Annual Sustainability Report

2020

OAK RIDGE National Laboratory

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Oak Ridge National Laboratory Annual Sustainability Report

Sustainable ORNL Program

August 2020

Prepared by
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OAK RIDGE NATIONAL LABORATORY

Solving Big Problems

Mission

Deliver scientific discoveries and technical breakthroughs needed to realize solutions in energy and national security and provide economic benefit to the nation.

Conducting R&D with Impact

The US Department of Energy's (DOE's) Oak Ridge National Laboratory (ORNL) researchers apply unique facilities, sophisticated tools, and signature strengths in neutron science, high-performance computing, advanced materials, nuclear science and engineering, and isotopes to benefit science and society.

Addressing National Needs

Established in 1943 as part of the Manhattan Project, ORNL is building on a legacy of discovery and innovation. Today, ORNL is a leading science and energy laboratory.

The Director's Updated Message in Response to the COVID-19 Health Crisis

"I could not be prouder of our staff who have stepped up to offer their scientific and technical expertise to address this international pandemic," said ORNL Director Thomas Zacharia. "It is during times of crisis that we have the greatest opportunity to distinguish ourselves in service to the nation. That is our legacy at Oak Ridge; it is who we are."

5,100+
Staff, representing 60+ nations

$2B
Funding by DOE mission

3,200+
Guest researchers annually

#1
World's most intense neutron source

2,000+
FY19 journal publications

#1
Nation's fastest supercomputer

"What we do matters and makes a lasting impact on the world."

Thomas Zacharia, ***Laboratory Director***

Oak Ridge Snapshot

Located near the Great Smoky Mountains, ORNL's campus is just one hour away from the country's most visited national park. Within a day's drive of all major cities on the East Coast, ORNL provides the best of both worlds: proximity to the great outdoors and growing urban centers with diverse cultural attractions. The city of Oak Ridge, Tennessee has 150 miles of shoreline for water recreation, rowing, and boating. Nearby is Knoxville, Tennessee, home to the thriving research campus of the University of Tennessee (UT) and a historic downtown known for its dining, theaters, shopping, and cultural and music festivals. Additionally, East Tennessee is affordable, with a cost of living more than 14.5% lower* than the national average and no state income tax. It is one of the safest areas in the United States and has excellent school systems, including the Oak Ridge School District.

** bestplaces.net*

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 effects on a wide range of sustainability issues, enabling them to be more transparent about the risks and opportunities they face.
Learn more at https://www.globalreporting.org.

ORNL's Commitment to Sustainable Operations

ORNL is a 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. ORNL, managed by UT-Battelle LLC, executes the widest range of mission capabilities of any Office of Science site. ORNL is engaged in an extensive range of activities that support the DOE mission: "to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions." To execute these activities, ORNL is tasked with managing the most extraordinary set of distinctive scientific facilities and equipment within the DOE. With sustainable responses to national priorities, ORNL has delivered over 75 years of continuous operations, consisting of facilities with commissioning dates ranging from the 1940s until now.

With such a wide range of buildings types, conventional energy and water savings practices are not enough to deliver straight-line results in efficient operations. This diverse and unique set of major facilities, totaling more than 5.8 million square feet, requires an innovative program to accomplish advancements in operational efficiencies supported by all stakeholders, from the leaders to the most engaged employees. 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. The Sustainable ORNL program promotes the legacy of system-wide best practices, management commitment, and employee engagement that will lead ORNL into a future of efficient, sustainable operations. ORNL leadership, facilities management, and Sustainable ORNL champions receive regular status reports on the progress of each project and program area (also known as roadmaps), and periodic summary reports for the program as a whole. The Sustainable ORNL Roadmap structure has been streamlined to demonstrate 12 vital projects. The graphic depiction below illustrates the roadmap assignments and was designed to indicate that each project contributes to the wellbeing of the whole.

ORNL is tasked with the management of an extraordinary set of distinctive scientific facilities and research equipment for DOE, as well as research management for numerous partners. 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. The Oak Ridge Leadership Computing Facility hosts leading computational resources, including the Summit supercomputer system 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.

The Sustainable ORNL Program and its predecessors have supported the quest for sustainable operations for more than 12 years. Our experience results in sharing lessons learned with other DOE programs as well as environmental conferences in Tennessee and the United States.

ORNL's vast portfolio of research facilities must be maintained and carefully upgraded to protect the national investment in scientific analysis. **The goal of sustainable operations is to enable safer and 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 environmental stewardship.

What can corporations and community partners do to promote sustainable operations?

