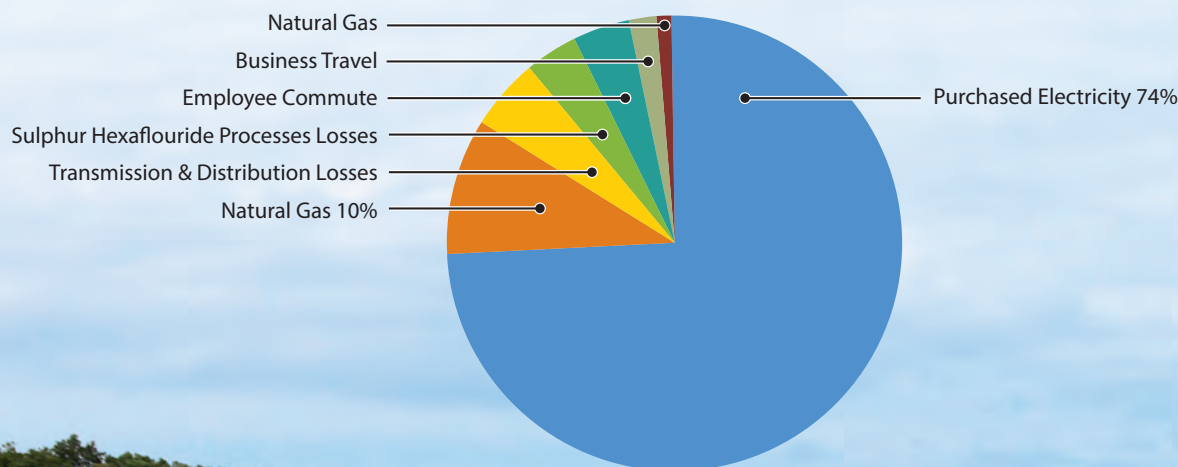
GREENHOUSE GAS MANAGEMENT

Well before the federal government established greenhouse gas (GHG) emission goals, ORNL had taken the proactive step of building a comprehensive GHG inventory and management reduction plan. Since 2008 ORNL has evaluated GHG inventories annually and our goal has been to support projects designed to meet or exceed federal GHG reduction targets.

The Johnson Controls project to improve steam plant efficiency is an excellent example of this commitment. As a result of the more efficient process, the use of **natural gas** and the resulting GHG emissions has declined by 28% over the past 10 years.

As with most national labs, the use of electricity to **power our research** has always been the major source of GHG emissions at ORNL. The operation of our mission-critical high-energy mission-specific facilities (such as the Spallation Neutron Source and the Summit Supercomputer) has required the increased purchase of electricity from our regional provider, Tennessee Valley Authority. As our mission has grown, so has the use of electricity to accomplish these commitments. We acknowledge the basic message of sustainability - our research continues to have a positive influence on national priorities such as domestic security and energy independence and has the potential to reach a breakthrough that could transform emissions associated with energy use.

ORNL 2018 GHG Emissions by Source



Building 4100 Solar Array

SUSTAINABLE BUILDINGS

Green Buildings: Guiding Principles

In 2018, ORNL's high performance sustainable building (HPSB) inventory included a total of 20 buildings that are certified as having attained 100% of the HPSB Guiding Principles (GPs). This represents 15% of the total applicable site buildings according to the Guiding Principles for Federal Leadership in Sustainable Buildings. ORNL is one of the few federal sites to have reached the GP target (15% by building count) for DOE Green Buildings, 100% GP attainment. Achieving HPSB status is only the beginning of an ongoing cycle of "plan, do, check, act" energy policy designed for continuous improvement. Advanced metering and building automation system data are leveraged to monitor ongoing performance. ORNL will focus on leveraging energy data and performance analytics whenever possible to make progress towards fulfilling GPs.



One of the ways that ORNL achieved HPSB success was through our long association with the US Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) certification program.

Project Highlight: Building 5200 LEED GOLD, LEED ARC

In 2018 ORNL achieved USGBC LEED GOLD certification for Building 5200, Research Support Center. During that process we won an Impact Benchmarking Challenge Award for our first completed LEED ARC project. The recognition was for Most Improved Water category for USGBC Tennessee.

