



U.S. DEPARTMENT OF ENERGY FY2020

Economic Impact In Tennessee

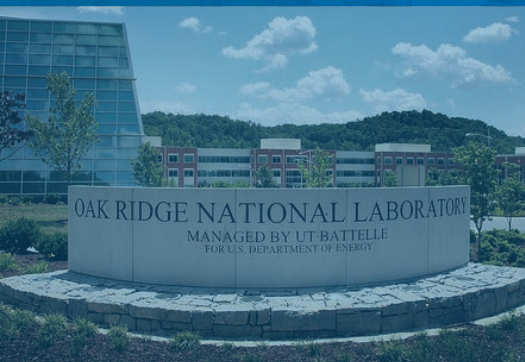


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Introduction

The Department of Energy's (DOE) missions at the Oak Ridge Reservation require cutting-edge tools and the best talent available. These assets are critically important to our state, our nation, and the world. How can science and engineering strengthen our security, enhance our lives, and improve our environment? People come to work every day in Oak Ridge to solve problems related to these issues. It is a place of innovation at the most basic level.

This past year was a remarkable one. Yet, despite the global COVID-19 pandemic, DOE's missions never ceased in Oak Ridge. Workers transitioned to work from home, vital employees maintained critical infrastructure at the Y-12 National Security Complex and Oak Ridge National Laboratory, and the cleanup program continued, on time and under budget. Plus, these missions contributed to scientific discoveries and innovations that are helping to stop the spread of COVID-19 at home and around the world.

The following pages contain a snapshot of DOE's impact in the state of Tennessee using data and information from fiscal year 2020. The study looks at payroll disbursements, nonpayroll spending, pensions and taxes paid, and the ripple effects of spending across the state. It assesses procurement activity, charitable giving, and more.

As you review this study's results, we want you to remember there is much more going on than just these numbers. Howard Baker Sr., Oak Ridge's first congressman, put it this way in a speech he delivered in 1959:

“Oak Ridge can never become just another attractive American city,” said Congressman Baker. “Its fame and its honors based upon past achievements are already too great for this, and its heavy responsibilities for the future of both America and the world preclude the possibility of a quiet, completely normal existence.”

This study is part of a series of studies initiated in 1998 by the University of Tennessee's Center for Business and Economic Research to estimate the economic impact of DOE activities in the state of Tennessee. The current study was conducted by the Howard H. Baker Jr. Center for Public Policy at the University of Tennessee, Knoxville and the East Tennessee Economic Council.

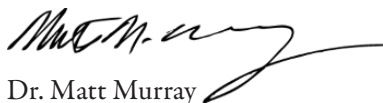
This report would not be possible without the investment of DOE and its partners in the East Tennessee region. We want to thank all those—too many to name—who helped us gather the data, collate it, and put it into readable form.

Sincerely,



Jim Campbell

President, East Tennessee Economic Council



Dr. Matt Murray

Director, Howard H. Baker Jr. Center for Public Policy



Key Findings for FY2020

- Overall spending by DOE and its contractors added approximately \$4.2 billion to Tennessee’s SGDP.
- DOE–related activities generated roughly \$2.9 billion in total personal income in Tennessee in 2020. Each in-state dollar of income directly paid by DOE translates into a total of \$1.89 in personal income for Tennessee residents.
- 42,906 full-time jobs were created in Tennessee by DOE in 2020, including direct and indirect jobs. This means that for every one DOE job, another 1.9 jobs were created across the state.
- DOE and its contractors procured approximately \$940 million in various goods and services from Tennessee businesses in 2020. The largest category of purchasing was in professional, scientific, and technical services.
- Spending by DOE and its contractors generated \$107,850,860 in state and local sales tax revenue in Tennessee in 2020.
- DOE-related employees are well educated and highly trained. In 2020, 1,828 employees held Ph.D. degrees, 3,528 held master’s degrees, and 6,749 held bachelor’s degrees.
- In addition to output, income, tax, and employment effects, DOE entities and their employees donated roughly \$4,180,377 to various charities in FY2020.

TABLE 1: FY2020 SUMMARY OF ECONOMIC IMPACTS IN TENNESSEE

| IMPACT | DIRECT | TOTAL |
|-------------------|-----------------|-----------------|
| Output (SGDP) | \$2,544,332,197 | \$4,214,111,853 |
| Personal Income | \$1,605,203,877 | \$2,924,759,810 |
| Sales Tax Revenue | \$59,192,081 | \$107,850,860 |
| Employment | \$14,667 | \$42,906 |

TABLE 2: GROWTH OF TOTAL ECONOMIC BENEFITS, FY2017 TO FY2020

| | FY2017 | FY2020 | PERCENT CHANGE |
|-----------------|-----------------|-----------------|----------------|
| Output | \$3,385,460,423 | \$4,214,111,853 | 24.5 |
| Personal Income | \$2,198,541,016 | \$2,924,759,810 | 33.0 |
| Employment | 34,496 | 42,906 | 24.4 |

DIRECT BENEFITS OF DOE SPENDING IN TENNESSEE

DOE-related spending produces noteworthy direct benefits for Tennessee's economy.

Approximately 14,667 full-time jobs were directly provided by DOE and its major contractors within Tennessee in 2020, with annual wages and salaries totaling nearly \$1.311 billion.

In addition to the \$1.311 billion spent on payroll, \$294,488,293 was spent on pension disbursements, bringing total income paid to current and former employees for FY2020 to \$1.605 billion. The average annual salary for a DOE-related employee in 2020 was \$89,364, significantly above the statewide average.