- Create smart, integrated policy to promote energy efficiency and environmental compliance
- Create organizational structures that support sustainability
- Engage with outside organizations that promote the environmental and cultural benefits of sustainability best-practices
- Embed sustainability into corporate culture and take steps to enhance employee engagement
- Create an inclusive culture that supports sustainability-related innovation
- Prepare for the effects of severe weather events on sustainable operations
- Develop and prioritize actions based on site-specific risks and threats
- Build awareness and improve skills to respond to potential events, including outreach to local first responder teams
- Join a national dialogue on responsible energy consumption
- Engage value chain members, including vendors, utility providers, and university, research, and industry partners

ORNL's Impact on the Local Economy and Our Communities

It's Not Just Science

Another important way that ORNL staff members reach out to enrich the lives of those in nearby communities is through Team UT-Battelle. Over the years, Team UT-Battelle volunteers have donated personal time and resources to participate in several community ventures, including public space cleanups, nature restorations, assembling care packages, donating to local food banks, and conducting fundraising activities for many local non-profits.

ORNL Facilities and Operations and Environment, Safety, Health, and Quality directorates joined forces to help with two Habitat for Humanity projects in the region.

News Release: Oak Ridge, Tenn., April 2, 2020

"Community food banks are experiencing more stress than ever as they work to address the increased need caused by COVID-19. UT-Battelle, the managing contractor of Oak Ridge National Laboratory for the U.S. Department of Energy, has responded by donating $10,000 to Second Harvest Food Bank of East Tennessee, providing 30,000 meals for those in need. Second Harvest is the largest hunger-relief charity in East Tennessee, providing assistance to more than 500 food pantries, soup kitchens, schools and shelters. The nonprofit operates broad programs specific to children, elderly and families – populations that are especially vulnerable during the current stress on food resources."

K–12 STEM Education and Outreach

STEM outreach is vital to the nation's development of future scientists, engineers, and innovators. As the DOE's largest multiprogram science and energy laboratory, ORNL is committed to serving the public as a valued partner in educational initiatives, promoting and expanding STEM experiences for the next generation. ORNL offers students, educators, and community members a variety of learning opportunities that correspond to the Laboratory's distinct areas of scientific research.