What is LEED ARC?

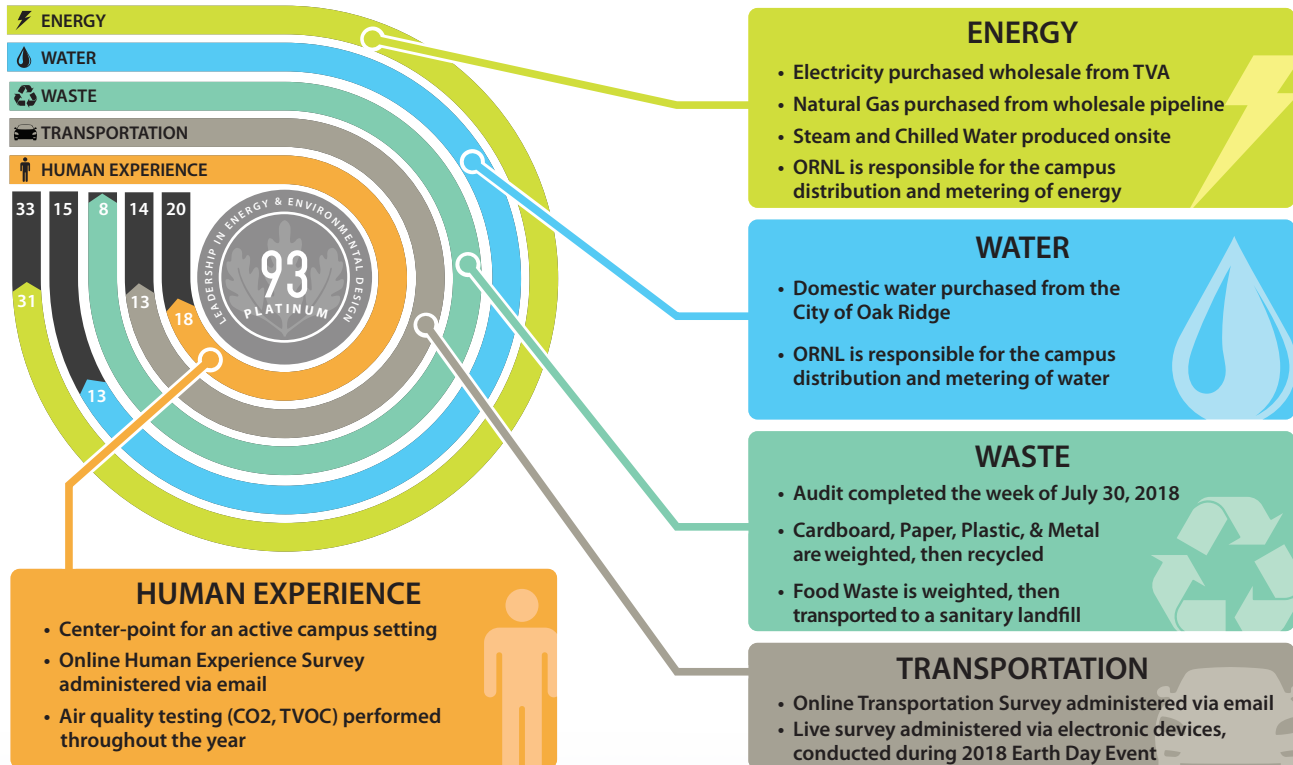
ARC is a complement to LEED and other green building systems, standards and protocols that allows buildings and spaces to connect to the built environment in a new way by comparing performance metrics and connecting them to green building strategies.



As a digital platform for performance data, ARC uses real-time data to help individual buildings, as well as cities and communities, measure, track, and improve sustainability performance. Established in 2016, ARC Skoru Inc.,[™] is the first program to track building progress using a performance metrics scoring system. The platform creates a holistic view of sustainability efforts and helps projects track and improve performance across energy, waste, water, transportation, and human experience with the goal of certifying them to LEED or other rating systems. ARC collects, manages and tracks activity in one place, allowing project teams to benchmark performance and compare progress against local, regional, and global averages. The ARC platform provides the means for greater transparency through quality data, so organizations can make more informed decisions.