TABLE 3: FY2020 DIRECT EMPLOYMENT IN TENNESSEE BY ENTITY

| ENTITY | NUMBER OF EMPLOYEES IN TENNESSEE |
|---|----------------------------------|
| Consolidated Nuclear Security / Y-12 | 6,300 |
| UT-Battelle, LLC / Oak Ridge National Laboratory | 5,151 |
| UCOR | 1,848 |
| Oak Ridge Associated Universities and Oak Ridge Institute for Science and Education | 617 |
| Isotek Systems, LLC | 156 |
| Office of Science Consolidated Service Center | 150 |
| Office of Secure Transportation | 126 |
| National Nuclear Security Administration Production Office | 77 |
| Oak Ridge Office of Environmental Management | 73 |
| North Wind Solutions, LLC / Transuranic Waste Processing Center | 69 |
| Golden SVCS, LLC | 60 |
| Office of Scientific and Technical Information | 39 |
| Total Direct Employment in Tennessee | 14,667 |

Non-payroll expenditures (or direct procurement spending) by DOE totaled more than \$939 million in 2020.

This non-payroll spending created sizeable increases in new income and jobs in various sectors of the state economy. The largest category of purchasing was in professional, scientific, and technical services.

DOE and its contractors, along with businesses and workers affected by the ripple effects of the multiplier, together paid nearly \$107,850,860 in state and local sales taxes in 2020.

When DOE acquires goods and services from Tennessee businesses, it contributes to the state and local sales tax base. In 2020, sales tax payments to state and local governments totaled \$81.1 million and \$26.7 million, respectively. However, these figures only represent revenue generated by sales tax; thus, it understates total tax revenue benefits resulting from DOE-related operations in the state.

TABLE 4: FY2020 SALES TAX REVENUE IMPACT IN TENNESSEE

| | REVENUE | PERCENT |
|--|----------------------|--------------|
| DIRECT PAYMENTS | | |
| State Sales Tax Revenue | \$44,528,661 | 41.3 |
| Local Sales Tax Revenue | \$14,663,419 | 13.6 |
| Total Direct | \$59,192,081 | |
| INDIRECT & MULTIPLIER EFFECTS | | |
| State Sales Tax Revenue | \$36,604,733 | 33.9 |
| Local Sales Tax Revenue | \$12,054,046 | 11.2 |
| Total Indirect | \$48,658,779 | |
| TOTAL SALES TAX REVENUE IMPACT | \$107,850,860 | 100.0 |

TOTAL ECONOMIC BENEFITS OF DOE'S DIRECT SPENDING IN TENNESSEE

Spending by DOE produces additional benefits when direct spending generates new jobs and new income, sending ripples through Tennessee's economy.

In 2020, Tennessee's SGDP increased to approximately \$4.2 billion as a result of direct, indirect, and multiplier effects of DOE-related expenditures.

Changes in SGDP represent DOE's impact on total state output from payroll and non-payroll expenditures, a figure that is almost 25 percent higher than the 2017 study. The output multiplier is 1.66, which suggests that for every dollar directly spent by DOE in Tennessee, SGDP increased by \$1.66.

TABLE 5: FY2020 OUTPUT IMPACT IN TENNESSEE BY SOURCE

| | REVENUE | PERCENT |
|--|------------------------|--------------|
| DIRECT EFFECTS | | |
| Payroll Spending | \$1,310,715,584 | 31.1 |
| Non-payroll Spending | \$939,128,321 | 22.3 |
| Pension Disbursements | \$294,488,293 | 7.0 |
| Total Direct | \$2,544,332,197 | |
| INDIRECT & MULTIPLIER EFFECTS | | |
| Payroll Spending | \$491,780,487 | 11.7 |
| Non-payroll Spending | \$1,067,507,161 | 25.3 |
| Pension Disbursements | \$110,492,008 | 2.6 |
| Total Indirect | \$1,669,779,656 | |
| TOTAL OUTPUT IMPACT | \$4,214,111,853 | 100.0 |

TABLE 6: FY2020 INCOME IMPACT IN TENNESSEE BY SOURCE

| | REVENUE | PERCENT |
|--|------------------------|--------------|
| DIRECT EFFECTS | | |
| Payroll Spending | \$1,310,715,584 | 44.8 |
| Pension Disbursements | \$294,488,293 | 10.1 |
| Total Direct | \$1,605,203,877 | |
| INDIRECT & MULTIPLIER EFFECTS | | |
| Payroll Spending | \$526,383,378 | 18.0 |
| Non-payroll Spending | \$674,906,056 | 23.1 |
| Pension Disbursements | \$118,266,498 | 4.0 |
| Total Indirect | \$1,319,555,933 | |
| TOTAL INCOME IMPACT | \$2,924,759,810 | 100.0 |

DOE-related operations supported 42,906 full-time jobs in Tennessee in 2020.

This suggests that for every direct job provided by DOE, another 1.9 jobs were supported across Tennessee's economy. The significant size of the multiplier reflects, in part, the high average annual salary of DOE-related employees in the state and the notable spending that flows from this income.

TABLE 7: FY2020 EMPLOYMENT IMPACT IN TENNESSEE BY SOURCE

| | EMPLOYMENT | PERCENT |
|--|---------------|--------------|
| DIRECT EFFECTS | | |
| Employees | 14,667 | 34.2 |
| INDIRECT & MULTIPLIER EFFECTS | | |
| Payroll Spending | 12,192 | 28.4 |
| Non-payroll Spending | 13,307 | 31.0 |
| Pension Disbursements | 2,739 | 6.4 |
| Total Indirect | 28,239 | |
| TOTAL EMPLOYMENT IMPACT | 42,906 | 100.0 |

Total state and local sales taxes associated with DOE-related operations were roughly \$107,850,860 in 2020.