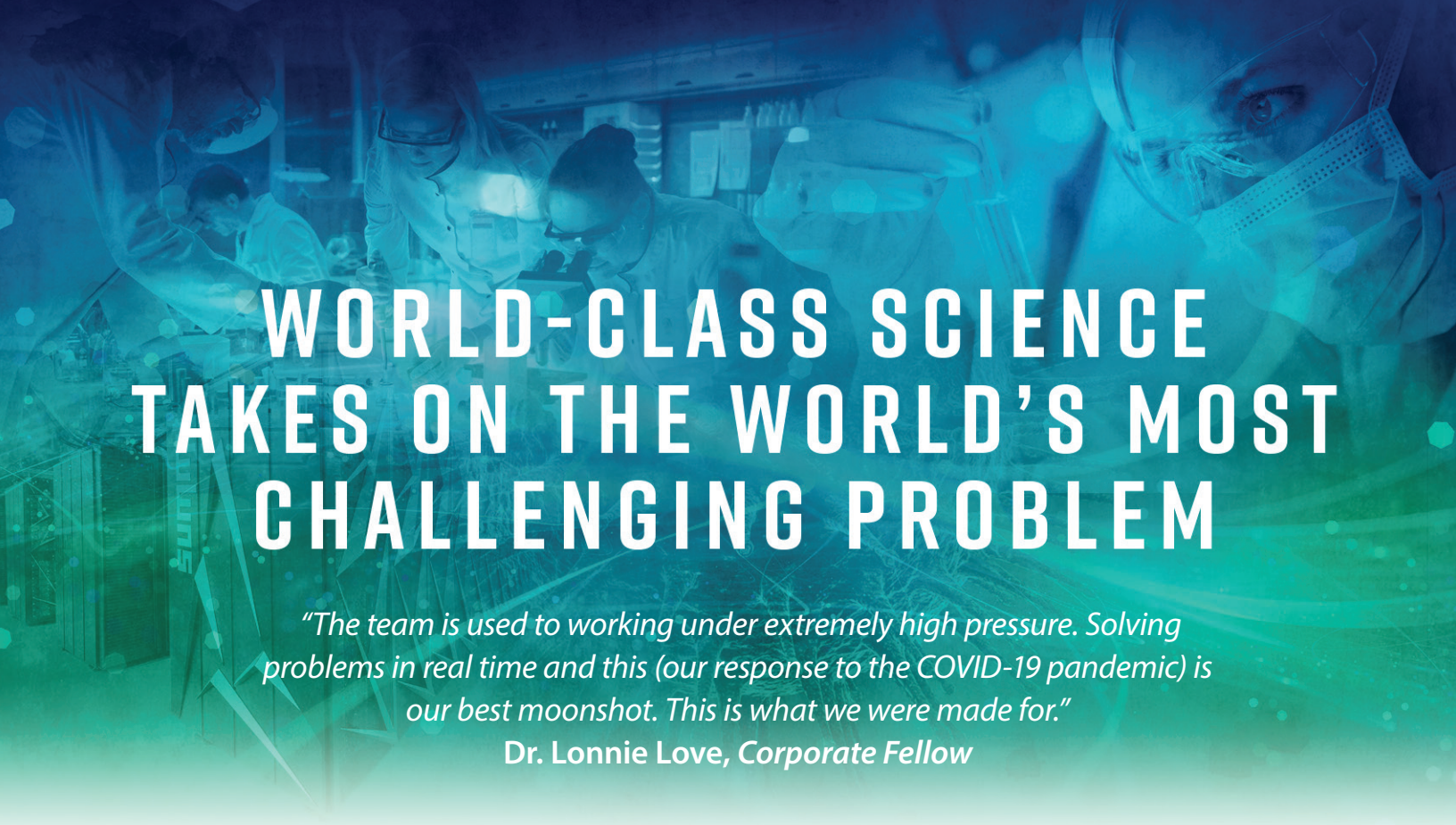
School and Community Events

ORNL proudly partners with many schools and community groups in the surrounding area in a variety of events, including school STEM nights, science fairs, career fairs, teacher professional development, and other educational events. Through hands-on activities and demonstrations, students and community members can gain an understanding of the concepts that fuel scientific research. Employee volunteers visit regional schools for events such as the National Science Bowl, First Robotics, Hour of Code, Environmental Science Week, and Nuclear Science Week.

Notably, employee volunteers helped with Computer Science Education Week activities in elementary, middle schools, and high schools in ten Tennessee districts in the past year.

Traveling Science Fair

ORNL's Traveling Science Fair provides guests of all ages with the opportunity to learn more about science and the importance of research conducted at ORNL. Students enter carnival-style, interactive trailers that describe various fields of research and areas of future job opportunities. Theme trailers include Become a Neutron, Extreme Science, Get into Green, Tiny Atoms…Big Science, What's Your Problem, and Mission Support provide participants with hands-on, interactive experiences centered around ORNL's diverse areas of research. In 2018, more than 387,000 people visited the ailers in Oak Ridge and and its surrounding areas, as well as in Washington, DC.



WORLD-CLASS SCIENCE TAKES ON THE WORLD'S MOST CHALLENGING PROBLEM

"The team is used to working under extremely high pressure. Solving problems in real time and this (our response to the COVID-19 pandemic) is our best moonshot. This is what we were made for."
Dr. Lonnie Love, *Corporate Fellow*

As ORNL embarked upon a new year, the expectations for research projects in 2020 were bountiful and exciting. However, by mid-March, the United States experienced a pandemic that required retooling our expectations in a most pressing way. (https://www.ornl.gov/news/ornl-fight-against-covid-19)

In the race to identify solutions to the coronavirus disease 2019 (COVID-19) pandemic, researchers at ORNL are joining the fight by applying expertise in computational science, advanced manufacturing, data science, and neutron science.

From research to community support, ORNL enlists world-class science and staff in the fight against COVID-19.

Research and mission support are proceeding at ORNL, both onsite and as roughly two-thirds of staff members work from home to maximize social distancing. ORNL is providing remote access to its world-leading supercomputing and neutron facilities for researchers around the world to conduct critical scientific studies on severe acute respiratory syndrome coronavirus 2, or SARS-CoV-2, the novel coronavirus that causes COVID-19.

ORNL and its staff are also working to support local communities in need of financial support and access to educational resources.

"I could not be prouder of our staff who have stepped up to offer their scientific and technical expertise to address this international pandemic," said ORNL Director Thomas Zacharia. "It is during times of crisis that we have the greatest opportunity to distinguish ourselves in service to the nation. That is our legacy at Oak Ridge; it is who we are."

COMPUTATIONAL SCIENCE: ORNL's Summit, the world's most powerful supercomputer, is accelerating COVID-19-related research through the new COVID-19 High Performance Computing Consortium. Several computing allocations are already running on Summit aimed at improving scientists' understanding of the virus structure and biology toward developing targeted therapies and vaccines. Researchers at ORNL and UT have used Summit to identify small-molecule drug compounds that might warrant further study. Dr. Colleen Jonsson of UT Health Science Center in Memphis directs one of the few laboratories permitted to perform live virus tests and is testing the efficacy of drugs from the ORNL list on the novel coronavirus.

Research in Energy and Environmental Sciences

ORNL Energy and Environmental Sciences Directorate (EESD) programs play an important role in America's clean, efficient energy future. Our scientists and engineers work with many of America's best innovators and businesses to research, develop, and demonstrate cutting-edge technologies to advance solutions for sustainable transportation, renewable power, and energy efficiency for homes, buildings, and manufacturing. We bring a multidisciplinary focus to resolve some of the biggest challenges in energy and the environment. We are working to develop systems to create better crops for biofuels and are developing new materials for automobiles and wind turbines. Clean energy innovations are indispensable to effective long-term solutions in a changing environment and will help provide affordable, reliable energy to support a thriving economy.