LEED ARC Platform Scoring Display

ORNL has established a vast network of utility meters throughout the campus to measure how much of each utility is being consumed, usually from a building-level perspective. The data from each meter is sent, collected, and visually displayed by CEDS. The verified quality data is collected and then shared with Energy Star Portfolio Manager® for continuous benchmarking of LEED and HPSB buildings at ORNL. For Building 5200 benchmarking, Portfolio Manager® is connected to the ARC platform and is used to populate the monthly data input for the ARC project.



USGBC LEED ARC Platform scoring display, including scores in the following five categories: energy, water, waste, transportation, and human experience.

ORNL Research Support Center, Building 5200, an award-winning USGBC LEED Gold, LEED ARC green building.

Working Together for Sustainability

ORNL participates in the Bridge to Employment in Service and Tourism (B.E.S.T) program which provides internships for adults with disabilities and barriers to employment. This program gives these adult students on-the-job training through internships at various industries. Jimmy Stone pioneered the idea of bringing the B.E.S.T program to ORNL, and mentors from around the Lab quickly got on board. For creating these opportunities, Jimmy won the Equity Award from the City of Knoxville's Community Development Department, which honors those who mentor or employ people with disabilities. "Though I brought the idea forward, plenty of others embraced the concept with passion and commitment. It's been life-changing for the B.E.S.T students and their families," said Stone.

As part of the Building 5200 LEED ARC team, ORNL engaged the help of a B.E.S.T Intern to weigh all plastic and aluminum recyclable material collected from the building for an entire year. The work of the intern was key to the collection of quality data for waste and recyclables, which was then analyzed and reported for the LEED certification documentation.

The Building 5200 Certification is a perfect example of how our actions provide for a sustainable future

Protect the ENVIRONMENT

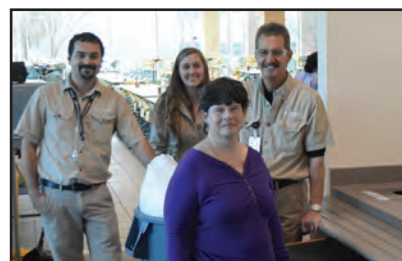
- Energy efficiency and sustainable operations were measured and recognized for the project
- Waste and recycling volumes were documented and recorded

Support the ECONOMY

- Doing things the right way, the sustainable way, provides more viable job creation for the long-run
- The ORNL Pollution Prevention Program performed waste audits, employing professional who make a difference

Provide for a better SOCIETY

- Receiving recognition, such as the Knoxville Community Development Equity Award, allows others to see our commitment to the community
- Specifically, the Building 5200 project was an synergistic way for ORNL to support the B.E.S.T program



RESEARCH IN BUILDING TECHNOLOGIES

Providing Uniquely ORNL Sustainable Solutions

ORNL's campus is home to the Building Technologies Research and Integration Center (BTRIC), the only DOE-designated National User Facility devoted to building technologies research and development. BTRIC is the nation's premier research center for the development of technologies that improve energy efficiency and environmental compatibility of buildings. The flagship of the BTRIC campus is the MAXLAB – Maximum Building Energy Efficiency Research Laboratory.

Buildings consume 40 % of the nation's energy and about 20% of this energy escapes through the building envelope, resulting in efficiency losses. BTRIC research focuses on reducing energy use and increasing grid balance and develops modeling, advanced materials, design and prefabrication techniques for building envelopes. Ongoing research leverages advanced materials and manufacturing for sensors and transactive controls; creates building energy modeling innovation using high-performance computing and big data; and reimagines thermodynamic processes for building equipment and natural gas-fired systems.