DOE-related operations in 2020 gave rise to strong sales tax revenue for state and local governments in Tennessee. Total state sales tax attributed to DOE was \$81.1 million; sales tax revenue generated at the local level reached \$26.7 million.

OTHER BENEFITS AND INITIATIVES

Many benefits of DOE-related operations, such as support for economic development initiatives and entrepreneurship, are hard to quantify. Nonetheless, these activities have a meaningful and positive impact on Tennessee and its residents. Some of these activities are highlighted in this report.

- DOE employees and contractors donated more than \$4,180,377 in charitable contributions, community grants, and equipment to schools and organizations across Tennessee in 2020.
- DOE contractors have continually supported the creation of an Oak Ridge Municipal Airport, downtown Oak Ridge revitalization, and other projects.
- While COVID-19 limited access to the American Museum of Science and Energy in 2020, it was open briefly and continued to provide virtual events and educational programs, including a new podcast dedicated to conveying the importance of STEM.

CASE STUDY

INNOVATION CROSSROADS: ADVANCING NEXT-GENERATION INNOVATORS AND TECHNOLOGY

Innovation Crossroads is a two-year program supported by Oak Ridge National Laboratory (ORNL), the U.S. Department of Energy's Advanced Manufacturing Office, Building Technologies Office, and the Tennessee Valley Authority that leverages ORNL's unique scientific resources and capabilities and connects the nation's top innovators with experts, mentors, and networks in technology-related fields to take world-changing ideas from R&D to the marketplace.

Selected innovators receive a fellowship that includes a personal living stipend, health insurance and travel allowance, a substantial grant to use on collaborative R&D at ORNL, and comprehensive mentoring assistance to build a sustainable business model.

Now on its fifth cohort of innovators, Innovation Crossroads companies and graduates have raised \$23.7 million to date with around \$5 million in venture funding, \$18.4 million in grants, and \$300,000 in other awards and competitions. Several innovators have been recognized by Forbes 30 Under 30, R&D 100, Forbes Next 1000, and other prestigious awards and have placed in numerous competitions, including the Stu Clark New Ventures Championship and National Renewable Energy Laboratory's Industry Growth Forum. Since graduating, approximately half of each cohort has remained in Oak Ridge to advance their technologies and grow their companies.



Above, left: Erica Grant, Founder and Chief Executive Officer, Quantum Lock Technologies, LLC; Innovation Crossroads Cohort 4 Fellow
Above, right: Innovation Crossroads Cohort 5 includes left to right: Caleb Alexander, DayLyte Batteries; Sam Evans, Unbound Water Technologies; Tommy Gibbons, Hempitecture; Shuchi "SK" Khurana, Addiguru; Forrest Shriver, Sentinel Devices; and Philip Stuckey, FC Renew
Right: Erica Grant (in yellow hard hat) participates in a tour of an electric power distribution center led by Peter Fuhr, Group Leader, Grid Communications and Security, Energy Science and Technology Directorate, Oak Ridge National Laboratory

CASE STUDY

INFRASTRUCTURE ENHANCEMENTS

Cranes are visible all over the Oak Ridge Reservation.

The biggest are at the Y-12 National Security Complex, where Bechtel and its contractors are at the peak of construction of the Uranium Production Facility, a \$6.5 billion effort to replace manufacturing and chemical operations originally built in 1943. You could also see them at the former Biology Complex at Y-12, where crews from UCOR demolished those facilities to make way for a new lithium processing facility, with construction commencing in the next year.

In addition to these bigger efforts, Y-12 has 98 active projects in this current fiscal year (2021), planned at a cost of \$390 million. Projects include upgrades to power lines, fixing service hoods, and improving a metal fabrication facility, among others.

The Oak Ridge National Laboratory (ORNL) campus is undergoing a \$4.5 billion rejuvenation that will enable new capabilities and improve aging infrastructure to recapitalize important existing assets. These active projects will enhance the delivery of world-class science.

In neutron science, the Spallation Neutron Source is receiving a proton power upgrade that will double its power, and scientists at the High Flux Isotope Reactor are designing and procuring a new pressure vessel and performing a beryllium changeout that will extend the life of the reactor. In high-performance computing, ORNL is building out infrastructure to support the deployment of its new supercomputer, Frontier. In radioisotopes, the radioisotopes production facility has been approved as a category 2 nuclear facility with hot cells to enable increased production. Projects are also on the books for facilities for stable isotopes production. In material science, a new general sciences facility is being constructed to increase ORNL's research capabilities across multiple disciplines. The new facility will focus on quantum materials as the lab advances its work in quantum affirmation science. And, in fusion science, ORNL is building an



Above, left: Aerial view of Spallation Neutron Source at Oak Ridge National Laboratory

Above, right: Aerial view of the High Flux Isotope Reactor complex

experimental facility called the Material Plasma Exposure eXperiment, or MPEX, a next-generation linear plasma device that will support the study of how plasma interacts long term with the components of future fusion reactors.

Utilities upgrades are being completed to support these projects. ORNL is building a craft resource support facility and recently opened the research operations support center, which consolidates fire department and security services. The old fire hall was converted into a drive-through COVID-19 testing and vaccination center. Throughout the pandemic, 55,000 COVID-19 tests were administered on-site.