ORNL's research user facilities offer a diverse set of tools for experiments across a range of fields, including biology, materials and energy sciences, physics, engineering, and chemistry. Access to ORNL user facilities is through the review and approval of user proposals, and depends on the scientific merit and other considerations.

DOE National User Facilities Hosted by ORNL's EESD

The **Building Technologies Research and Integration Center (BTRIC)** develops breakthroughs to improve the energy efficiency and environmental compatibility of residential and commercial buildings, focusing on building envelopes, equipment, building systems integration, energy storage and building-to-grid interactions, sensors, controls, and data modeling and simulation.

The **Carbon Fiber Technology Facility (CFTF)** provides a platform for evaluating new processing technologies and identifying high-potential, low-cost raw materials, including textile, lignin, polymer, and hydrocarbon-based precursors. Using the CFTF, ORNL is developing optimal mechanical properties for carbon fiber material, focusing on structural properties and process optimization.

The **Manufacturing Demonstration Facility (MDF)** houses integrated capabilities that drive the development of new materials, software, and systems for advanced manufacturing. From 3D tomography to in situ monitoring to digitizing manufacturing, the MDF leverages a range of equipment and expertise designed to deliver results that generate energy efficiency improvements in the manufacturing sector, promote efficient use of domestic energy resources, and support the secure production of clean energy products.

The **National Transportation Research Center (NTRC)** helps industry, academia, and other agencies accelerate the development and deployment of efficient and secure transportation technologies. Research focuses on electrification, efficiency of combustion and emissions, data science and connected vehicles, and materials for future systems.

More Breaking News! *ORNL EESD user facilities support COVID-19 response*

Researchers at the MDF and CFTF are using their materials science, fiber production, and additive manufacturing expertise and capabilities to provide US industry with the necessary resources to mass-produce health care supplies in record time in the fight against COVID-19.

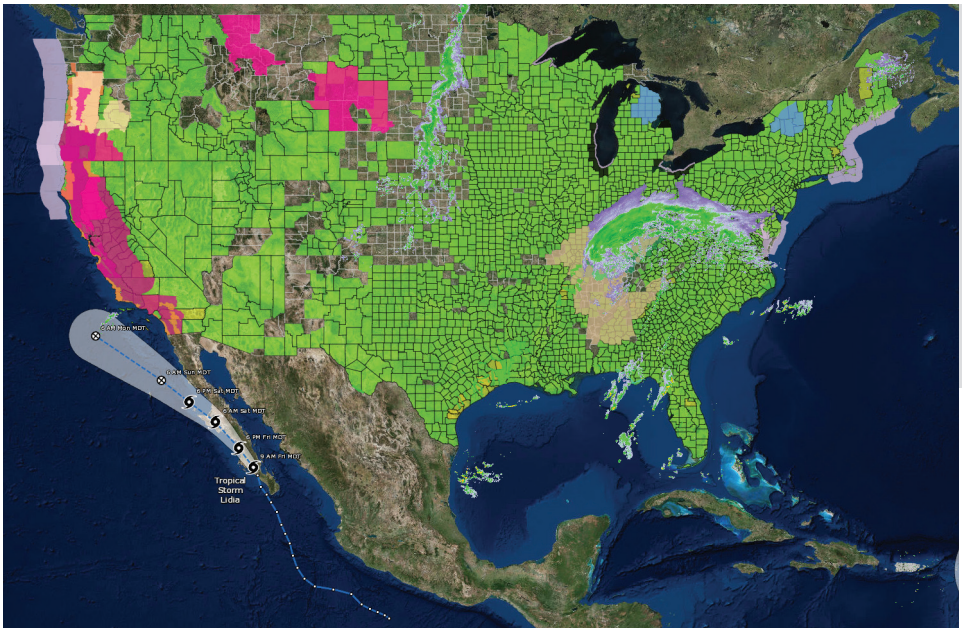
- The MDF is developing tooling such as molds that will enable the production of face masks, shields, and test collection tubes in quantities estimated from hundreds of thousands to millions. These efforts are at the heart of a new national initiative for machine tools technology between DOE and the US Department of Defense. Collection tube manufacturing efforts are conducted in coordination with the US Department of Health and Human Services. Funding is provided in part by the DOE Office of Science through the National Virtual Biotechnology Laboratory, a consortium of DOE national laboratories focused on responding to COVID-19, with appropriations provided by the Coronavirus Aid, Relief, and Economic Security (CARES) Act.
- Researchers at the CFTF recognized the potential to recalibrate melt-blown machines used to produce textiles, filters, or carbon fiber to help address the shortage of highly protective N95 masks. This effort led to the development of a specific and reproducible set of parameters that companies can use to produce N95 filters quickly and with assurance that the resulting material will meet the required specifications.