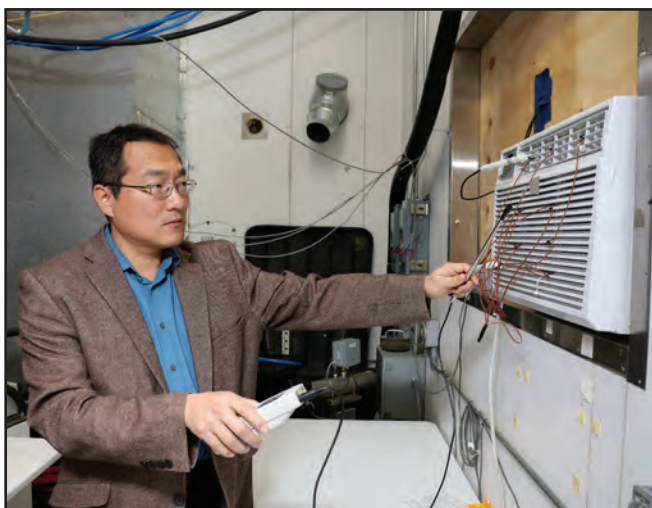
In addition, BTRIC research has developed several energy saving consumer tools such as the Roof Savings Calculator, a web-based tool for evaluating efficiency upgrades at the time of roof replacement, which easily integrates with roofing contractor quotation systems for industry-wide adoption; and the Building Science Advisor, a web-based expert system that puts into the hands of builders guidance on how to achieve highly energy-efficient, moisture-durable wall systems in any climate.

Key impacts from BTRIC research include: developing the world's most respected hygrothermal models for understanding the flow of heat, air and moisture through building envelope assemblies and moisture-durability thresholds; 3D-printing molds for the architectural precast concrete industry, enabling many more castings per mold, reducing production time; and creating spray-on water-based building envelope air sealant that is fast setting and four times faster to install than previous technologies.



Hygrothermal.
A term used to characterize the temperature (thermal) and moisture (hygro) conditions, particularly with respect to climate, both indoors and out.





In 2018, BTRIC researchers demonstrated and proved that modified atmosphere insulation, or MAI, could be a viable solution for improving the energy performance of buildings, providing higher performance than current commercially available insulations. BTRIC researchers also designed a window air conditioning unit that uses propane as the refrigerant cooling the air with a 17% higher efficiency than the best ENERGY STAR® commercial units. The propane-based air conditioner also creates 700% less pollution than standard refrigerants, improving air quality and reducing global warming potential.

"Sustainability is more than a buzzword at Oak Ridge, leaning instead on the lab'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. From major retrofits to mindful staff careful of their personal energy consumption, we have made responsible practices a matter of routine on the ORNL campus. I'm looking forward to the next generation of innovation led by the Sustainable ORNL Program as we place our scientific proficiency into practice, nurturing a culture in which sustainability guides every decision."

—**Moe Khaleel**, Associate Laboratory Director
Energy and Environmental Sciences
Cosponsor of Sustainable ORNL



On a Saturday last summer, we opened up the laboratory to the public to showcase our facilities and help celebrate ORNL's 75th anniversary. Our Sustainable ORNL team (across research and facilities organizations) supported many outreach activities for the event. A guest highlight was a ride on a future sustainable transportation option called "GROVER". GROVER (Ground-based Robotic Omnidirectional Vehicle for Electric-mobility Research) is ORNL's first autonomous bus designed and built onsite from start to finish! The body of GROVER was 3D printed, then developed into a 12-passenger shuttle bus that operates on a unique omnidirectional platform – its four wheels operate independently, allowing movement in any direction—even sideways. Sensors using LiDAR, a laser-based positioning platform, provide the autonomous controls.

ECOLOGY AND SUSTAINABLE LANDSCAPING

Ecological landscaping at ORNL uses sustainable practices to improve habitat, protect water quality, minimize erosion, and enhance native wildlife. Using local plant species highlights the lab's uniqueness, strengthens its relationship with its natural surroundings, and demonstrates its dedication to conserving and showcasing the environment. In 2018, an inventory of tree species on the ORNL campus was conducted to provide data for use in studies of the economic and environmental benefits of urban trees. This inventory will be beneficial in support of the creation of a self-guided campus tree tour, which will help educate staff and visitors on the many benefits of the urban ecosystem on the ORNL Campus.

Over the years, ORNL has 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 (ORR) to provide a beautiful backdrop to the campus. Minimizing turf reduces the need for frequent mowing and maintenance, and thus reduces fuel consumption, pollution, and emissions associated with mowing. Native landscaping is not only aesthetically appealing, but name tags near plants also educate laboratory staff and guests by helping them identify the regional vegetation. Educational signs around campus explain the benefits of sustainable landscaping with native species.

"Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators", was issued with the goals of reducing honey bee colony losses, increasing the monarch butterfly population, and increasing pollinator habitat acreage for all pollinators on Federal land. The native plants used in ORNL's sustainable landscaping include many host plants for butterflies and nectar sources for all pollinators. Multiple new landscaping projects are focused on the inclusion of more areas beneficial to our local pollinators. The ORNL Natural Resources Management Team is also participating in the Monarch Watch program in which monarchs are tagged with an individual identification number and then released to track migration patterns and success.

"Incorporating Natural Infrastructure Ecosystem Services into Federal Decision Making", is an executive memorandum issued to integrate the consideration of ecosystem services benefits into Federal decision making. Sustainable landscaping policy on the ORNL campus provides many of the ecosystem services listed in the memorandum including improved water quality, increased wildlife habitat, enhanced climate resilience, storm mitigation, pollutant buffering, and ecosystem resilience as well as aesthetic values, and recreation. Recent projects have included stream riparian buffer zone enhancement and increased native grassland areas on campus.



Project Highlight: Butterfly Gardens and Pollinator Habitats

ORNL is committed to supporting DOE as a member of the **US Federal Pollinator Health Task Force** co-chaired by the Department of Agriculture and the EPA. ORNL and other DOE locations are working with the Task Force to provide research support and practical applications at DOE sites. The **“National Strategy To Promote The Health of Honey Bees and Other Pollinators”** is a US policy that has been implemented by the Pollinator Task Force.

Goals include

- Reduce honey bee colony losses
- Increase monarch butterfly numbers
- Restore or enhance millions of acres of land for pollinators

ORNL Landscape Review Committee:

For more than a decade, the ORNL Landscaping Review Committee has been promoting the use of native plants in landscaping and enhancing natural areas around the ORNL campus. Native plants are one of the key components to improving pollinator habitat. ORNL has committed to increasing pollinator habitat acreage on campus by 5% each year for the next 5 years.

ORNL Natural Resources Management Program:

The ORNL Natural Resources Management Program conducts natural resources management tasks for the 32,000-acre ORR. This makes ORNL uniquely suited for real-world, practical applications of the important strategies developed by the Pollinator Task Force.

The reservation includes a DOE National Environmental Research Park, which is an outdoor laboratory that provides opportunities for environmental studies on the protected lands that surround the DOE facilities. The Research Park provides over 20,000 acres of ORR protected land for research and education, including opportunities for pollinator research and habitat improvement.



Expanding ORNL Experiences to Oak Ridge Reservation

- Approved native plant list for landscaping
- Wetland plant propagation research
- Nuisance wildlife management
- Enhancement of wetland areas
- Native grass restoration
- Workshops on invasive management
- Improvement of pollinator habitat



SUSTAINABLE TRANSPORTATION

In 2018, ORNL's Fleet received the 2018 Government Green Fleet Award. This is the second consecutive year to receive the honor for our success in "greening" the ORNL Fleet by using alternative fuel and hybrid vehicles, emission reduction, long-range planning, and staff education and involvement. We improved our ranking from 29th in the nation to 20th in only one year. Next year we intend to replace light-duty diesel trucks with more efficient models that use alternative fuels. Diesel vehicles develop problems when they are used for short trips, are driven low speeds, and are driven in stop-and-go circumstances. We will also continue to analyze and study benefits of other fuel types and new vehicle technologies.

Transportation Efforts in Research and Employee Sustainability Options

The Sustainable ORNL team continues to actively engage in regional and local planning for sustainable transportation as well as outreach activities for the enhancement of sustainable transportation in the entire southeast region. We have coordinated with state and regional transportation programs to help create more effective, efficient, and affordable regional transportation and commuting options. Staff members are active in participation in local and regional organizations, including service on the Board of Directors of the East Tennessee Clean Fuels Coalition, focusing on regional sustainable transportation options. These meetings are important in interactions with regional stakeholders, including Knoxville Area Transit, the City of Knoxville, and Smart Trips (knoxsmartrips.org). ORNL remains committed to coordinating with local, state, and federal telecommute and rideshare initiatives.

