
THE ECONOMIC BENEFITS OF THE U.S. DEPARTMENT OF ENERGY FOR THE STATE OF TENNESSEE

**Matthew N. Murray, Associate Director
Brian Hill, Graduate Research Assistant
Stacia Couch, Publications Specialist
Center for Business and Economic Research**

**Prepared by
Center for Business and Economic Research
College of Business Administration
The University of Tennessee
Knoxville, Tennessee**

**Prepared for
U.S. Department of Energy, Oak Ridge Operations**

June 2004

Executive Summary

The operations of the U.S. Department of Energy (DOE) provide a major source of economic benefits for the state of Tennessee and its residents through the creation of jobs and income and expansions in state and local tax bases. DOE has a unique opportunity to help influence the economic success of the region. In order to detail and verify the benefits attributed to DOE operations, the Center for Business and Economic Research at the University of Tennessee began conducting in-depth analyses of the economic impacts of DOE payroll and non-payroll spending on the state of Tennessee in 1998. Subsequent analyses were conducted for fiscal years 1999, 2000, and 2001. The current study provides an analysis of the economic benefits for fiscal year 2003. The results of the current study provide evidence of DOE's role as a major contributor to the Tennessee economy.

“But the real future economic impact of the laboratory stems from its capabilities as a center for scientific research and technology development – Oak Ridge can become a growth engine for the entire region.”

Dr. Ray Orbach, Director,
Office of Science, U.S. DOE,
July 18, 2003

Key findings for FY 2003 include the following (FY 2001 results shown in parentheses):

- **Spending by DOE and its contractors led to an increase of nearly \$3.2 (\$2.5) billion in the state of Tennessee's gross state product in 2003.**
- **Total personal income generated in the state of Tennessee by DOE-related activities was nearly \$1.7 (\$1.3) billion in 2003. Each dollar of income directly paid by DOE in the state translates into a total of \$2.26 (\$1.92) in personal income for Tennessee residents.**
- **DOE spending supported 54,555 (37,660) full-time jobs in the state in 2003, meaning that for every one DOE job, 3.8 (2.6) additional jobs were supported in other sectors of the state economy.**
- **DOE-related spending generated \$66.7 (\$57.8) million in state and local sales tax revenue in Tennessee in 2003.**

- **DOE operations continue to recruit a highly trained and educated workforce. In 2003, 956 (937) employees held Ph.D. degrees, 1,668 (1,474) held Masters degrees and 3,461 (2,564) held a Bachelors degree.**
- **Other DOE activities serve to improve the quality of life for Tennesseans. While some enhance the productivity of Tennessee industries and workers, others contribute to the well-being of residents in a more personal manner. For example, DOE, its contractors and their employees donated over \$15.6 (\$12.0) million in 2003.**

I. DIRECT BENEFITS OF DOE

DOE spending yields significant direct benefits for the state economy.

- **DOE and its major contractors¹ provided 11,287 (10,336) full-time jobs in Tennessee in 2003 with annual wages and salaries totaling \$565.4 (\$489.4) million.**

During 2003, DOE and its major contractors employed 11,287 full-time equivalent employees living in the state of Tennessee and spent more than \$565.4 million in payroll expenditures. The jobs are relatively high wage jobs with an average annual salary of \$49,780.

- **Total non-payroll spending (or direct procurement spending) by DOE and its contractors totaled more than \$995 (\$516) million in 2003.**

Acquisition of goods and services from Tennessee businesses led to non-payroll spending of \$995 million by DOE and its contractors. Non-payroll spending generates millions of dollars in new income and supports thousands of jobs in a wide array of sectors in Tennessee's economy.

- **DOE and its contractors paid \$17.7 (\$12.6) million in state and local sales taxes in 2003.**

As a result of DOE and contractor purchases of goods and services in Tennessee, \$13.1 million and \$4.6 million were directly contributed to the public coffers of state and local governments, respectively. However, this number understates the total direct benefits to tax revenues resulting from DOE operations because it excludes other forms of tax payments such as payments-in-lieu-of-taxes, business and property taxes.

¹ BWXT-Y12, LLC; UT-Battelle, LLC; Oak Ridge Associated Universities; Bechtel Jacobs Company, LLC; Wackenhut Services Inc.; DOE Office of Scientific and Technical Information; DOE Oak Ridge Operations; DOE/NNSA Site Office; and other DOE Field Offices.

II. TOTAL ECONOMIC BENEFITS OF DOE'S DIRECT SPENDING IN TENNESSEE

DOE spending ripples through the state's economy, yielding additional benefits.

- **Tennessee's gross state product increased nearly \$3.2 (\$2.5) billion in 2003 as a result of direct, indirect and multiplier effects of DOE spending.**

The total output benefit, measured by changes in gross state product from payroll and non-payroll spending by DOE and its major contractors, was \$3.2 million in the state of Tennessee in 2003. The output multiplier was 1.83, meaning that for \$1.00 directly spent by DOE in Tennessee, an additional \$0.83 of output was produced in other sectors of the economy.

- **DOE activities in Tennessee gave rise to a total income benefit of \$1.7 (\$1.3) billion in the state in 2003.**

DOE's impact on personal income across the state of Tennessee totaled nearly \$1.7 billion in 2003. The income multiplier was 2.26 indicating that for every \$1.00 DOE and its contractors spent on wages and salaries, an additional \$1.26 in personal income was created for the residents of the state.

- **DOE operations supported 54,555 (37,660) full-time jobs in the state of Tennessee in 2003.**

The new income generated in Tennessee as a result of DOE operations supported a total of 54,555 jobs in the state. The employment multiplier was 4.83, meaning that for every direct job provided by DOE, an additional 3.83 jobs were supported in other sectors of the state's economy. This relatively high employment multiplier reflects in part the high average annual salary of DOE-related employees in the state.

- **The total state and local sales taxes attributed to DOE operations totaled more than \$66.7 (\$57.8) million in 2003.**

DOE operations give rise to significant increases in sales tax revenue for state and local governments in Tennessee. In 2003, the total state sales tax attributed to DOE was \$49.5 million, while local tax coffers benefited by an additional \$17.2 million in local sales tax revenue.

**Table A: Summary of Economic Benefits of DOE in Tennessee, 2003
(dollars in millions)**

Impact	Direct	Total
Output	\$1,744.2	\$3,188
Income	\$748.4	\$1,695
Sales Tax	\$17.7	\$66.7
Employment	11,287	54,555

III. OTHER BENEFITS AND INITIATIVES

Many of the benefits arising from DOE activities are not easily quantified. At the same time, these broader activities perhaps have an even more important positive impact on the state and its future well-being than the quantifiable economic benefits.

- **DOE, its contractors and their employees donated over \$15.6 (\$12.0) million in charitable contributions, community grants, and equipment bequests to organizations across Tennessee in 2003.**
- **In 2003, nearly 1,983 (1,482) guest researchers generated over 11,000 (8,500) overnight stays in the Knoxville-Oak Ridge area.**
- **The American Museum of Science and Energy drew nearly 78,302 (109,000) visitors during Fiscal Year 2003.**
- **Through its Reindustrialization Initiatives, DOE has achieved approximately \$570 million in cost avoidance and savings while creating nearly 1,600 jobs.**