"User facilities such as the MDF and CFTF have served a critical purpose in the fight against COVID-19. Researchers at each facility have dedicated countless hours to developing tools and resources to support the healthcare community. As a national laboratory, ORNL is here to serve the nation and to find solutions to deliver technology for the betterment of the United States and a more sustainable economy."

—Stan Wullschleger, *Interim Associate Laboratory Director, Energy and Environmental Sciences, Cosponsor of Sustainable ORNL*

Project Highlight: ORNL Solutions for a Secure, Resilient Energy Grid

In the United States, our safety, security, and vitality can depend on the uninterrupted delivery of electricity to homes, businesses, and public spaces. The nation's power grid is a great asset, but it is also vulnerable to both cyber and physical disruption from natural events or malicious attacks. ORNL scientists and engineers work in close partnership with the private sector to develop innovations to stabilize the grid's defenses, ensure it can quickly recover from potential disruptions, and advance best practices in grid security for more sustainable operations.



ORNL researchers are mapping energy system interdependencies as part of the North American Energy Resilience Model project to enhance reliable and resilient energy delivery.

Innovations for a Modern Grid

Monitoring—Increasing the visibility of grid assets by developing and embedding high-fidelity sensors to provide essential data

Modeling—Creating a reliability and resilience model of the North American power grid that identifies energy system interdependencies and infrastructure investments needed for faster recovery

Advanced controls—Developing software to dynamically network microgrids for system resilience and potential blackstart operations; creating algorithms for transactive control of customer loads in response to price signals for better demand response and load balancing

Megawatt-scale energy storage—Providing greater control of power demand and supply for a more flexible, responsive grid, with solutions including networked microgrids, low-cost redox flow batteries, mechanical electricity storage, hydrogen fuel cells, and the recycling of electric vehicle batteries

Cyber-physical risk mitigation—Advancing a strategy to eliminate cyber and physical threats to the grid with a focus on real-time interdependency monitoring and critical facilities defense

MODELING
grid functions for improved resilience

PROTECTING
the grid with novel cyber-physical security methods

AUTOMATING
control monitoring with sensors

SECURING
communications controls with a private network

ENGINEERING
power systems with modern electronics

ORNL Facilities and Operations

ORNL facilities make up the DOE's largest science and energy laboratory and therefore, execute the widest range of mission capabilities of any Office of Science site. ORNL is tasked with managing an extraordinary set of distinctive research facilities and scientific equipment. The site has achieved more than 75 years of continuous operations, consisting of facilities with commissioning dates ranging from the 1940s to 2020. Therefore, conventional perceptions for achieving energy and water savings are not enough to deliver straight-line results in efficient operations. Such a diverse and unique set of major facilities, totaling more than 5.8 million square feet, requires an innovative plan to accomplish advancements in operational efficiencies supported by all stakeholders, from the leaders to the most engaged employees.

DOE has been tasked to "enhance the resilience of Federal infrastructure and operations, and enable more effective accomplishment of its mission" when implementing the policies to improve energy performance and consider environmental factors in resilience planning. **Resilience is the ability of an agency to adapt to changing conditions, and withstand or recover from disruption.** Resilience efforts help sites manage risks to our assets, infrastructure, and operational readiness.

Operational resilience is an integral part of the ORNL planning process. The process is coordinated with the DOE Office of Science and is part of an integrated and proactive approach by including sustainability efforts and resilience into site-strategic plans. Strategic best practices include the following:

- Focus on resilience strategies and procedures that **identify and respond to events with the potential to disrupt, strain, or compromise DOE activities or facilities**
- 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
- Apply organizational resilience best practices into the facilities-planning process and the design of new agency buildings

The ORNL sustainable operations plan for resilience was put to the test early in 2020 with the onset on a national health crisis COVID-19. The response to the crisis proves our dedication to the research mission.

The response to the challenges of COVID-19 in sustainable operations is an opportunity for facility support to SHINE.

As the supply chain became taxed and notices of shortages were commonplace, several Facilities and Operations (F&O) support divisions tackled the unique situation with a self-reliant response. The critical research provided by ORNL is more important than ever, so the facilities must be available, clean, and safe for use. To slow the spread of the virus on our campus, the application of disinfectants had to ramp up in volume, coverage, and frequency. Teams from several divisions approached laboratory management about in-house production of a safe and powerful disinfectant that would reduce operational risks. The consensus was to use hypochlorous acid, a proven, safe, and effective product. **INTERNAL RELIANCE** would ensure a continual supply; thus, a production plan was developed as an alternative to outside supply chains. The project was launched with management approval and unused laboratory space was identified to house the production line. Technical resources such as electricians, pipefitters, and sheet metal workers were used for fabrication. Instrumentation technologies such as monitoring, leak detection, and quality production data were also needed. Labeling, storage, and distribution systems were developed to complete the venture; **from concept to conveyance, the project was delivered in 30 days.**

Furthering the strength of an integrated solution, custodial supervisors quickly recognized the value of using electrostatic spray machines to apply disinfectant. The new equipment was quickly procured to test applicability at ORNL. The electrostatic units safely release a fine mist of electrically charged particles of disinfectant quickly and effectively. The technology allows for complete coverage in places not easily reached by traditional means. The results are outstanding and well-received by janitorial staff, supporting a **NEW NORMAL** in cleaning and disinfection tasks.