Specific efforts include

- Promotion of the UT, PSCC, ORNL bus route
- 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
- Annual Reporting through the TN Workplace Charging Challenge in partnership with the DOE nationwide Workplace Charging Challenge



EV Owner's Club and Charging the ORNL Fleet

ORNL remains a leader in the region in promoting electric vehicle use and has been actively participating in regional workplace charging efforts, including the installation and maintenance of EV supply equipment, including solar EV Parking spaces. Charging stations are available at the Chestnut Ridge facilities, the Hardin Valley Campus, and ORNL's main campus.

In 2018 there were 58 members in the **ORNL EV Owner's Club** with access to 40 staff charging station locations. Employees and associates pay an annual fee to join the club; and are then allowed to charge their EVs in one of the charging stations during work hours. The club funds support the cost and maintenance of the EV chargers devoted to non-fleet (employee owned vehicles) charging. Interest in the workplace EV charging is expected to receive a BOOST as more employees chose sustainable vehicles.



Other Fleet News

- ORNL remains a leader in the southeast and among national labs in the use of alternative fuels and advanced vehicle technologies. We are expanding the use of plug-in EVs in the ORNL fleet to help meet petroleum reduction goals.
 - Five of these service ORNL Fleet vehicles only and involve a fleet research study
 - Installation of 3 telematics systems on multiple vehicles was completed this past winter, with collection and analysis of data ongoing; a summary report will be developed
- The ORNL fleet vehicle count has remained steady at 439 for several years. The Fleet Office has purchased 25 alternative fuel vehicles to replace many diesel-fueled vehicles. In 2018 we replaced larger diesel trucks with more a sustainable option; smaller alternative fuel (E85 or GAS-PHEV) vehicles. Our long-term plan will not increase the size of the fleet but will reduce petroleum emissions: As vehicles are retired from service, they will be replaced with models that are more efficient and meet our sustainability goals.
- The **"Bike-It-Green"** Program is part of the Sustainable Transportation Initiative at ORNL. Of the original 100 bicycles in the campus bike-sharing program, most are still operational. In order to participate in the program, members must complete online training, wear a helmet while riding the bikes, and avoid using sidewalks. More than 1,700 Lab employees have completed the training. The use of the bikes for on-campus meetings mitigates the need to use petroleum, by using human power instead! **Now that's sustainable!!**



The Sustainable ORNL Team celebrates an ORNL award-winning FLEET.

POLLUTION PREVENTION

ORNL continues efforts to conserve resources and reduce the cost of R&D activities through its Pollution Prevention (P2) Program by developing and implementing techniques, technologies, and programs that minimize waste and pollution. First and foremost in preventing waste is source reduction, such as increasing the use of nontoxic or less-toxic alternative chemicals to replace more hazardous chemicals or reducing the amount of materials used, thus improving safety and reducing materials that one day must be managed as waste. The P2 Program encourages all staff members to use less paper and rely on electronic records instead of hardcopy files. After source reduction, ORNL promotes reuse and recycle initiatives. The promotion of source reduction strategies and reuse and recycling opportunities has reaped benefits. In a recent 5-year period, new pollution prevention initiatives have eliminated approximately 65 million kilograms (143 million pounds) of waste.

Source Deduction: From Reuse to Research

Source reduction efforts at ORNL touch all research and support activities and are shared across the nation so others can benefit by applying similar techniques and realize the benefits. For example, one of our researchers took the initiative to identify and implement a more sustainable replacement for xylene by utilizing a nonhazardous solvent. The solution was successfully used as a clearing agent in a histology experiment. This accomplishment improved safety and reduced hazardous waste and will continue to be shared with other research facilities.

Another key contributor to our success in waste reduction is ORNL's Property Disposition Program which prevents millions of dollars of usable equipment, furniture, and supplies from being sent to a landfill. These efforts not only reduce procurement costs, but also avoid waste disposition costs. Unwanted furniture and equipment can be given a new home at another ORNL office or DOE facility.

- In a recent 12-month period, ORNL reused more than \$6.8 million worth of materials and equipment through redeployments, donations, and transfers.
- We sell excessed equipment and recyclable material to prequalified partners eliminating waste, avoiding costs, saving manpower, reducing fuel use, and mitigating GHG emissions.
- We also support the Computers-for-Learning Program (provides excess working computers and related equipment to primary and secondary schools throughout the state) and the Energy-related Laboratory Equipment Grant Program (established by DOE to donate available used equipment to institutions of higher education for energy-related research). These efforts have allowed ORNL to make annual property donations of more than \$1.5 million to schools and nonprofit organizations.