Table of Contents

Executive Summary	ii
I. INTRODUCTION	1
II. PROFILES OF DOE ACTIVITIES	2
Oak Ridge Operations	2
Oak Ridge National Laboratory	2
Oak Ridge Institute for Science and Education	3
East Tennessee Technology Park	4
Wackenhut Services Incorporated	4
National Nuclear Security Administration, Y-12 Site Office	5
Y-12 National Security Complex	5
The Office of Scientific and Technical Information	5
<i>What DOE Facilities Offer Tennessee</i>	6
III. JOB, INCOME, OUTPUT AND SALES TAX BENEFITS OF DOE IN TENNESSEE IN 2003	7
<i>DOE Expenditure Data</i>	7
<i>Summary of Benefits</i>	9
Output Benefits	9
Income Benefits	9
Employment Benefits	10
Sales Tax Benefit	12
<i>Additional DOE Contributions to Tennessee</i>	13
IV. A BRIGHT PAST – A BRILLIANT FUTURE	14
<i>Reindustrialization</i>	14
Community Reuse Organization of East Tennessee	15
Bechtel Jacobs Company, LLC	16
Y-12 National Security Complex	16
Oak Ridge National Laboratory	17
The Oak Ridge Institute for Science and Education	19
V. CONCLUSION	20
Appendix A: Overview of the Economic Impact Model	21
Appendix B: Companies or Business Lines Developed through ORNL Technologies, FY 2003	23
Appendix C: ORNL’s User Facilities	24

List of Tables

Table A: Summary of Economic Benefits of DOE in Tennessee, 2003	iv
Table 1: DOE-Related Expenditures in Tennessee by Industrial Sector, 2003	8
Table 2: Summary of Economic Benefits of DOE in Tennessee, 2003	9
Table 3: DOE Output Benefit in Tennessee by Source, 2003	9
Table 4: DOE Income Benefit in Tennessee by Source, 2003	10
Table 5: DOE Employment Benefit in Tennessee by Entity, 2003	11
Table 6: DOE Employment Benefit in Tennessee by Source, 2003	11
Table 7: Tennessee's Largest Employers (Non-Governmental), 2003	12
Table 8: DOE Sales Tax Revenue Benefit in Tennessee, 2003	13
Table 9: DOE Community Charitable Contributions by Entity, 2003	13

THE ECONOMIC BENEFITS OF THE U.S. DEPARTMENT OF ENERGY FOR THE STATE OF TENNESSEE IN 2003

I. INTRODUCTION

Since the U.S. Department of Energy (DOE) first sited its facilities in Tennessee in the 1940s, its operations have made significant contributions to the state of Tennessee, its residents and local governments. DOE's on-going operating budget yields significant benefits to the state economy through the creation of jobs and income, increases in state output and expansions in state and local tax bases. Even though DOE's primary presence in the state is in Anderson and Roane Counties, located in or adjacent to the Knoxville Metropolitan Statistical Area, the economic benefits accrue statewide. The spillover of benefits into the rest of the state can be attributed to the ripple effect of initial economic benefits as well as the numerous programs offered by the DOE to companies located within the state.

The Center for Business and Economic Research (CBER) at the University of Tennessee started conducting an in-depth analysis of the annual economic benefits for Tennessee attributable to the operations of DOE in 1999. The current report represents the fifth analysis and presents the economic benefits of DOE for Fiscal Year 2003. The remainder of the report consists of three sections. First, the next section (Section II) provides a brief overview of DOE-related facilities in Tennessee. Section III provides a detailed analysis of the economic benefits for Tennessee in terms of output, income, jobs and sales tax revenue arising from activities of DOE and its major contractors. The final section (Section IV) includes a brief discussion of future directions of DOE and its operations in the state. This section also discusses many of the "qualitative" benefits of DOE's operations in the state.

II. PROFILES OF DOE ACTIVITIES²

The DOE is present in Oak Ridge in three distinct capacities: 1) Oak Ridge Operations Office (ORO), which is one of DOE's major Field Offices; 2) the Y-12 Site Office of the National Nuclear Security Administration (NNSA), an independent agency of the DOE; and 3) the Office of Scientific and Technical Information (OSTI), which is part of the DOE Headquarters Office of Science but is located in Oak Ridge rather than Washington, D.C. ORO and the NNSA use several contractors in the management and operation of their facilities in Oak Ridge.

Based in Oak Ridge, Tennessee, the DOE's facilities are rich in history, dating back to World War II when the organization played a major role in the production of materials for the Manhattan Project. Since then, ORO has expanded far beyond that first mission and today is responsible for implementing DOE mission elements in five major DOE programs: Science and Technology; Environmental Management; National Security; Uranium Programs; and Assets Utilization.

The DOE's 33,749-acre Oak Ridge Reservation is located within the City of Oak Ridge in Anderson and Roane counties. There are three major plant complexes on the Oak Ridge Reservation: the Oak Ridge National Laboratory (ORNL); the East Tennessee Technology Park (ETTP); and the NNSA's Y-12 National Security Complex. Also located in the City of Oak Ridge are the Office of Scientific and Technical Information (OSTI), the Oak Ridge Institute for Science and Education (ORISE) and the American Museum of Science and Energy (AMSE). Together, these facilities and their capabilities represent a unique technological and educational resource and a major component of the growing East Tennessee Technology Corridor.

Oak Ridge Operations (<http://www.oakridge.doe.gov>)

ORO is responsible for the major programs at ORNL, ETTP, and ORISE. ORO is also responsible for programs at Thomas Jefferson National Accelerator Facility in Newport News, Virginia and the gaseous diffusion plants in Paducah, Kentucky and Portsmouth, Ohio.

Oak Ridge National Laboratory (<http://www.ornl.gov>)

ORNL is a multi-program science and technology laboratory managed for DOE by UT-Battelle, LLC. Scientists and engineers at ORNL conduct basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science, increase the availability of clean abundant energy, restore and protect the environment, and contribute to national security. ORNL also performs other work for the DOE, including isotope production, information management, and technical program management, and provides research and technical assistance to other organizations. Originally known as Clinton Laboratories, ORNL was established in 1943 to carry out a single, well-defined mission: the pilot-scale production and separation of plutonium for the World War II Manhattan Project. From this foundation, the Laboratory has evolved into a unique

² Profiles provided by U.S. Department of Energy and its contractors.

resource for addressing important national and global energy and environmental issues. Today, ORNL pioneers the development of new energy sources, technologies, and materials and the advancement of knowledge in the biological, chemical, computational, physical, engineering, environmental and social sciences.

Oak Ridge National Laboratory is the home of highly sophisticated experimental user facilities. These research laboratories are designed to serve not only staff scientists and engineers, but also researchers from universities, industry, foreign institutions, and other government laboratories. They simultaneously advance national research and development and fulfill the DOE missions by minimizing unnecessary duplication of effort, promoting beneficial scientific interactions, and making the most effective use of costly and, in many cases, unique equipment. The diverse and sophisticated research conducted by staff scientists, coupled with the availability of unique resource equipment, is attracting a growing number of guest researchers.

Oak Ridge Institute for Science and Education (<http://www.ornl.gov/orise.htm>)

ORISE has been an integral part of the DOE laboratory system since it was established in 1946 as the Oak Ridge Institute for Nuclear Studies. Today, ORISE and its programs are operated by Oak Ridge Associated Universities (ORAU) with a diverse array of complementary, and often unique, programs including: science education programs; research and training in workforce health, safety, and security; emergency preparedness and response; cleanup verification and radiological site characterization; technical training systems; and integrated scientific and technical expertise.

For more than 50 years, ORISE has administered research participation and fellowship programs for the DOE and other federal agencies. Programs target faculty, postgraduates, graduates, and undergraduates in the fields of science, mathematics, and engineering. These programs offer participants the opportunity to work in state-of-the-art research facilities and encourage collaboration among researchers in academia

ORNL wins four R&D 100 awards, pushing total to 116

During FY 2003, researchers at the Department of Energy's Oak Ridge National Laboratory won four R&D awards from R&D Magazine, which since 1963 has given the awards for the 100 most significant innovations of the year. ORNL's total of 116 awards is second only to General Electric. The following inventions received honors:

RAMiTS - Raman Integrated Tunable Sensor, developed and submitted by Tuan Vo-Dinh, Joel Mobley, Brain Cullum and David Stokes of the Life Sciences Division, and Alan Wintenberg and Steven Frank of the Engineering Science and Technology Division. Robert Maples of RIS of Knoxville is a co-developer.