"We've distributed more than 1,500 bottles of ORNL-made hypochlorous acid throughout the campus. This disinfectant provides a powerful and safe way for ORNL staff to routinely clean work spaces. The idea to pursue in-house production of the acid was a combined effort involving the ORNL Fire Department, the HAZMAT team, and ORNL Transportation and Waste Management. Team members quickly installed a production system in a former lab space in less than a month. Producing a disinfectant in-house allows us to keep a high volume of supplies on hand at all times."

—Jimmy Stone, *Associate Laboratory Director, Facilities and Operations, Cosponsor of Sustainable ORNL*

Achievements in Energy Management, the Hallmark of Sustainable Operations

Facility Metering: Quality Data is the KEY to Data-Driven Performance

Over the past 10+ years, ORNL has implemented and improved upon an extensive site-wide metering plan that includes all metered utilities on the campus. The metering plan is a comprehensive document that charts a course for ORNL's continued advanced metering deployment, which is consistent with the November 2014 Update to the Federal Building Metering Guidance and with current DOE directives focused on advanced utility metering where cost-effective and appropriate. The metering plan considers variables such as square footage, space use design, and energy consumption estimates (current and future). The metering plan is updated at least annually to document progress that has been made and to note any shift in priorities.

In 2019, we installed 42 additional advanced utility meters across all utilities, including electrical, steam, chilled water, natural gas, and potable water. The meters were connected to the ORNL Central Energy Data System (CEDS) to ensure quality energy performance data. CEDS can record multiple parameters from each meter on a standard 15-minute interval. This system also enables meter data trend analysis, report generation, and energy awareness dashboard deployment, as well as data export for use in other analyses.

To enhance data-driven decisions, we have deployed a new module for the CEDS system called "Resource Advisor" (RA) to enhance data archiving and decision analysis. ORNL utility and energy engineers used RA's advanced configuration capabilities to easily calculate and quickly display total building energy consumption using data from the advanced utility meters. RA provides comprehensive dashboard and energy-analysis capabilities that align with ORNL's continued maturation in energy data use. RA directly feeds metered energy data into the US Environmental Protection Agency's **ENERGY STAR Portfolio Manager** for benchmarking and measuring and reporting performance for federal reporting.

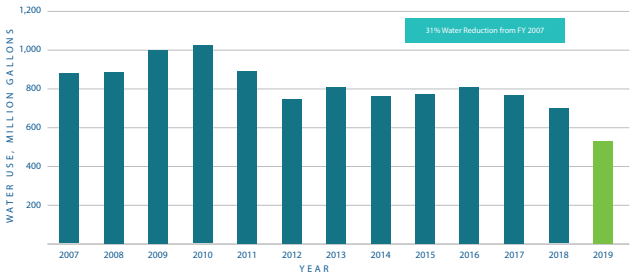
Intelligent Building Analytics

One of the Sustainable ORNL roadmaps of increasing significance communicates the growth of intelligent building analytics as a system to advance energy efficiency and water use improvements on the campus. We are engaged in continuous efforts to expand the RA platform for energy and demand data management utility sources and estimated building-level energy consumption. This allows for sequencing of operations data collection and improves visibility of data, leading to better real-time decisions and actions. As the system expands, more opportunities become apparent to actively engage field engineers in using meter alerts for preventing and diagnosing of operational issues. We continue to find and document success with meter alert implementation for catching operational issues such as stuck flush valves and heating valves that fail to open. As ORNL's CEDS, RA, and the Building Automations Systems continue to grow in size and operational significance, we are building capabilities for data quality, reporting, and configuration management. At the same time, we expand efforts 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.

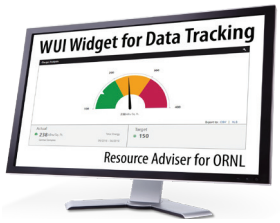
Achievements in Water Use Management

The City of Oak Ridge provides potable water to ORNL and other DOE facilities for domestic use (handwashing, flushing), cooling (cooling towers, chillers), heating (steam generation, hot water generation), laboratories, and special research processes. One of our most popular research systems, the Summit supercomputer, was designed to be super in more ways than just processing speed, thanks to design strategies using the leading concepts for energy and water use efficiency.