ORNL is also working to become a net-zero campus. Initiatives to support this effort include increasing solar capacity and converting its existing fleet to electric vehicles. Much of this effort hinges on the Tennessee Valley Authority deploying a nuclear reactor at the Clinch River site, which they have an early site permit for.

The cleanup mission is also moving into demolition work at ORNL and Y-12, which will enable future missions at those sites. Redevelopment of those sites for future mission work in the science and national security realms is critical to building the innovation campuses of the future.



Y-12 Biology Complex in various stages of demolition, making way for the construction of new production facilities.



CASE STUDY

TECH TRANSFER SUCCESS: EARLY-STAGE BIOPHARMACEUTICAL COMPANY PIONEERING ADVANCES IN REGENERATIVE MEDICINE

Founded in 2008, NellOne Therapeutics (NellOne) is an early-stage biopharmaceutical company pioneering advances in regenerative medicine founded from Oak Ridge National Laboratory (ORNL) technology. NellOne's Chief Science Officer and co-founder, Dr. Cymbeline (Bem) Culiati, spent a decade as a senior scientist at ORNL, where her research elucidated the role of the NELL1 protein in promoting growth and maturation of the musculoskeletal and cardiovascular systems.

Dr. Culiati is the inventor on 21 patents issued in eight countries on the veterinary and human applications of NELL1 as a novel therapeutic for soft tissue regeneration. These patents are exclusively licensed worldwide to NellOne. Bill Malkes, an accomplished entrepreneur and co-founder of GRIDSMART Technologies (which he sold to Cubic Corporation for \$87 million in 2019), joined NellOne as its Chief Executive Officer in early 2020.

In August 2020, NellOne secured a key patent to revolutionize large-scale production of the company's novel variant of the NELL1 protein, allowing the company to commercialize its pioneering science. The company also received a National Science Foundation Small Business Innovation Research Phase I grant in 2021 to further advance its technology.



Top: Dr. Cymbeline (Bem) Culiati, Chief Science Officer and co-founder of NellOne Therapeutics

Above, left: Summit supercomputer

Above, right: Chris Ellis, Chief Executive Officer of NellOne Therapeutics

Department of Energy Sites and Offices in Oak Ridge

OAK RIDGE NATIONAL LABORATORY

Oak Ridge National Laboratory (ORNL) is the largest DOE science and energy laboratory, conducting basic and applied research to deliver transformative solutions to compelling problems in energy and security.

ORNL's diverse capabilities span a broad range of scientific and engineering disciplines, enabling the laboratory to explore fundamental science challenges and carry out the research needed to accelerate the delivery of solutions to the marketplace. ORNL supports DOE's national missions of:

- **Scientific discovery:** Assemble teams of experts from diverse backgrounds, equip them with powerful instruments and research facilities, and address compelling national challenges.
- **Clean energy:** Deliver technology solutions for energy-efficient buildings, transportation, and manufacturing and study biological, environmental, and climate systems to develop new biofuels and bioproducts and explore the impacts of climate change.
- **Security:** Develop and deploy "first-of-a-kind" science-based security technologies to make the world a safer place.

ORNL supports these missions through leadership in four major areas of science and technology:

- **Neutrons:** Operate two of the world's leading neutron sources, which enable scientists and engineers to gain new insights into materials and biological systems.
- **Computing:** Accelerate scientific discovery through modeling and simulation on powerful supercomputers, advance data-intensive science, and sustain U.S. leadership in high-performance computing.
- **Materials:** Integrate basic and applied research to develop advanced materials for energy applications.
- **Nuclear:** Advance the scientific basis for 21st century nuclear fission and fusion technologies and systems and produce isotopes for research, industry, and medicine.

ORNL is managed and operated by UT-Battelle, LLC, a private not-for-profit company established in 2000 for DOE's Office of Science.

Following are a few highlights of the cutting-edge facilities and capabilities at ORNL:

GRID-C

The Grid Research Integration and Deployment Center (GRID-C) at ORNL's Hardin Valley Campus combines electrification research activities across the utility, buildings, and vehicle spaces. The combination of innovative research and development in power and energy systems, vehicle and buildings science, power electronics, energy storage, sensors and controls, data science and modeling, and cybersecurity enables breakthroughs to support a resilient and secure power grid from the first instant of electricity generation to end use.

Supercomputing

ORNL is home to one of the world's most powerful supercomputers, called Frontier, along with a suite of other machines that comprise the nation's most powerful open scientific computing facility. Because ORNL's expertise covers a wide range of scientific disciplines, its supercomputing capabilities can be uniquely applied to problems across multiple areas.

Spallation Neutron Source

The Spallation Neutron Source (SNS) is a singular facility that provides the world's most intense pulsed neutron beams for scientific research and industrial development. SNS welcomes researchers from around the world through an independent proposal selection process conducted by the neutron-scattering community.

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

The Oak Ridge Institute for Science and Education (ORISE) is a DOE asset that is dedicated to enabling critical scientific, research, and health initiatives of the department and its laboratory system by providing world-class expertise in STEM workforce development, scientific and technical reviews, and the evaluation of radiation exposure and environmental contamination.

ORISE accomplishes its mission by providing superior, integrated solutions to:

- Recruit and prepare the next generation of our nation's scientific workforce.
- Promote sound scientific and technical investment decisions through independent peer reviews.
- Facilitate and prepare for the medical management of radiation incidents in the U.S. and abroad.
- Evaluate health outcomes in workers exposed to chemical and radiological hazards on the job.
- Ensure public confidence in environmental cleanup through independent environmental assessments.