MicroTrapM - developed and submitted jointly by Michael Ramsey, William Whitten and Peter Reilly of the Chemical Sciences Division; Oleg Kornienko, postdoctoral ORNL fellow; and Protasis Corp. of Marlboro, Mass.

CF8C-Plus - New Cast Stainless Steel for High-Temperature Performance, developed and submitted jointly by Philip Maziasz and Robert Swindeman of the Metals and Ceramics Division and Caterpillar of Peoria, Ill. Joint developers are Timothy McGreevy, Bradley University; Paul Browning, Solar Turbines - DeSoto Overhaul Facility of DeSoto, Texas; and Arun Bhattacharya of Solar Turbines - Materials and Processes Engineering of San Diego.

Uncooled Micromechanical Infrared Camera (UMIR-Cam - developed and submitted by Panos Datskos, Slobodan Rajic, Lawrence Senesac and Nickolay Lavrik of the Engineering Science and Technology Division and James Corbeil, an ORNL research associate.

and the national laboratories. ORISE also operates several world-renowned facilities, including the Radiation Emergency Assistance Center/Training Site, the Radiation Internal Dose Information Center, and the Center for Epidemiologic Research. Nationwide, several ORISE programs hold excellent reputations for their expertise: the Environmental Survey and Site Assessment Program, the Center for Human Reliability Studies, the Emergency Management Laboratory, and the Environment, Safety, and Health Group.

East Tennessee Technology Park (<http://www.ettpreuse.com>) and (http://www.oakridge.doe.gov/env_mgmt.html)

Decades of activities on the Oak Ridge Reservation in support of the government's nuclear research and national security missions has left a legacy of radioactive and toxic chemical wastes, which require management and/or cleanup and disposal. As much as 10 percent of Reservation lands are occupied by old waste sites and contaminated structures. The East Tennessee Technology Park (ETTP), also known as the Heritage Center, is the home of the former gaseous diffusion plant and is a primary focus for DOE's Environmental Management Program.

Cleanup of ETTP is a major component of DOE's accelerated cleanup and closure plan. Under DOE's Accelerated Cleanup approach, the department is focusing on performing environmental cleanup of identified high-risk areas first, setting the following milestones for completion: Melton Valley (near ORNL) - 2006; ETTP - 2008, and the balance of the Reservation - 2015. The cleanup is managed for DOE by Bechtel Jacobs Company LLC, which both self-performs and subcontracts work. In 2003, Bechtel Jacobs and its subcontractors employed approximately 2,400 people in the Oak Ridge cleanup effort.

Reindustrialization is integral to DOE's strategy to accomplish cleanup at ETTP. The current focus of the Reindustrialization Program is to transfer facilities and land to the Community Reuse Organization of East Tennessee (CROET). Twenty-six facilities are slated for transfer to CROET. The remaining buildings will be demolished, and the land will be cleaned up by DOE. If all 26 facilities are transferred, DOE will save nearly \$75 million. These savings will be realized because the new property owner will be responsible for ultimate demolition of the buildings; thus, DOE will not fund these actions. Once cleanup of ETTP is complete, CROET plans to establish a Brownfield industrial complex on the property. Prior to transfers, CROET will continue to lease facilities from DOE and sublease them to private-sector tenants, as it has been doing since 1996. Please see the Reindustrialization section of this report for further information on this effort.

Wackenhut Services Incorporated

In January 2000, DOE/ORO contracted with Wackenhut Services Incorporated (WSI) to provide protective services for the Oak Ridge Complex. WSI brought to this contract a team comprised of three small businesses: PAI Corporation; Critique, Inc.; and NCI. Under this contract, the WSI-OR team provides physical, information and personal protective services for Y-12 National Security Complex, ORNL, ETTP, and the

Federal Office Building Complex. The WSI-OR team employs approximately 735 Tennesseans who protect the DOE's Oak Ridge resources.

National Nuclear Security Administration, Y-12 Site Office

(<http://www.oro.doe.gov/nnsa/>)

The NNSA carries out the national nuclear security responsibilities of the DOE. These responsibilities include maintaining a safe, secure, and reliable stockpile of nuclear weapons and associated materials, capabilities and technologies; promotion of international nuclear safety and nonproliferation; and administration and management of the naval nuclear propulsion program. As required by the National Defense Authorization Act for Fiscal Year 2000, the national security functions and activities performed by certain elements of the DOE were transferred to the NNSA. Management responsibility for operations at the Y-12 National Security Complex (formerly known as the Y-12 Plant) transferred to the Y-12 Site Office (YSO) under the NNSA. ORO provides a variety of services to the YSO as part of a service agreement between the two DOE organizations.

Y-12 National Security Complex (<http://www.y12.doe.gov/index.html/>)

The DOE's National Security mission in Oak Ridge is carried out at the Y-12 National Security Complex. Operated by BWXT Y-12, LLC, for DOE's NNSA, the Y-12 National Security Complex is a manufacturing facility that plays an integral role in NNSA's Nuclear Weapons Complex. Programs at Y-12 include manufacturing and reworking nuclear weapon components, dismantling nuclear weapon components returned from the national arsenal, serving as the nation's storehouse of special nuclear materials, preventing the spread of weapons of mass destruction, and providing special production support to other programs. The Y-12 National Security Complex was part of the Manhattan Project. Its job was to process uranium for the first atomic bomb. Construction of Y-12 started in February 1943; enriched uranium production started in November of the same year. For almost 60 years, Y-12 has been one of the DOE's premier manufacturing facilities. Every weapon in the stockpile has some components manufactured at the Y-12 National Security Complex. Today, NNSA's Y-12 National Security Complex manufacturing facility stretches over approximately 800 acres with more than 575 structures that contain more than 7.0 million square feet of floor space.

The Office of Scientific and Technical Information

(<http://www.osti.gov>)

Research and development (R&D) can only be successful if the knowledge gained through the R&D process is shared. DOE's Office of Scientific and Technical Information (OSTI), as part of DOE Headquarters Office of Science, collects, organizes, preserves, and disseminates information resulting from DOE's \$8.3 billion R&D program. OSTI is responsible for sharing the agency's R&D knowledge and fulfills this responsibility through leading-edge e-government information systems. Among other systems, OSTI's DOE Information Bridge (www.osti.gov/bridge), Energy Citations Database (www.osti.gov/energycitations), and E-Print Network (www.osti.gov/eprints) provide unique access to all forms of R&D information of interest to DOE and the U.S. scientific community. Patrons of OSTI's vast, electronic R&D information collections

include DOE and other federal and contractor researchers, academic institutions, science-attentive citizens, and U.S. industry.

OSTI coordinates an agency-wide program for the corporate management of R&D information involving over 60 DOE Headquarters Offices, Field Offices, National Laboratories, and over 4,000 other contractor facilities. ORSI also partners with 11 federal agency counterparts in providing Science.gov, a premier, “one-stop” web system for citizens and researchers to access the government’s R&D collections. Science.gov is an OSTI-hosted gateway to over 1,700 sites and databases of federal R&D information, over 360 of which are DOE’s.

With OSTI’s e-government systems, the output of DOE’s R&D program has seen exponential increases in usage. For example, less than 10 years ago, the agency’s R&D information was accessed fewer than one million times annually. Today, metrics from OSTI’s web-based systems show usage in excess of 12 million transactions annually. This level of access has undoubtedly improved research productivity, hastened commercial applications of DOE technology, and brought increased visibility and recognition of DOE’s contributions to the sciences.

OSTI’s mission applies not only to current information but also to a repository of 1.2 million technical reports dating back to the 1940s. Although the majority of DOE’s R&D output is open to the scientific community, a sizable share is classified or sensitive. Here, OSTI’s responsibilities are to ensure protection and limited, appropriate access in order to promote homeland defense.

Internationally, OSTI represents DOE and the United States in two multilateral information exchange agreements, which add to the wealth of scientific knowledge available to the domestic science community. OSTI obtains and provides domestic access to approximately 80,000 foreign research summaries annually.