Waste from Construction and Remodeling Projects

We integrate pollution prevention into all activities at ORNL including construction and remodeling projects through sustainability clauses that require use of sustainable products and recycle a large portion of project waste and excess materials. Last year 80% of construction and demolition-related waste was diverted from the landfill.

EMPLOYEE PARTICIPATION

Each year, ORNL sponsors several programs and events that are designed to encourage employee participation in activities that enhance a healthy lifestyle and a promote a sustainable community.



A healthy lifestyle is key to a healthy and productive workforce at ORNL, and better managing health care costs. ORNL's Wellness Program is fully integrated across several program areas including benefits, safety, sustainability, occupational health, and disability.

Employees have many opportunities to maintain and improve their health through a comprehensive program of fitness and educational activities. Seminars and health screenings, along with a variety of campaigns for exercise, fitness, nutrition, and weight loss are offered throughout the year.



Workplace Workouts

ORNL's Wellness Program now offers more than 50 fitness classes a month, including **low-impact aerobics, cycling, yoga, and Pound®**. Classes are held in the newly renovated group exercise studio in 4500S and are free for UT-Battelle employees.



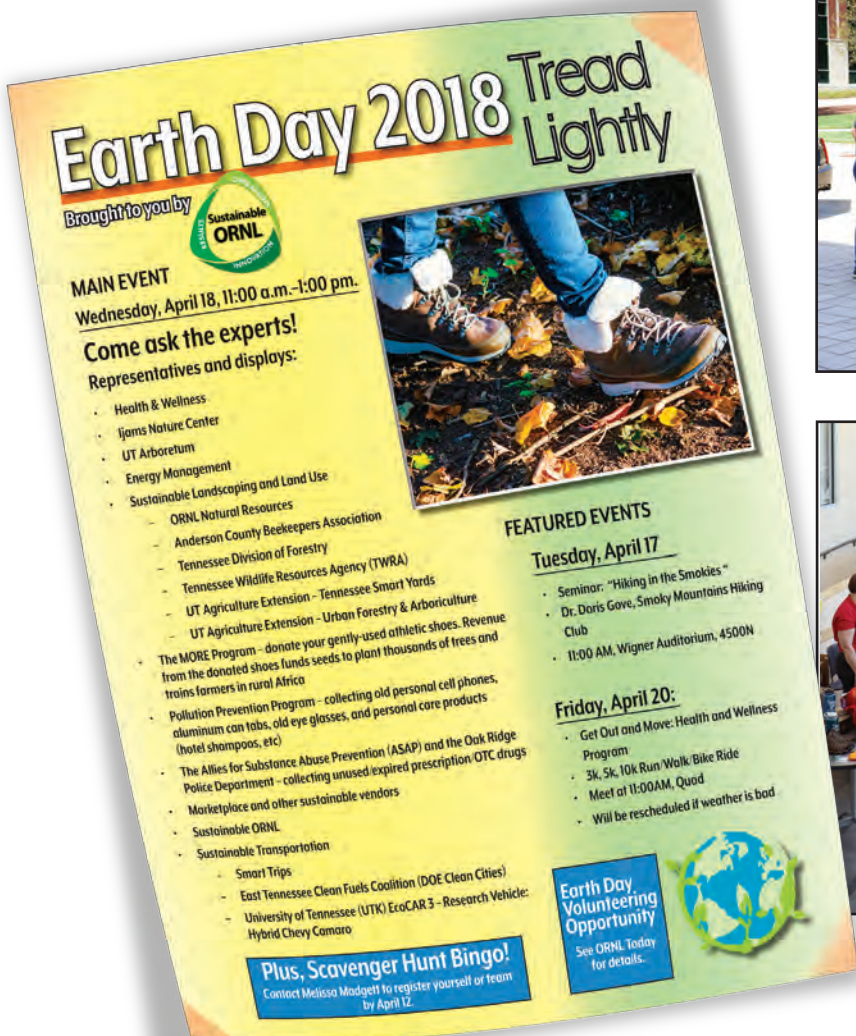
ORNL: Bike-It-Green

The Bike-It-Green program provides 3-speed bicycles to use for campus mobility as an alternative to using motor vehicles for transportation to meetings. Bike-it-Green is a joint effort by ORNL's Wellness Program, Sustainable Transportation, and the Energy Management group to promote energy efficiency and sustainability. Upon completing the required bike safety training, employees receive a bike helmet to wear when riding the bikes.