ORISE is managed by Oak Ridge Associated Universities (ORAU), a 127-member consortium of major Ph.D.-granting academic institutions cultivating collaborative partnerships that enhance the scientific research and education enterprise of our nation. ORAU, a 501(c)(3) nonprofit corporation, manages ORISE for DOE's Office of Science.

Y-12 NATIONAL SECURITY COMPLEX

The Y-12 National Security Complex is a key National Nuclear Security Administration (NNSA) facility in the U.S nuclear security enterprise. Y-12 is responsible for ensuring the effectiveness of the nuclear weapons deterrent through manufacturing and storage operations and technology development. Y-12 provides the uranium feedstock that powers the U.S. Navy's nuclear fleet and reduces global threats by retrieving and storing nuclear materials.

The Oak Ridge, Tennessee facility was originally built as part of World War II's Manhattan Project. For over 75 years, Y-12 has responded to unique challenges in support of national security. Today, Y-12 continues to adapt and deliver as it expands its capabilities and continues to modernize site infrastructure.

NNSA is constructing the Uranium Processing Facility (UPF) at Y-12. UPF supports the Uranium Mission Strategy, which ensures the long-term viability, safety, and security of enriched uranium capabilities in the United States. Currently, these unique capabilities reside in an aging World War II-era facility.

UPF is a multi-building complex designed for enriched uranium operations. This approach allows each building to be constructed to the safety and security requirements appropriate to its function, promoting cost-saving opportunities in construction and equipment installation. A \$6.5 billion investment, UPF is one of DOE's largest investments in Tennessee since the Manhattan Project and one of NNSA's largest construction projects.

Y-12 is managed and operated by Consolidated Nuclear Security, LLC (CNS), which also operates the Pantex Plant, located near Amarillo, Texas, in support of NNSA. CNS is building UPF for NNSA through a subcontract with Bechtel National, Inc.



OFFICE OF SCIENCE CONSOLIDATED SERVICE CENTER

The Office of Science Consolidated Service Center (CSC) plays a critical role in program execution and implementation by administering the office's \$10 billion annual laboratory budget and providing professional services in support of the entire federal Office of Science complex.

CSC provides crosscutting support services, including subject matter expertise in environmental compliance, safety and health, safeguards and security, quality assurance, personal property, real property and infrastructure, funds management, financial evaluation, financial assistance, procurement and contracts, information management, and Equal Employment Opportunity, Diversity, and Inclusion.

CSC operates as a single organization utilizing the combined business, administrative, and technical capabilities from multiple locations, including Lemont, Illinois and Oak Ridge, Tennessee. CSC support is delivered through a customer-service model focused on the safe, compliant, and efficient execution of Office of Science activities at supported sites.

OAK RIDGE OFFICE OF ENVIRONMENTAL MANAGEMENT

The Oak Ridge Office of Environmental Management (OREM) is a DOE field site located in Oak Ridge, Tennessee. The site dates to 1942 as part of the Manhattan Project. Engineers developed three distinct campuses within the Oak Ridge Reservation to support the wartime effort. Two explored various technologies to enrich uranium, while the other explored how to produce plutonium.

In the decades since, each of these campuses— ORNL, Y-12, and East Tennessee Technology Park (ETTP) — evolved and conducted different missions for the department. OREM has worked since the 1980s to eliminate environmental legacies created from those Manhattan Project and Cold War-era operations, and its important work continues today.

OREM has made incredible progress in recent years. The program achieved a historic environmental cleanup milestone in 2020 by becoming the first site in the world to remove a former enrichment complex. This initiative involved removing more than 500 contaminated buildings and major soil excavation. OREM's work has transformed the former K-25 Gaseous Diffusion Plant into today's ETTP. Land that previously had no future has been cleaned and transferred to the community for beneficial reuse as a multi-use industrial center, national park, and conservation area to attract visitors and industry to the region.

Now, a new chapter of cleanup is underway at Y-12 and ORNL. At Y-12, OREM is tearing down deteriorated structures, preparing excess and contaminated facilities for demolition, and building infrastructure for crews to address sources of mercury contamination. These efforts are eliminating risks, enhancing safety, and clearing land for national security missions. At ORNL, OREM is removing aging, contaminated buildings, eliminating inventories of radioactive waste, and preparing numerous research reactors for demolition to enhance safety and enable modernization at one of the nation's most important research sites.

OREM executes its mission using five primary contractors – UCOR, NorthWind, Isotek, APTIM-North Wind, and Jacobs Engineering.

OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

A unit of the Office of Science, DOE's Office of Scientific and Technical Information (OSTI) fulfills agency-wide responsibilities to collect, preserve, and disseminate unclassified and classified scientific and technical information (STI) emanating from DOE-funded R&D activities at DOE national laboratories and facilities and at universities and other institutions nationwide. Established in 1947, OSTI grew out of the post-World War II initiative to make the scientific research of the Manhattan Project as freely available to the public as possible, and its corporate function is authorized in several laws covering DOE and its predecessor agencies.

OSTI provides access to DOE STI through OSTI.gov, its primary search tool, and a suite of other web-based, searchable discovery tools, offering ever-expanding sources of R&D information to DOE, the research community, and the science-attentive public. OSTI also provides services to DOE labs and other federal agencies in support of open science concepts, particularly in issuing persistent identifiers to interlink related research outputs such as publications, data, and software.