What DOE Facilities Offer Tennessee

The presence of DOE and its contractors in Tennessee gives rise to many benefits, both quantitative and qualitative. Obviously, the facilities discussed above provide employment and income for residents of the state. The jobs provided are most often high-skilled, high-paying jobs resulting in a high quality workforce comprised of some of the top researchers in their field. The presence of DOE also provides the state with national recognition as a leader in manufacturing, advanced materials, neutron sciences, biological sciences and transportation technologies. With its R&D capacity and technology sharing programs, DOE plays a significant role in enhancing Tennessee’s competitive position in attracting private firms to locate within the state. In addition, DOE is active in bringing federal research grant money to the state and its institutions of higher education. The DOE facilities provide an excellent resource to the University of Tennessee through expanded research capabilities and academic programs. The remainder of the report details the more easily quantifiable economic benefits attributed to the operations of DOE supported facilities in Tennessee and enumerates important qualitative benefits to households, firms and workers.

III. JOB, INCOME, OUTPUT AND SALES TAX BENEFITS OF DOE IN TENNESSEE IN 2003

In this section of the report, estimates of quantifiable DOE benefits are developed and presented. The benefit categories considered are output for the state economy, income and jobs that accrue to Tennessee residents, and sales tax revenues for state and local residents. The model used to generate the estimates is summarized in Appendix A.

DOE Expenditure Data

The data used as input into the economic impact model consisted of detailed expenditure data for the 2003 Fiscal Year and was provided by DOE and its major contractors. Field Offices of DOE located outside the state but with expenditures in Tennessee provided the ORO with the detail of those expenditures. Omitted are the contributions of smaller contractors, credit unions and federal employees. Therefore, the benefits detailed below represent a conservative estimate of the actual benefits attributable to DOE's presence in Tennessee.

Steps were taken in the data collection process to prevent the double counting of contracted and subcontracted spending. Expenditures were disaggregated into 36 major industrial sectors for input into the model. Table 1 displays DOE-sponsored spending in Tennessee by sector for Fiscal Year 2003. Total payroll, pension and non-payroll spending in the state in 2003 was \$1,744.2 million, a 47.9 percent increase over 2001.³

Payroll spending represented the largest expenditure category, accounting for \$565.4 million or 32.4 percent of the total spending in Tennessee. Total payroll spending – including payroll and pension disbursements – totaled \$748.4 million. Other notable spending categories include business and miscellaneous services.

DOE contracts out the vast majority of its operations to private companies. The two largest DOE contracts in Tennessee in 2003 were for BWXT Y-12, LLC for the operation of the Y-12 National Security Complex and Bechtel Jacobs Company, LLC. Together these two contractors accounted for 60.0 percent of the total DOE-related expenditures in Tennessee. Other major contractors include UT-Battelle, LLC for the operation of the ORNL and Wackenhut Services Incorporated.

³ See "The Economic Benefits of the U.S. Department of Energy for the State of Tennessee in 2001," Center for Business and Economic Research, The University of Tennessee, Knoxville.

Table 1: DOE-Related Expenditures in Tennessee by Industrial Sector, 2003

Sector	Expenditures
Payroll	565,404,785
Miscellaneous services	417,181,900
Business services	184,129,100
Pensions	183,018,465
Engineering and management services	121,533,321
Health Insurance	111,415,155
Industrial machinery and equipment	31,340,900
Construction	24,132,100
Wholesale trade	22,231,000
Electric, gas, and sanitary services	15,897,300
Real Estate	10,697,800
Instruments and related products	10,323,900
Retail trade	10,241,200
Communication	8,595,400
Transportation	7,392,500
Electronic and other electrical equipment	3,986,500
Chemicals, allied, petroleum and coal products	3,856,500
Health services	3,666,900
Apparel and other textile products	1,577,200
Fabricated metals products	1,505,700
Paper and allied products	1,283,600
Rubber and misc. plastics products, leather products	1,005,000
Other transportation equipment	791,300
Legal services	639,000
Miscellaneous manufacturing industries	509,300
Personal and repair services (except auto)	481,000
Insurance	370,000
Hotels and other lodging places, recreation services	307,000
Printing and publishing	210,000
Eating and drinking places	189,000
Stone, clay and glass products	150,200
Farm products and agricultural, forestry and fishing services	67,300
Lumber and wood products and furniture and fixtures	45,000
Food and kindred products and tobacco products	7,000
Depository and non-depository institutions	5,000
Primary metals industry	1,300
Total Tennessee Expenditures	\$1,744,188,626
Total Non-payroll and Non-pension Expenditures	\$995,765,376

Summary of Benefits

Direct benefits of DOE-funded activity in Tennessee in Fiscal Year 2003 include \$565.4 million in payroll spending, \$995.8 million in non-payroll spending, \$183.0 million in pensions, \$17.7 million in state and local sales tax and 11,287 full-time jobs. The initial injection of money works its way through the state's economy to produce even more substantial impacts via indirect and multiplier effects. Total economic benefits of DOE spending in Tennessee include a \$3,188.3 million increase in output or gross state product (GSP), a \$1,695.0 million increase in personal income, \$66.7 million in state and local sales tax revenue and the support of 54,555 full-time equivalent jobs (see Table 2). A complete discussion of these benefits is presented in the following sections.

Table 2: Summary of Economic Benefits of DOE in Tennessee, 2003

Output (GSP)	\$3,188 million
Personal Income	\$1,695 million
Sales Tax Revenue	\$66.7 million
Employment	54,555 jobs

Output Benefits

The output benefit of DOE-funded activities is measured as the increase in gross state product from its expenditures within the state. In 2003, the output benefit totaled \$3,188.3 million. Table 3 provides a breakdown of the total benefit by initial spending source. The leading source of output benefits was non-payroll spending which accounted for \$2,138.1 million or 67.1 percent of the total output effect. Payroll spending contributed an additional \$788.1 million or 24.7 percent of the total benefit, and pension disbursements and visitor spending gave rise to the remaining increases. As a result of spending and re-spending in the state's economy, DOE-related expenditures resulted in an implicit output multiplier of 1.83. This indicates that for every dollar spent by DOE in Tennessee, the state's GSP is increased by \$1.83.

Table 3: DOE Output Benefit in Tennessee by Source, 2003 (in millions)

Non-payroll Spending	2,138.1
Payroll Spending	788.1
Pension Disbursements	255.1
Visitor Spending	7.0
Total Output Benefit	\$3,188.3

Income Benefits

The total increase in personal income in Tennessee attributable to DOE spending was \$1,695.0 million in 2003. The total income benefit can be divided between direct, indirect and multiplier benefits. Direct income effects accrue as a result of spending on wages, salaries and pension disbursements. In 2003, these effects accounted for more than \$748.4 million, a 12.9 percent increase over the same period in 2001. Indirect effects arise from DOE purchases of goods and services and spending

by visitors to DOE-related facilities. Finally, multiplier effects occur as DOE payroll and non-payroll spending ripples through the state's economy. In 2003, non-payroll expenditures accounted for \$643.3 million in indirect and multiplier income benefits. Visitor spending gave rise to \$2.2 million in income benefits. The remaining \$301.1 million in benefits are attributable to the multiplier effect of payroll and pension disbursements. Table 4 provides a summary of the income benefit to the state of Tennessee as a result of DOE activity in 2003.

Table 4: DOE Income Benefit in Tennessee by Source, 2003 (in millions)

Direct Effects	
Payroll Spending	\$565.4
Pension Disbursements	183.0
Indirect/Multiplier Effects	
Payroll Spending	227.5
Non-payroll Spending	643.3
Pension Disbursements	73.6
Visitor Spending	2.2
Subtotal	946.6
Total Income Benefit	\$1,695.0

The implicit income multiplier, which is calculated by dividing the total income benefit by direct spending on income, is 2.26. In other words, every dollar of income paid directly to the employees of DOE or its contractors results in the creation of \$2.26 in total state income.