In 2019, we completed an extensive water use reduction project, demonstrating the benefits that can be achieved through cooperation from F&O and research divisions. The ORNL research legacy includes various systems that use water as a cooling agent to manage the temperature of research



equipment using the once-through cooling (OTC) process. The older research systems are inefficient and use potable water that is delivered at utility-level temperatures. The water is circulated to cool the equipment and then discharged to the environment (i.e., native streams) after just one use. In two major research buildings, the older OTC delivery system was replaced by connecting research fixtures to a modern chilled-water closed-loop system.



OPERATIONAL RESILIENCE: Water use reductions by OTC eliminations and other water efficiency projects contribute to sustainable operations at ORNL by increasing reliability and reducing dependency on organizations that are external to ORNL, improving organizational resilience and reducing operational and environmental risks.

ORNL has an extensive awareness of the benefits of effective water management, having already established conservations measures that resulted in a 66% reduction in water use compared with the highest level of water use (experienced in 1985). Using the federally mandated baseline of 2007 for graphic illustration, water use in 2019 measured 604 million gallons, compared with a high of 1,025 million gallons used in 2010. ORNL's history of water use reductions shows our firm commitment to the sustainable practices of lower levels of water consumption, considerations for environmental impact, and better economic stewardship of research dollars.

Notable Activities: DOE 50001 Ready Certification for ORNL

To complement the benefits of investments in advanced energy and water metering technology and intelligent building analytics, ORNL recognized the advantage of implementing a structured process to take its energy performance to the next level. We were in a prime position to deploy a system that could facilitate and document continuous energy and water usage reductions and help to improve operational costs.

After learning more about 50001 Ready at DOE's annual Energy Exchange conference, the ORNL energy team obtained the approval and support from the Facilities Management Division to implement the prescribed energy management system. The 50001 Ready Navigator guidance and tools helped to formally document the energy management processes and procedures and organize data records. The modestly sized ORNL energy team particularly appreciated the efficiencies of a central system for storing its plans, policies, energy data, and annual performance progress. The endorsed system took about 12 months to implement and has surpassed expectations in identifying relevant variables and accelerating energy analyses through the emphasis of life-cycle energy analysis and staff engagement.

DOE launched the 50001 Ready Program in 2017, and ORNL is the third federal location and only the second national laboratory to receive the certification. DOE's 50001 Ready program is a self-guided approach for facilities to validate an energy management system and self-attest to the structure of the International Organization for Standardization for energy-efficient operations. To achieve the 50001 Ready certification, organizations are responsible for completing all 25 tasks in the DOE 50001 Ready Navigator online tool and for measuring and improving energy performance over time.

Visit DOE's Better Building's website for more details outlined in the ORNL Facility Management Division Case Study (https://betterbuildingssolutioncenter.energy.gov/iso-50001/showcase-projects/oak-ridge-national-laboratory-%E2%80%94-50001-ready-facility)

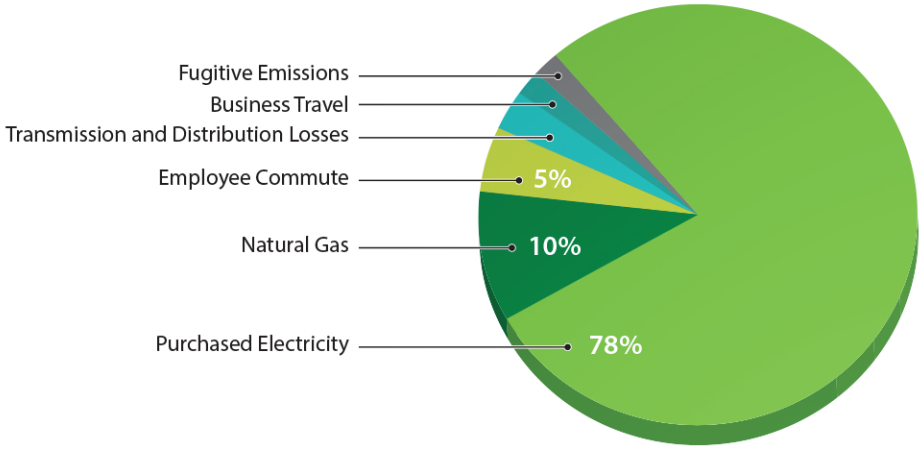
Greenhouse Gas Management and Best Workplaces for Commuting

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 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.