OFFICE OF SECURE TRANSPORTATION

A part of NNSA, the Office of Secure Transportation (OST) is responsible for the safe and secure transport of government-owned special nuclear materials in the contiguous United States. These classified shipments can contain nuclear weapons or components, enriched uranium, or plutonium. Cargo is transported in highly modified secure tractor-trailers and escorted by armed federal agents in other vehicles who provide security and national incident command system response in the event of emergencies.

There are three commands from which OST federal agents operate: Albuquerque, New Mexico; Amarillo, Texas; and Oak Ridge, Tennessee. OST headquarters is located in Albuquerque, while the OST Training Command is located at Fort Chaffee, Arkansas.

A key component of OST operations is the law enforcement/emergency management liaison program. OST provides briefings to various federal, tribal, state, and local organizations on which OST depends for support.

CASE STUDY

FEDERAL-AND-STATE FUNDED PARTNERSHIP: OAK RIDGE ENHANCED TECHNOLOGY AND TRAINING CENTER

The National Nuclear Security Administration is investing \$20 million into a new Simulated Nuclear and Radiological Activities Facility that, along with a \$15 million state-funded Emergency Response Training Facility, will become part of a new Oak Ridge Enhanced Technology and Training Center (ORETTC).

Once complete, this joint federal- and state-funded investment will focus on enhancing national security in the areas of nuclear processes, security services, emerging technologies, and detection testing. As an integrated security campus, ORETTC will draw skilled personnel and visitors from around the world, making East Tennessee a destination for those interested in security testing, training, emergency response, and non-proliferation.

Construction of the facilities is expected to directly employ 125 people. Once operational, dozens of permanent employees will be based at ORETTC, while hundreds of visitors to Oak Ridge may participate in training at any given time.



Above, left: Rendering of the Simulated Nuclear and Radiological Activities Facility

Above, right: Rendering of the Emergency Response Training Facility

Department of Energy Program Offices in Oak Ridge

OFFICE OF SCIENCE

- Oak Ridge National Laboratory Site Office (<https://science.energy.gov/oso>)
 - Oak Ridge National Laboratory (<https://www.ornl.gov>)
 - Oak Ridge Institute for Science and Education (<https://orise.ornl.gov>)
- Office of Science Consolidated Service Center (<https://www.energy.gov/science/office-science-consolidated-service-center-csc>)
- Office of Scientific and Technical Information (<https://www.energy.gov/science/resources/scientific-and-technical-information> or <https://www.osti.gov>)

NATIONAL NUCLEAR SECURITY ADMINISTRATION

- National Nuclear Security Administration Production Office (<https://www.energy.gov/nnsa/locations>)
 - Y-12 National Security Complex (<https://www.y12.doe.gov>)
 - Uranium Processing Facility Project Office (<https://www.bechtel.com/projects/uranium-processing-facility>)
- Office of Secure Transportation Eastern Command (<https://www.energy.gov/nnsa/office-secure-transportation>)

OFFICE OF ENVIRONMENTAL MANAGEMENT

- Oak Ridge Office of Environmental Management (<https://www.energy.gov/orem/oak-ridge-office-environmental-management>)

CASE STUDY

VISITING ONE OF THE NATION'S NEWEST NATIONAL PARKS

The Manhattan Project National Historical Park is one of the nation's newest national parks. Established in November 2015, the park preserves portions of the World War II-era sites where the U.S. developed the world's first atomic weapons. This unique park, managed in partnership by the National Park Service and the U.S. Department of Energy, is composed of three principal locations: Oak Ridge, Tennessee; Hanford, Washington; and Los Alamos, New Mexico.

The Clinton Engineer Works, which became the Oak Ridge Reservation, was the administrative and military headquarters for the Manhattan Project and home to more than 75,000 people who built and operated the city and industrial complex in the hills of East Tennessee. During their visit to Oak Ridge, visitors can view and tour the X-10 Graphite Reactor National Historic Landmark, Buildings 9731 and 9204-3 at the Y-12 National Security Complex, and the K-25 building site. Visitors may also explore the K-25 History Center, the American Museum of Science and Energy, New Bethel Church at Oak Ridge National Laboratory, Y-12 New Hope History Center, and other significant historical sites in the region.



Above, left: American Museum of Science and Energy



Above, right: Entrance to the Secret City Commemorative Walk

Right: K-25 History Center



CASE STUDY

ENVIRONMENTAL CLEANUP PROGRESS CREATING NEW ECONOMIC OPPORTUNITIES FOR THE REGION

A former uranium enrichment complex that was pivotal in building the nation's nuclear arsenal during World War II and the Cold War is now home to new businesses, a national park, and trails and greenways thanks to the U.S. Department of Energy's Oak Ridge Office of Environmental Management (OREM) and its prime contractor, UCOR.

Almost 25 years ago, when the former K-25 Gaseous Diffusion Plant sat shuttered with dilapidated, contaminated buildings, its future as an economic and recreational hub was hard to imagine. Now, with major cleanup complete, that transformation is becoming a reality.

Over that span, OREM's environmental management program worked tirelessly to remove 500 vacant, contaminated structures and transform the site into a multi-use industrial park that creates new economic opportunities for the region. The East Tennessee Technology Park (ETTP), as it is known today, has 20 private businesses located on-site, with other companies recently announcing plans to construct bigger projects there in the coming years.

In spring 2021, the Tennessee Valley Authority and Kairos Power announced plans to collaborate on deploying a low-power demonstration reactor at the site. Kairos Power's initial \$100 million investment is expected to create 55 jobs, and it will be located on land that OREM cleaned and cleared for beneficial reuse.