Employment Benefits

The total employment benefit of DOE-related expenditures in Tennessee for Fiscal Year 2003 was 54,555 full-time equivalent (FTE) jobs. The direct employment of DOE and its major contractors was 11,287. A decomposition of direct employment is provided in Table 5. BWXT Y-12, LLC and UT-Battelle, LLC represented the two largest DOE-related employers in the state with 4,748 and 3,798 employees residing in Tennessee, respectively. Combined, these two contractors accounted for 75.7 percent of the total direct employment effect.

Table 5: DOE Employment Benefit in Tennessee by Entity, 2003

Division/Contractor	Full-time Employees
BWXT Y-12, LLC	4,748
UT-Battelle, LLC	3,798
Bechtel Jacobs Company	1,009
Wackenhut Services Inc.	735
ORO	510
ORAU	418
OSTI	69
Total Direct Employment	11,287

While DOE-related employment rose only 9.2 percent from 2001 (10,336 to 11,287 full-time equivalent jobs), indirect employment – defined as jobs supported through the purchase of goods and services within the state, visitor spending, and the induced effects of DOE employees spending their income in Tennessee – grew by 58.4 percent. Most significantly, jobs created by non-payroll spending nearly doubled from 2001 to 2003 (14,857 to 29,447 full-time equivalent jobs). A breakdown of the employment impacts by source is provided in Table 6.

Table 6: DOE Employment Benefit in Tennessee by Source, 2003

Direct Effects	FTE Jobs
DOE-related Employees	11,287
Indirect/Multiplier Effects	
Payroll Spending	10,347
Non-payroll Spending	29,447
Pension Disbursements	3,349
Visitor Spending	125
Subtotal	43,268
Total Employment Benefit	54,555

The employment multiplier for DOE-related activities in Tennessee for FY 2003 is 4.83 which means that for every job directly created by DOE an additional 3.83 jobs are supported throughout the state. The resulting employment multiplier is notably higher than for most other industries, suggesting that DOE-related activities have a larger capacity to support jobs, due to the higher than average salary of \$49,780 received by DOE-related employees and the extensive use of contracted employees.

Comparing the number of DOE full-time equivalent employees with other top employers in Tennessee in 2003 indicates that DOE-related employment is a significant contributor to the state's overall employment. With 11,287 DOE-related employees,

DOE employs slightly fewer people in Tennessee than the *fourth largest* non-governmental employer, Kroger Limited Partnership Inc. As shown in Table 7, Tennessee's largest employer is Wal-Mart Associates, which employs 35,700 people.

Table 7: Tennessee's 10 Largest Employers (Non-Governmental), 2003

Company	Employment (in thousands)	Product/Service
Wal-Mart Associates	35.7	Department stores
FedEx Corp.	33.7	Cargo carrier
Vanderbilt University	18.0	University/ hospital
Kroger Limited Partnership, Inc.	11.8	Retail groceries
Lebonheur Childrens Medical Center	8.0	Childrens hospital
United Parcel Service	7.6	Parcel delivery service
Eastman Chemical Company	7.5	Plastics, fibers, chemicals
Nissan Motor Mfg. Corp. USA	7.1	Auto assembly plant
Saturn Corp.	6.7	Auto assembly plant
U.S. Xpress Inc.	6.5	Courier services

Source: Tennessee Department of Economic & Community Development, Tennessee's 50 Largest Employers (Non-Governmental), <<http://www.state.tn.us/ecd/pdf/top50empl.pdf>>.

Sales Tax Benefit

The total contribution of DOE-related activities to state and local sales tax revenue in the state of Tennessee for FY 2003 is estimated to be \$66.7 million. Of that total, approximately 74 percent or \$49.5 million accrues to the state's sales tax coffers and the remaining 26 percent or \$17.2 million accrues to local governments.

The contribution of DOE on state and local sales tax revenue arises from several sources. First, there is the direct payment of sales tax by DOE and its contractors. Additional taxes are paid by DOE-related employees as they spend their income, as well as by visitors to DOE facilities as they make purchases during their stay. Finally, taxes accruing from the activities of businesses and workers supported through direct, indirect, and multiplier-generated income can be attributed to DOE. Table 8 provides a breakdown of the sales tax benefit. In addition to sales taxes, DOE-related activities give rise to other fiscal benefits for state and local governments such as payments-in-lieu-of-taxes, property taxes and business taxes. The current study limits its analysis to sales tax revenue. For this reason, the fiscal benefit of DOE in Tennessee is significantly larger than the sales tax benefit detailed in this section.

Table 8: DOE Sales Tax Revenue Benefit in Tennessee, 2003 (in millions)

Direct Payments	
State	\$13.1
Local	4.6
Indirect/Multiplier	
State	36.4
Local	12.6
Total Sales Tax Revenue Benefit	\$66.7

Additional DOE Contributions to Tennessee

In addition to the obvious economic benefits of DOE's presence in the state, there exist many avenues by which DOE and its contractors contribute to the state's economy and well-being through the many different programs it offers. These programs include community involvement; technology partnerships resulting in the establishment of new businesses and technical assistance to Tennessee firms; contributions to Tennessee educational institutions; and reuse of government assets, DOE grants and job creation initiatives to offset the downsizing of government operations in East Tennessee. These DOE-supported programs have been instrumental in reshaping the state's economy by leading to new products and processes and by improving the overall well-being and competitiveness of the state's industrial base.

One of the more personal ways in which DOE benefits the community at large is through charitable contributions. DOE, its contractors and their employees made significant contributions to charitable causes in 2003. The donations ranged from local United Way campaigns to donations of equipment to area schools. In total, over \$15 million in charitable contributions can be directly attributed to DOE operations in Tennessee. A detail of the donations by firm is provided in Table 9. Of course, community involvement extends beyond monetary donations as staff and employees of these firms are active in civic organizations and volunteer programs. Therefore the figures presented in Table 9 understate the overall benefits that accrue to the state.

Table 9: DOE Community Charitable Contributions by Entity, 2003

	Donation of Equipment	Corporate Contributions	United Way, CFC, etc.	Other Charitable Contributions	Matching Funds for Education	TOTAL
UT-Battelle, LLC	962,280	5,662,935	672,560	--	--	\$7,297,775
BWXT Y-12, LLC	5,712,449	112,034	662,564	280,779	13,477	\$6,781,303
ORO	--	--	58,846	--	--	\$58,846
Bechtel Jacobs Company	--	--	171,649	972,999	7,615	\$1,152,263
ORAU	--	238,658	50,000	--	--	\$288,658
Wackenhut Services Inc.	--	38,000	4,000	14,000	--	\$56,000
OSTI	2,355	--	7,231	--	--	\$9,586
TOTAL	\$6,677,084	\$6,051,627	\$1,626,850	\$1,267,778	\$21,092	\$15,644,431

IV. A BRIGHT PAST – A BRILLIANT FUTURE

The DOE has undergone significant changes in the last few years. All of these changes will effect the conduct of the DOE's missions today and the future direction of DOE operations in Tennessee. Some of these changes hold the prospect for even greater technological leadership in Tennessee.

The future remains bright with several initiatives including the continued construction of the Spallation Neutron Source, and other new facilities at ORNL. The Center for Nanophase Materials marks another important step toward Oak Ridge's position as the Nation's premier center for materials science. This center will provide state-of-the-art nanofabrication and nanoscience facilities. It will join some of the world's best computing facilities, the upgraded HFIR, the SNS, and a new state-of-the-art Advanced Materials Characterization Laboratory to give the Nation a unique set of tools for materials research. This will support leading edge research that is central to ensuring our energy security and economic competitiveness. Progress continues on Reindustrialization initiatives, Accelerated Cleanup, and new facility initiatives at the Y-12 National Security Complex and ORISE. There are more new projects in Oak Ridge than at any other DOE site.

About SNS

The Spallation Neutron Source (SNS) is an accelerator-based neutron source being built in Oak Ridge, Tennessee. This one-of-a-kind facility will be completed in 2006 and will provide the most intense pulsed neutron beams in the world for scientific research and industrial development. The SNS is being built by a partnership of six DOE laboratories.