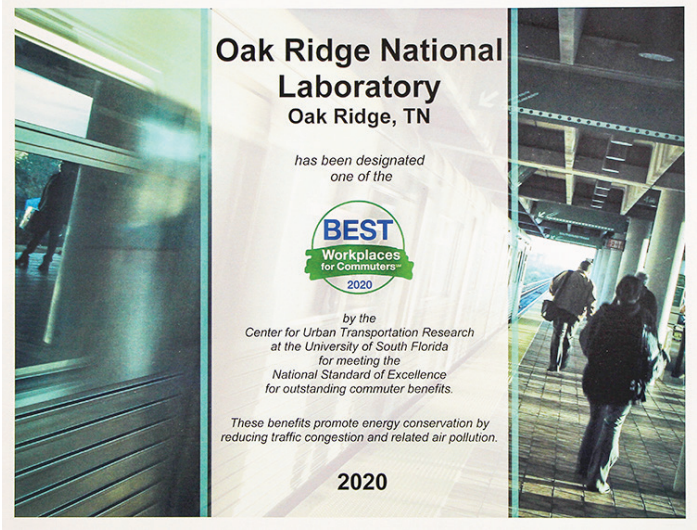
The Johnson Controls project to improve steam plant efficiency is an excellent example of this commitment. As a result of the more efficient process, the use of **natural gas** at ORNL and the resulting GHG emissions have declined by 28% over the past 10 years.

As with most national laboratories, 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. As 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 2019 GHG Emissions by Source



ORNL was named as one of the 2020 Best Workplaces for Commuters *for offering exceptional commuter benefits to employees*



- We promote electric vehicle use and have installed electric vehicle charging stations.
- We offer a carpool/vanpool program that provides premium parking to participants.
- We implemented alternative work schedules and a formal telework process to allow employees to work from home or other remote locations.
- We initiated a commuter transit service (bus) that connects UT-Knoxville, Pellissippi Community College, and ORNL.
- We partner with Smart Trips to promote sustainable commuting.
- We provide a no-cost taxi service (two taxis in full-time operation) for access to facilities throughout our 10,000-acre campus.
- We provide two-hour parking spaces for employees who need to attend meetings in our more heavily-congested areas.

Ecology and Sustainable Landscaping

ORNL is located within the 32,000 acre DOE Oak Ridge Reservation (ORR). ORR is home to major stands of forests, grasslands, and aquatic habitats. The ORNL Natural Resource Management Team is tasked with the conservation efforts for the entire ORR, making ORNL uniquely suited for real-world, practical applications for natural resource management in natural and urban settings. The ORNL Landscaping Committee and Sustainable ORNL promote sustainable landscaping practices.

Ecological landscaping at ORNL uses sustainable practices to improve habitat, protect water quality, minimize erosion, and promote native wildlife. Cultivating local plant species highlights the laboratory's uniqueness, strengthens its relationship with its natural surroundings, and demonstrates its dedication to conserving and showcasing the environment. 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 ORR to provide a more natural 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 is important to showcase the benefits of sustainable landscaping with indigenous species. We invite you to **EXPLORE** the ORNL Sustainable Landscaping web page as a resource to **LEARN and ABSORB** much more about native landscaping practices in our area (https://nerp.ornl.gov/)

ORNL: Home to a New Arboretum, Wisdom is Stored in Trees

After completing an inventory of more than 1,200 campus trees, a portion of the campus was selected to sponsor an accredited arboretum. Designating an arboretum within the ORNL campus was primarily the result of a strategic vision among ORNL, the Tennessee Division of Forestry, and UT. Collaboration with numerous state agencies and UT departments/programs was essential for this unique partnership to support research efforts for the university, the state, and ORR. In 2019, the ORNL Arboretum was certified through the internationally recognized ArbNet Arboretum Accreditation Program, for the benefit of conservation, science, and the public. The new ORNL Arboretum, which is accessible to all badged employees and visitors, contains 52 different species of trees native to East Tennessee—including the Tennessee state tree, the tulip poplar, and the common hackberry. The new certification will showcase ORNL and DOE efforts within the ORR boundary to preserve native trees species and improve pollinator habitats. The arboretum website contains maps, information, benefit to wildlife and ecosystem services, and strategic partnerships that created this sustainable landscaping feature (https://nerp.ornl.gov/ornl-arboretum/).

With 52 of the 62 tree species on ORNL's campus featured within the arboretum, the arboretum is a diverse example of native trees found in the area. This allows the Landscaping Review Committee to promote sustainable practices by presenting employees and visitors a wide range of native tree species they might try planting in their own yards. Although urban trees in general provide environmental services such as reducing air pollution, preventing runoff, and sequestering carbon, native trees have added benefits. In addition to their natural beauty, native trees help provide food and suitable habitats for other native species, including important pollinators such as birds and insects. The native eastern redbud trees found in the arboretum flower in early spring and produce a vital food source for pollinating insects in the dormant period before other species bloom in early summer.

This American basswood is just one of 52 native tree species found in the ORNL Arboretum.

Earth Day at ORNL

The Sustainable ORNL Program sponsors a popular Earth Day event for employees each year, such as the one highlighted here from 2019. Preparations for the 2020 Earth Day Celebration began with an exciting start in January. ORNL had plans to go the extra mile to properly honor the 50th anniversary of organized Earth Day events. The response to COVID-19 might have delayed the occasion, but we will be back stronger than ever!

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Sustainable ORNL
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