Another innovative company, Coqui Radio Pharmaceuticals Corp., announced it intends to build a medical isotope production facility at ETTP to produce medical isotopes for use in diagnosis and treatment procedures. The company expects to begin operating its facility in 2026, generating 200 jobs.

Also located at ETTP is one of UniTech Services Group's global locations, the Oak Ridge Service Center (ORSC). ORSC is a specialized hub for waste management and serves as a facility for the Bulk Survey for Release process. The center receives shipments from UniTech's regional facilities and serves all North American UniTech customers. ORSC is one of three UniTech plants with full import and export capabilities to decontaminate materials from Canadian nuclear plants.



Left: DOE's Office of Environmental Management removed some of the largest buildings in the world as part of its cleanup at the East Tennessee Technology Park, including the former K-33 uranium enrichment building.

Above, left: DOE's Office of Environmental Management removed more than 500 buildings spanning more than 13 million square feet as part of its cleanup efforts at the East Tennessee Technology Park.

Above, right: Kairos Power is planning a low-power demonstration reactor on a 185-acre parcel that once housed the massive K-31 and K-33 enrichment buildings.

Appendix

OVERVIEW OF METHODOLOGY

The new RIMS II output, income, and employment multipliers used in this analysis are specific to Tennessee and are calculated by the Bureau of Economic Analysis. These multipliers represent the most recent regional multipliers available and supplant those used in the last study. The multipliers are calculated from industries of the North American Industry Classification System (NAICS).

There are 64 industries aggregated into three (output, income, and employment) multipliers based on NAICS. Output multipliers represent the total dollar change in output that occurs in all industries for each additional dollar of output delivered to final demand by industry. For example, the average output multiplier for all industries in 2019 is 2.11 and the average multiplier for 2013 was 2.12. The income multiplier represents the total dollar change in household earnings for each additional dollar of output delivered to final demand. The average income multiplier for 2019 is 0.58 and the average multiplier for 2013 was 0.56. The employment multipliers, which represent the total change in the number of jobs that occur in all industries for each additional one million dollars of output delivered to final demand by industry, averaged 13.0 in 2019 and 14.9 in 2013.

The primary purpose of this study is to analyze the benefits of DOE operations in Tennessee. The economic benefits accruing to the state are measured by the increase in production of goods and services as measured by SGDP, the number of jobs created, and the amount of personal income that is generated for residents. The main fiscal benefit accounted for in this study is the additional sales tax revenue generated for state and local governments due to the increase in DOE economic activity.

The economic impact measures are further broken down into direct, indirect, and multiplier effects. Direct effects are those specifically associated with DOE. Workers employed by DOE and its contractors represent the direct employment benefit of DOE. Likewise, expenditures by DOE on wages and salaries are the direct income effect. Direct fiscal effects arise through a range of taxes on businesses such as property and sales taxes from investment in real and personal property and purchases of sales taxable items. Additionally, there are payments in lieu of taxes and other fees paid by DOE and its contractors that contribute to DOE direct fiscal benefit.

Indirect effects arise from DOE's procurement of raw materials, services, supplies, and other operating services that help support jobs in regional businesses, as well as expenditures by visitors to facilities supported by DOE. For example, many business services used by DOE are purchased from firms within Tennessee. The economic effects of DOE increase as the share of raw materials and other inputs acquired within the region increase. Only the portion of expenditures actually retained by an in-state vendor can be used in the calculation of the firm's indirect income benefit to the state economy. For example, if new computers are purchased from a supplier in middle Tennessee but the computers were actually manufactured outside the state, only the mark-up of the machines above cost would be the source of new income in the state. State and local governments gain benefits resulting from taxes on these sales, but this impact is counted separately. Therefore, the size of DOE's indirect impact on regional jobs and income depends primarily on the dollar value of regionally purchased goods and services and whether these same goods and services are produced within the region or imported to the community.

The indirect effects arising from visitors to DOE facilities are unique in that most private sector firms would not be expected to attract many visitors. However, because many DOE facilities provide research opportunities for visiting scientists and because the public at large is interested in science and energy, the visitor effect has a substantial quantitative and qualitative benefit. The quantitative effect of visitors to DOE facilities results from expenditures on lodging, food, entertainment, etc., incurred in the state during a visit.

Finally, multiplier effects are created as additional income generated by the direct and indirect effects is spent and re-spent within the local economy. For example, part of the wages received by DOE employees will be spent on retail sales. If employees shop in Nashville, part of the sales receipt will be used to pay local employees at retail establishments. These employees will, in turn, spend a portion of their income in the state on groceries, housing, clothing, etc., thereby adding to the amount of statewide personal income directly attributed to DOE's activities. It should be noted that during each of these subsequent rounds of spending, a portion of the income generated leaks out of Tennessee's economy through taxes, savings, and spending outside the state, thereby diminishing the increment to total state income attributable to these firms.

Total economic impacts attributed to increased business activity are computed as the sum of the direct, indirect, and multiplier effects. The model used in this report was developed by the Howard H. Baker Jr. Center for Public Policy at the University of Tennessee, Knoxville and relies on RIMS II multipliers to calculate economic impacts noted above. Using the expenditure and employment data provided by DOE, the model allows calculation of the output, income, employment, and sales tax revenue impacts accruing in the state of Tennessee.