Although most people don't know it, neutron-scattering research has a lot to do with our everyday lives. For example, things like jets; credit cards; pocket calculators; compact discs, computer disks, and magnetic recording tapes; shatter-proof windshields; adjustable seats; and satellite weather information for forecasts have all been improved by neutron-scattering research.

Neutron research also helps researchers improve materials used in high-temperature superconductors, powerful lightweight magnets, aluminum bridge decks, and stronger, lighter plastic products.

Like other DOE facilities, the SNS will be a user facility open to scientists and engineers from universities, industries, and government laboratories in the United States and from foreign countries. The user community has specified the performance parameters for the SNS and will design and use its instruments. The SNS, which is designed with the future in mind, will be the leading neutron research facility for many years to come.

Reindustrialization

The mission of the Reindustrialization Program is to enable commercial companies to reuse underutilized buildings and land at ETPP in an effort to help diversify the local economy. To accomplish this, ORO has leveraged valuable but unused assets to accelerate cleanup, reduce environmental risk, and create private sector jobs to compensate for the expected loss of jobs as cleanup is completed. Through its varied initiatives, the Reindustrialization Program has achieved approximately \$570 million in cost avoidance and savings. A total of 6.3 million square feet of plant floor space has been transitioned via innovative contracting and leasing initiatives, with the added benefit of creating nearly 1,600 jobs. The jobs created

include those generated by the DOE direct-funded cleanup projects (e.g., the Three Building D&D Project) and those created by tenants leasing space at ETTP through CROET.

CROET has been acting as the leasing agent for Reindustrialization properties since 1996 and, at the end of FY 03, consummated over 75 leases with more than 35 diverse private-sector companies. Businesses locating at ETTP often rehabilitate space in these buildings for reduced lease rates and make use of existing machinery and other assets to reduce their operating costs.

As part of DOE's Accelerated Cleanup Plan for ETTP, the Reindustrialization Program is transitioning from leasing underutilized facilities to transferring them to CROET. Currently, DOE is working on the transfer of eight facilities at ETTP. These transfers are expected to be complete in the 2004-2005 time frame.

Another important initiative that was created by the Reindustrialization Program is the Homeland Defense Equipment Reuse (HDER) Program. This pilot program, spearheaded by a partnership between the DOE and the Department of Homeland Security (DHS), was recently awarded a Pollution Prevention award, which is given to recognize pollution prevention and recycling activities. The HDER program was established to make excess radiological detection equipment available to emergency response and security agencies in the United States. Instrumentation is inspected, repaired and calibrated by The Oak Ridge National Recycling Center (a current tenant at ETTP), which ships the equipment directly to first responder agencies. This Program is funded using DHS resources, and DHS provides training. New equipment would cost between \$800 and \$30,000 each, depending on size and capability, but through the HDER program, the equipment and training is supplied free of cost to first responders throughout the United States.

Community Reuse Organization of East Tennessee (<http://www.croet.com>)

Through September 2003, DOE had committed \$56 million in community transition grant funds to the Oak Ridge region. The funds were used for a variety of programs including training assistance, loans to businesses, development of new and existing industrial parks and grants to local governments for new economic development projects. The Community Reuse Organization of East Tennessee (CROET) reported that 355 jobs were created or retained during FY 2003 as a result of the reindustrialization effort at the Heritage and Horizon Centers in Oak Ridge.

As an alternative to locating at Heritage Center, CROET can offer incoming companies the option of locating at the completed Horizon Center, a greenfield business park adjacent to Heritage Center. CROET's first tenant in Horizon Center is a medical isotope company which has constructed a \$30 million facility that will house upwards of 240 workers who will produce a revolutionary and highly successful cancer therapy treatment.

Bechtel Jacobs Company, LLC (<http://www.bechteljacobs.com>)

During FY 2003, DOE transformed its cleanup contract with Bechtel Jacobs Company, LLC, to a closure contract reflecting the DOE focus on accelerated cleanup. The closure contract is projected to accelerate cleanup by five years saving \$1.4 billion over the life of the program.

The cleanup of the “Boneyard/Burnyard site” was completed during FY 2003. This was one of the first projects to be completed under the Bear Creek Valley Record of Decision. The successful completion of this project sets the stage for the DOE ORO Accelerated Cleanup Plan, which calls for cleanup and closure of major portions of the Oak Ridge Reservation by 2008.

Y-12 National Security Complex (<http://www.y12.doe.gov>)

Modernization of the Y-12 National Security Complex will ensure the continuation of a vital national security resource for the country and an economic mainstay in East Tennessee.

**BWXT Y-12 Support to
Business, Education and Community**

- *Donated more than \$300,000 to East Tennessee Charitable organizations.*
- *Funded \$40,000 endowment for an engineering scholarship at the University of Tennessee.*
- *Funded \$25,000 endowment for pre-engineering scholarships at Pellissippi State Technical Community College.*
- *Expanded efforts in college and university outreach and improved outreach to minority institutions.*
- *Concluded an agreement with Tennessee State Univ., an HBCU, to enhance technology transfer and provide a loaned executive.*
- *Established a mentor-protégé agreement and signed license agreement with MS Technology, a local small business.*
- *Provided a senior loaned executive to the Tennessee Office of Homeland Security.*
- *Provided support for the JASON Project, a supplemental science education project for grades four through eight.*

BWXT Y-12, the contractor that manages and operates the complex for the National Nuclear Security Administration, has created plans for modernizing the site, including construction of new facilities and facility upgrades. Construction of a new purification facility is currently under way and ground will be broken in 2004 for a new materials storage facility. Building these new facilities will stimulate the local economy by initially creating construction jobs and eventually creating long-term high-tech skill needs. BWXT Y-12’s Infrastructure Reduction project is decommissioning and demolishing old, unneeded and unused buildings at Y-12 to reduce the maintenance costs and clear the way for construction of new facilities as part of Y-12’s modernization. BWXT Y-12 also has worked with the National Security Administration to develop an extensive strategic plan that includes redefining critical skill needs for the future.

Oak Ridge National Laboratory (<http://www.ornl.gov>)

Several major construction initiatives were completed at Oak Ridge National Laboratory in FY 2003, and significant progress was made on many more. A new Computational Sciences Building was completed as was a new Engineering Technology facility. Five new parking lots were constructed, and work was initiated on the new mammalian genetics center ("Mouse House"). The Spallation Neutron Source (SNS) and the Center for Nanophase Materials Sciences (CNMS) projects continued their construction progress on schedule and within budget. Numerous workshops are being held to acquaint future users with the proposed research scope of these facilities. SNS construction will be completed in FY 2006 and anticipates beginning its user program in FY 2008. CNMS began a user-initiated research program in FY 2004 and will be open to users in the new facility in FY 2006, with over 100 users projected to be on-site during the first full year of operation, with growth to over 200 users in FY 2007. This center will provide state-of-the-art nanofabrication and nanoscience facilities. It will join some of the world's best computing facilities -- the upgraded HFIR, the SNS, and a new state-of-the-art Advanced Materials Characterization Laboratory -- to give the Nation a unique set of tools for materials research. This will cement Oak Ridge's position as the Nation's premier center for materials science and will support research that is central to ensuring our energy security and economic competitiveness.

During FY 2003, the Inorganic Membrane Technology Laboratory program, transferred to ORNL from Bechtel Jacobs Company, LLC. The laboratory is successfully providing technologies in the field of inorganic membranes for commercial use.

DOE has recently awarded a contract to Isotek Systems, LLC, to down blend enriched uranium-233 and to extract isotopes that show great promise in the treatment of deadly cancers. The contract's total estimated cost is \$128 million over an estimated nine-year period beginning in FY 2004. DOE's Pacific Northwest National Laboratory, through a Cooperative Research and Development Agreement, and Theragenics, Inc., a CROET tenant at Horizon Center, will partner with Isotek to produce and deliver the isotopes.