ORNL Earth Day Celebration

Sponsored by the Sustainable ORNL Program



Earth Day 2018 Tread Lightly
Brought to you by Sustainable ORNL

MAIN EVENT
Wednesday, April 18, 11:00 a.m. - 1:00 p.m.
Come ask the experts!
Representatives and displays:

- Health & Wellness
- Ijams Nature Center
- UT Arboretum
- Energy Management
- Sustainable Landscaping and Land Use
 - ORNL Natural Resources
 - Anderson County Beekeepers Association
 - Tennessee Division of Forestry
 - Tennessee Wildlife Resources Agency (TWRA)
 - UT Agriculture Extension - Tennessee Smart Yards
 - UT Agriculture Extension - Urban Forestry & Arboriculture
- The MORE Program - donate your gently-used athletic shoes. Revenue from the donated shoes funds seeds to plant thousands of trees and trains farmers in rural Africa
- Pollution Prevention Program - collecting old personal cell phones, aluminum can tabs, old eye glasses, and personal care products (hotel shampoos, etc)
- The Allies for Substance Abuse Prevention (ASAP) and the Oak Ridge Police Department - collecting unused/expired prescription OTC drugs
- Marketplace and other sustainable vendors
- Sustainable ORNL
- Sustainable Transportation
 - Smart Trips
 - East Tennessee Clean Fuels Coalition (DOE Clean Cities)
 - University of Tennessee (UTK) EcoCAR 3 - Research Vehicle: Hybrid Chevy Camaro

Plus, Scavenger Hunt Bingo!
Contact Melissa Madgett to register yourself or team by April 12.

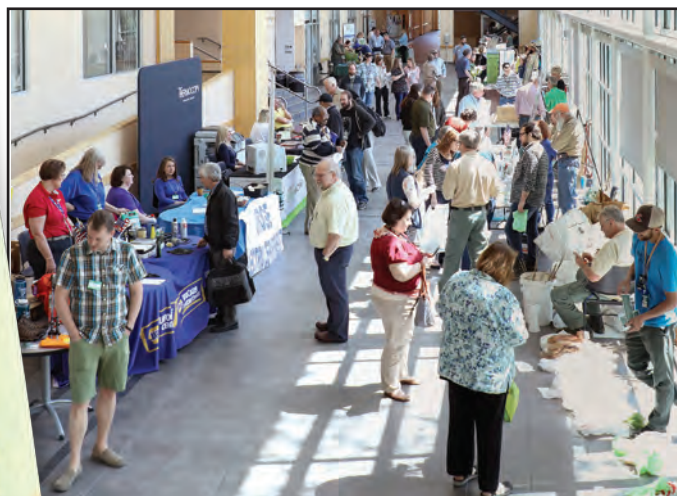
FEATURED EVENTS
Tuesday, April 17

- Seminar: "Hiking in the Smokies"
- Dr. Doris Gore, Smoky Mountains Hiking Club
- 11:00 AM, Wigner Auditorium, 4500N

Friday, April 20:

- Get Out and Move: Health and Wellness Program
- 3k, 5k, 10k Run/Walk/Bike Ride
- Meet at 11:00AM, Quad
- Will be rescheduled if weather is bad

Earth Day Volunteering Opportunity
See ORNL Today for details.



ORNL Outreach Event—Bring Your Child to Work Day

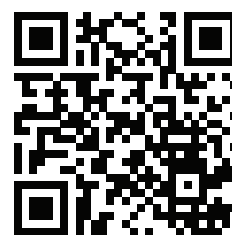
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Sustainable ORNL website:
<https://www.ornl.gov/sustainable-ornl>



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