TABLE 8: FY2020 EXPENDITURES IN TENNESSEE BY INDUSTRIAL SECTOR

| SECTOR | EXPENDITURES |
|--|---------------------|
| Farms | \$0 |
| Forestry, fishing, and related activities | \$420,304 |
| Oil and gas extraction | \$0 |
| Mining (except oil and gas) | \$1,380,401 |
| Support activities for mining | \$0 |
| Utilities | \$5,682,397 |
| Construction | \$70,865,758 |
| Wood product manufacturing | \$780,065 |
| Nonmetallic mineral product manufacturing | \$1,285,163 |
| Primary metal manufacturing | \$790,681 |
| Fabricated metal product manufacturing | \$19,549,466 |
| Machinery manufacturing | \$20,710,364 |
| Computer and electronic product manufacturing | \$19,381,812 |
| Electrical equipment, appliance, and component manufacturing | \$8,936,155 |
| Motor vehicles, bodies and trailers, and parts manufacturing | \$0 |
| Other transportation equipment manufacturing | \$1,766,960 |
| Furniture and related product manufacturing | \$3,282,632 |
| Miscellaneous manufacturing | \$12,678,290 |
| Food and beverage and tobacco product manufacturing | \$3,417,137 |
| Textile mills and textile product mills | \$173,006 |
| Apparel, leather, and allied product manufacturing | \$4,961,694 |
| Paper manufacturing | \$632,565 |
| Printing and related support activities | \$37,321 |
| Petroleum and coal products manufacturing | \$2,406,112 |
| Chemical manufacturing | \$3,240,823 |
| Plastics and rubber products manufacturing | \$500,983 |
| Wholesale trade | \$23,051 |
| Motor vehicle and parts dealers | \$0 |
| Food and beverage stores | \$0 |
| General merchandise stores | \$0 |
| Other retail | \$1,743,561 |
| Air transportation | \$1,000 |
| Rail transportation | \$0 |
| Water transportation | \$0 |

TABLE 8: FY2020 EXPENDITURES IN TENNESSEE BY INDUSTRIAL SECTOR (CONT'D)

| SECTOR | EXPENDITURES |
|---|------------------------|
| Truck transportation | \$1,096,699 |
| Transit and ground passenger transportation | \$0 |
| Pipeline transportation | \$0 |
| Other transportation and support activities | \$37,184 |
| Warehousing and storage | \$159,658 |
| Publishing industries (except Internet) | \$2,465,987 |
| Motion picture and sound recording industries | \$12,755 |
| Broadcasting (except Internet) and telecommunications | \$569,683 |
| Data processing, hosting, and other information services | \$887,670 |
| Monetary Authorities-central bank, credit intermediation, and related services | \$0 |
| Securities, commodity contracts, and other financial investments and related activities | \$4,611,859 |
| Insurance carriers and related activities | \$0 |
| Funds, trusts, and other financial vehicles | \$0 |
| Real estate | \$74,969,586 |
| Rental and leasing services and lessors of nonfinancial intangible assets | \$5,034,664 |
| Professional, scientific, and technical services | \$479,669,864 |
| Management of companies and enterprises | \$0 |
| Administrative and support services | \$58,020,667 |
| Waste management and remediation services | \$79,823,096 |
| Educational services | \$39,601,683 |
| Ambulatory health care services | \$3,184,107 |
| Hospitals | \$0 |
| Nursing and residential care facilities | \$0 |
| Social assistance | \$413,901 |
| Performing arts, spectator sports, museums, and related activities | \$7,500 |
| Amusement, gambling, and recreation industries | \$0 |
| Accommodation | \$1,000 |
| Food services and drinking places | \$17,130 |
| Other services | \$3,895,925 |
| TOTAL NON-PAYROLL SPENDING | \$939,128,321 |
| PAYROLL EXPENDITURES | \$1,310,715,584 |
| PENSIONS DISBURSEMENT | \$294,488,293 |
| TOTAL EXPENDITURES | \$2,544,332,197 |

Acronyms

| | | | |
|---------------|---|----------------|--|
| CNS | Consolidated Nuclear Security, LLC | PhD | Doctor of Philosophy |
| CSC | Office of Science Consolidated Service Center | R&D | research and development |
| DOE | U.S. Department of Energy | RIMS II | Regional Input-Output Modeling System |
| ERTF | Emergency Response Training Facility | SGDP | state gross domestic product |
| ETTP | East Tennessee Technology Park | SNRAF | Simulated Nuclear and radiological Activities Facility |
| FY | fiscal year | SNS | Spallation Neutron Source |
| GRID-C | Grid Research Integration and Deployment Center | STI | Scientific and Technical Information |
| K-25 | original name for Oak Ridge Gaseous Diffusion Plant, now East Tennessee Technology Park | STEM | science, technology, engineering, and mathematics |
| MDF | Manufacturing Demonstration Facility | UCOR | URS CH2M Oak Ridge LLC, now an Amentum-led partnership with Jacobs |
| MPEX | Material Plasma Exposure eXperiment | UPF | Uranium Processing Facility |
| NAICS | North American Industry Classification System | UPO | Uranium Processing Facility Project Office |
| NNSA | National Nuclear Security Administration | US | United States of America |
| ORAU | Oak Ridge Associated Universities | UT | University of Tennessee |
| OREM | Oak Ridge Environmental Management | X-10 | original name for Oak Ridge National Laboratory |
| ORETTC | Oak Ridge Enhanced Technology and Training Center | Y-12 | Y-12 National Security Complex |
| ORISE | Oak Ridge Institute for Science and Education | | |
| ORNL | Oak Ridge National Laboratory | | |
| ORSC | Oak Ridge Service Center | | |
| OST | Office of Secure Transportation | | |
| OSTI | Office of Scientific and Technical Information | | |



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