About CNMS

The Center for Nanophase Materials Sciences (CNMS) at ORNL is a collaborative nanoscience user research facility for the synthesis, characterization, theory/ modeling/ simulation, and design of nanoscale materials. It is one of five Nanoscale Science Research Centers currently being established by the Office of Science, U.S. Department of Energy.

Nanotechnology is the creation and utilization of materials, devices, and systems through the control of matter on the nanometer-length scale, that is, at the level of atoms, molecules, and supramolecular structures.

The essence of nanotechnology is the ability to work at these levels to generate larger structures with fundamentally new molecular organization. These "nanostructures," made with building blocks understood from first principles, are the smallest human-made objects, and they exhibit novel physical, chemical, and biological properties and phenomena. The aim of nanotechnology is to learn to exploit these properties and efficiently manufacture and employ the structures.

The CNMS is expected to begin operation in the late spring of 2005, following completion of its new building adjacent to the Spallation Neutron Source.

In the community-service arena, UT-Battelle employees donated \$672,560 to local charities through the payroll plan in FY 2003. Furthermore, UT-Battelle made corporate contributions in the amount of \$5,662,935. In addition, \$962,280 worth of equipment was donated to schools and educational institutions in FY 2003.

Technology transfer and economic development maintained their exciting pace in FY2003. Some highlights included:

- Eleven new companies or new product lines were developed through ORNL technologies. Eight of these companies are locally based (See Appendix B).
- Ten Center for Entrepreneurial Growth clients moved to the next stage of business maturation.
- UT-Battelle promoted regional awareness of opportunities available to regional businesses at a Chattanooga Mayor's Town Hall Forum. Approximately 250 people representing industry, economic development professionals and government agencies attended this meeting.
- UT-Battelle expanded our technology transfer influence in Memphis by partnering with the FedEx Institute of Technology at the University of Memphis.

ORNL assists small technology-businesses expand their product offerings by partnering with them on government-sponsored Small Business Innovation Research (SBIR) projects. As a partner with the small business, ORNL researchers and facilities can be used to enhance the quality of the research provided by their small business partners. In FY 2003, to encourage and equip small businesses to pursue funding from SBIR programs, the state of Tennessee sponsored UT-Battelle to provide SBIR proposal writing and SBIR opportunity awareness conferences at various locations around the state and region.

The ORNL, in a partnership with the Knoxville Area Chamber Partnership, supports the Technology Mining and Matching (TMM) Program. The TMM Program seeks opportunities for existing businesses to utilize the facilities and expertise of ORNL for the purpose of improving their competitive positions. Through this program, ORNL capabilities are utilized to solve technical problems that threaten the potential profitability of an existing business.

ORNL is assisting local industry recruitment efforts by participating in visits to the area by companies considering relocating their business. This support is provided through the East Tennessee Economic Development Agency, the East Tennessee Economic Council, and the recruiting efforts of the local Chambers of Commerce.

The ORNL is supporting new businesses and entrepreneurs through the Center for Entrepreneurial Growth at Technology 2020. The mission of the Center for Entrepreneurial Growth, which is sponsored by UT-Battelle, is to create an entrepreneurial climate in the state of Tennessee and to improve the dissemination of ORNL technology through the creation and support of early stage companies focused on growth and long-term sustainability. This is accomplished through a developmental

program focused on the seven stages of growth and movement through the transitions that all start up companies must make to reach maturity and success.

Oak Ridge National Laboratory is the home of highly sophisticated experimental user facilities. See Appendix C for a list of these User Facilities. These research laboratories are designed to serve not only staff scientists and engineers, but also researchers from universities, industry, foreign institutions, and other government laboratories. They simultaneously advance national research and development and fulfill the DOE missions by minimizing unnecessary duplication of effort, promoting beneficial scientific interactions, and making the most effective use of costly and, in many cases, unique equipment. The diverse and sophisticated research conducted by staff scientists, coupled with the availability of unique resource equipment, is attracting a growing number of guest researchers. Some 50 new user agreements were signed during FY 2003, and over 150 new projects were initiated during the year.

The Oak Ridge Institute for Science and Education (<http://www.ornl.gov>)

In 2002, the National Institute for Occupational Safety and Health (NIOSH) selected a team headed by ORAU to reconstruct the radiation doses of employees who worked at DOE and DOE-contractor sites and who have developed cancer that may be work-related. Reconstructing workers' doses involves interviewing the workers or family members, retrieving and validating data, and reconstructing exposure conditions at the various sites.

The NIOSH Dose Reconstruction Program supports the Energy Employees Occupational Illness Compensation Program Act (EEOICPA), which became effective on July 31, 2001. EEOICPA provides benefits to workers (or their survivors) who are ill or who died as a result of their employment in the nuclear weapons industry.

Since beginning work on the project, the ORAU team has set up an impressive infrastructure to handle the growing volume of data. The NIOSH ORAU Team has seen a steady increase in the number of claims submitted. At the start of the project, the team had 7,559 total claims in house, which almost doubled in 2003 to 13,945. The team constantly strives to meet the project goal of completing 200 dose reconstructions per week.

Having invested in information technology application development, the team can perform difficult tasks in a timely and cost-effective manner. Several processes have been automated in order to reduce errors and simplify procedures. Databases, such as the site research database and employee database, are used extensively to accurately track and manipulate data. The team has implemented a specialized claims tracking system to provide detailed information about the status of any claim in the dose reconstruction process at any given time. The ORAU team has also developed a Web site for the project, which helps claimants and the public learn more about their efforts.

Throughout the project, the ORAU team has worked diligently to build confidence in the dose reconstruction process. They continue to process claims as efficiently as

possible, while upholding high standards for accuracy. At the heart of the project is the worker: ORAU's pervasive goal throughout the process is to protect claimant privacy and trust, while bringing the best possible science to bear on dose reconstruction.

ORAU is also making a key investment in its future and is pledging its commitment to continued improvements to DOE and other stakeholders through its plan to consolidate and modernize critical facilities. DOE is supporting this project with funds to construct and renovate government-owned facilities.

In 2001, ORAU began updating its plans and focused resources to modernize existing buildings as well as consolidate staff and facilities at two main sites—the ORAU Main Campus at Badger Avenue and the ORISE South Campus on Bethel Valley Road. In 2003 ORAU initiated a plan for the construction of a 55,000-square-foot office building on the ORAU main campus—with a total project cost estimated at \$8.65 million—and three new smaller buildings at the South Campus. Already completed and in full use on the South Campus is a 4,000 square-foot building expansion to relocate the Beryllium Lab and a new 5,500-square-foot office building.

The company also closed its Pollard Auditorium in October 2003 for a much-needed facelift. In partnership with the City of Oak Ridge and funded by a \$1 million federally appropriated Small Business Association grant, which was presented to ORAU by Tennessee Congressman Zach Wamp, the Pollard Auditorium will become a science and technology conference center. The improvements will include the latest advancements in technology—computer kiosks, plasma screens, state-of-the-art audio/visual equipment—which will enable ORAU to sponsor more technology-based conferences as an economic draw for the city.

V. CONCLUSION

DOE has been a major contributor to the economy of East Tennessee and the state as a whole since its initial presence in the 1940s. The benefits reaped by the state are both quantitative and qualitative. Quantitative benefits include expansions in income, output, employment and tax revenue. For Fiscal Year 2003, the presence of DOE led to the creation of nearly \$3.2 billion in gross state product, \$1.7 billion in personal income and over 54,555 full-time equivalent jobs for residents of Tennessee. In addition, state and local governments benefited from the generation of \$66.7 million in sales tax revenue. These quantitative benefits are significant, representing more than one percent of Tennessee's Gross State Product.

DOE-related programs enhance the welfare of the residents of Tennessee by supporting the economic development of the state and region. DOE contributes to the overall productivity and competitiveness of business and industry in Tennessee and improves the quality of its workforce through its technology partnerships, educational opportunities, community assistance programs and regional initiatives. Many of these programs are aimed at creating new jobs by attracting businesses to the state and helping to expand existing businesses.

Appendix A: Overview of the Economic Impact Model

The primary purpose of the current study is to evaluate the benefits of on-going operations of DOE in Tennessee. The economic benefits garnered by the state are best measured in terms of increased production of goods and services (i.e., gross state product), the number of jobs created and the amount of personal income that accrues to residents. The key fiscal benefit is the additional sales tax revenue generated as a result of the increase in economic activity attributable to DOE.

These economic impact measures can be further broken down into *direct*, *indirect*, and *multiplier* (or *ripple*) effects. *Direct* effects are those attributable specifically to DOE itself. For example, the workers employed by DOE and its contractors represent the direct employment benefit of these facilities. Similarly, the expenditures on wages and salaries account for its direct income effect. An important strength of DOE activities in Tennessee is that the primary market for its services is the national economy, rather than a local economy. As with a manufacturing or financial firm that services a national market, this leads to an injection of *additional* purchasing power and creation of *additional* jobs and income. If DOE were simply competing with other in-state firms, there might be little or no net benefit for the state's economy. Direct fiscal effects arise through a full range of taxes on businesses such as property and sales taxes from the firm's investment in real and personal property and spending on sales taxable items. In addition, there are other payments-in-lieu-of-taxes (PILT) and fees paid by DOE and its contractors which also contribute to the facility's direct fiscal benefit.

Indirect effects arise from DOE's acquisition of raw materials, services, supplies, and other operating services which help support jobs in regional businesses, as well as expenditures by visitors to the facilities supported by DOE. For example, many of the business services utilized by DOE are purchased from firms within Tennessee. The overall effects of DOE increase as the share of raw materials and other inputs acquired within the region increases. Note that only the *value added* via the local production process, not the total *retail sale*, gives rise to additional economic benefits for Tennessee. Only the portion of the expenditure 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 counted as new income in the state. It is for this reason that retail sales, in isolation, represent a poor measure of economic benefits. Of course, state and local governments reap the benefits of sales tax on these sales, but this is accounted for separately. Thus, the size of a firm's indirect impact on regional jobs and incomes 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 into the community.

The indirect effects arising from visitors to DOE facilities is somewhat unique in that most private sector firms would not be expected to attract many visitors. However, since some of the facilities supported by DOE provide excellent research opportunities for visiting scientists and the public at large is interested in its science and energy

research, the visitor effect has both a substantial quantitative and qualitative benefit. The quantitative impact of visitors to DOE facilities are derived from their expenditures on lodging, food, entertainment, and other expenditures incurred in the state during their visit. DOE provided the data on the number of guest scientists using ORNL facilities during the year and visitors to the AMSE. Estimates of expenditures per day were based on recent surveys conducted by the Knoxville Convention and Visitor's Bureau.

Finally, multiplier (or ripple) effects are created as the additional income generated by the direct and indirect effects is spent and re-spent within the local economy. Note again that it is the additional purchasing power from outside the community—the ability to export the product or service—that gives rise to the direct and indirect effects and hence the ripple or multiplier effects as well. For example, part of the wages received by a firm's employees will be spent on retail sales. If the employee goes shopping in Nashville, a portion of the sales receipt will be used to pay local employees of the retail establishments. These employees will in turn spend a portion of their income in the state on groceries, housing, etc., thus adding to the amount of state-wide personal income attributable to the firm's activities. However, during each of these subsequent rounds of spending, a large 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 attributable to increased business activity are computed as the sum of the direct, indirect, and multiplier effects. The TILI model was developed by the Center for Business and Economic Research at The University of Tennessee to calculate economic impacts of firm activity using the RIMS II multipliers specific to Tennessee. Using the expenditure data provided by DOE and its contractors, the model allows calculation of the output, income, employment, and sales tax revenue impacts accruing in the State of Tennessee.

Appendix B: Companies or Business Lines Developed through ORNL Technologies, FY 2003

- **Agri-Grow Technologies, Inc., Knoxville, TN.** Local company with patented technology focused on a revolutionary new growing method that allows an eight-fold increase in crop production indoors and independent of climate and soil conditions. Company has licensed hybrid lighting technology from ORNL as a lighting solution for their “vertical grow” technology.
- **Aware Entertainment, Inc., Knoxville, TN.** A technopreneurial company that has developed a new patented computer game development platform focused on multi-player action games for the fast growing on-line computer gaming industry. Platform technology is used to develop games and license game engine to other sources.
- **Crisis Prep Services, LLC, Oak Ridge, TN.** Company started by former ORNL employees who have developed software and processes to establish facility wide security and monitoring services in the event of a national or local crisis. Focused on Homeland security and government or large facility operations.
- **Fast Forward Devices, LLC, Knoxville, TN.** Company signed and completed a joint development project with ORNL – a metrology tool (instrument and software) for fault detection was developed under contract from the lab. Company has also developed a software package for production manual documentation.
- **Healthspex, Inc., Knoxville, TN.** Licensed technology focused on chip detection of diseases and for use in office based diagnostic test.
- **InRad, Inc., Knoxville, TN.** Former ORNL employee who leverages the lab for development and testing has secured a large grant to develop a totally automated system for searching, categorizing, and managing information against any strategic plan or roadmap. The focus will be the manufacturing sector and the R&D process.
- **Oak Ridge Micro-Energy, Oak Ridge, TN.** Nonexclusive patent license for ORNL’s thin-film battery technology on January 1, 2003.
- **Sci-Tech, Inc., Knoxville, TN.** Formed by a former ORNL employee to develop micro-array reader and software for gene analysis and detection. Client company has been awarded three SBIR’s for development of the solution.

New Companies (located outside the region)

- **KoogleLumen Corporation, Salt Lake City, UT.** Sole commercial patent license agreement for ORNL technology on January 1, 2003.
- **Infiniform, Mountain View, CA.** Nonexclusive patent license for ORNL’s molding ceramic powders technology on October 1, 2002.
- **Innovative American Technologies, Boca Raton, FL.** Patent license for ORNL’s CalSpec technology on December 9, 2002.

Appendix C: ORNL's User Facilities

- **Bioprocessing Research Facility** -- www.ct.ornl.gov/ber/userfacility2.htm
- **Buildings Technology Center** -- www.ornl.gov/btc/
- **Californium User Facility for Neutron Science** -- www.ornl.gov/divisions/nuclear_science_technology/cuf/
- **Computational Center for Industrial Innovation** -- <http://consult.ccs.ornl.gov/ccii/>
- **Cooling, Heating and Power Integration Laboratory** -- www.ornl.gov/btc/pdfs/fs-der-chp.pdf
- **Fuels, Engines, and Emissions Research Center** -- www.ornl.gov/etd/aptc/index.htm
- **High Flux Isotope Reactor** -- www.ornl.gov/hfir/hfirhome.html
- **High Temperature Materials Laboratory** -- www.ms.ornl.gov/htmlhome/default.htm
- **Holifield Radioactive Ion Beam Facility** -- www.phy.ornl.gov/hribf/
- **Metals-Processing Laboratory Users Facility** -- www.ms.ornl.gov/programs/mplus/mplus.htm
- **Mouse Genetics Research Facility** -- <http://bio.lsd.ornl.gov/mouse>
- **National Transportation Research Center** -- www.ntrc.gov
- **Oak Ridge National Environmental Research Park** -- www.esd.ornl.gov/facilities/nerp/index.html
- **Oak Ridge Electron Linear Accelerator** -- www.phy.ornl.gov/astrophysics/nuc/neutrons/neutrons.html
- **Physical Properties Research Facility** -- www.ornl.gov/divisions/nuclear_science_technology/pprf/index.htm
- **Power Electronics and Electric Machinery Research Facility** -- www.ornl.gov/etd/peemrc
- **Shared Research Equipment Collaborative Research Center** -- www.ornl.gov/share