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

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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. In order to detail 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. The current study provides an analysis of the economic benefits for fiscal year 2001. The results of the current study continue to support DOE's role as a major contributor to Tennessee's economy.

Key findings include the following:

- **Spending by DOE and its contractors led to an increase of more than \$2.5 billion in the state of Tennessee's gross state product in 2001.**
- **Total personal income generated in the state of Tennessee by DOE-related activities was nearly \$1.3 billion in 2001. Each dollar of income directly paid by DOE in the state translates into a total of \$1.92 in personal income for Tennessee residents.**
- **DOE spending supported 37,660 full-time jobs in the state in 2001, meaning that for every one DOE job, 2.6 additional jobs were supported in other sectors of the state economy.**
- **DOE-related spending generated \$57.8 million in state and local sales tax revenue in Tennessee in 2001.**
- **DOE operations continue to recruit a highly trained and educated workforce. In 2001, 937 employees held Ph.D. degrees, 1,474 held Masters degrees and 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 \$12 million in 2001.**

I. DIRECT BENEFITS OF DOE

DOE spending yields significant direct benefits for the state economy.

- **DOE and its major contractors provided 10,336 full-time jobs in Tennessee in 2001 with annual wages and salaries totaling \$489.4 million.**

During 2001, DOE and its major contractors employed 10,336 full-time equivalent employees living in the state of Tennessee and spent more than \$489.4 million in payroll expenditures. The jobs are relatively high wage jobs with an average annual salary of \$47,349.

- **Total non-payroll spending (or direct procurement spending) by DOE and its contractors totaled nearly \$517.0 million in 2001.**

Acquisition of goods and services from Tennessee businesses led to non-payroll spending of \$517.0 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 \$12.4 million in state and local sales taxes in 2001.**

As a result of DOE and contractor purchases of goods and services in Tennessee, \$9.0 million and \$3.7 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.

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 more than \$2.5 billion in 2001 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 \$2.5 billion in the state of Tennessee in 2001. The output multiplier was 2.14, meaning that for \$1.00 directly spent by DOE in Tennessee, an additional \$1.14 of output was produced in other sectors of the economy.

- **DOE activities in Tennessee gave rise to a total income benefit of \$1.3 billion in the state in 2001.**

DOE’s impact on personal income across the state of Tennessee totaled nearly \$1.3 billion in 2001. The income multiplier was 1.92 indicating that for every \$1.00 DOE and its contractors spent on wages and salaries, an additional \$0.92 in personal income was created for the residents of the state.

- **DOE operations supported 37,660 full-time jobs in the state of Tennessee in 2001.**

The new income generated in Tennessee as a result of DOE operations supported a total of 37,660 jobs in the state. The employment multiplier was 2.64, meaning that for every direct job provided by DOE, an additional 1.64 jobs were supported in other sectors of the state’s economy. This relatively high employment multiplier reflects 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 \$57.8 million in 2001.**

DOE operations give rise to significant increases in sales tax revenue for state and local governments in Tennessee. In 2001, the total state sales tax attributed to DOE was \$42.0 million, while local tax coffers benefited by an additional \$15.8 million in local sales tax revenue.

**Table A: Summary of Economic Benefits of DOE in Tennessee, 2001
(dollars in millions)**

Impact	Direct	Total
Output	\$1,179.6	\$2,521.8
Income	\$ 662.7	\$1,274.4
Sales Tax	\$ 12.4	\$ 57.8
Employment	10,336	37,660

III. OTHER BENEFITS AND INITIATIVES

Many of the benefits arising from DOE activities are not easily quantified. At the same time, the impact of these broader activities perhaps has 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 \$12 million in charitable contributions and community grants and equipment to organizations across Tennessee in 2001.**

- **In 2001, nearly 8,900 guest researchers generated over 53,000 overnight stays in the Knoxville-Oak Ridge area.**
- **The American Museum of Science and Energy drew nearly 109,000 visitors during Fiscal Year 2001.**
- **Through its Reindustrialization Initiative, DOE has achieved \$802 million in cost avoidance and savings while creating 1,329 jobs.**
- **Bechtel Jacobs Company, LLC created Bechtel Jacobs Development Company to meet its commitment of creating \$427 million in non-DOE-funded payroll in the region over a 5-1/2 year contract. More than \$155 million of payroll was paid in Fiscal Year 2001 and the company provided assistance to 30 businesses.**

Contents

EXECUTIVE SUMMARY	i
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.....	3
Wackenhut Services Incorporated.....	4
National Nuclear Security Administration, Y-12 Site Office ..	4
Y-12 National Security Complex.....	4
The Office of Scientific and Technical Information	4
What DOE Facilities Offer Tennessee.....	5
III. JOB, INCOME, OUTPUT AND SALES TAX BENEFITS OF DOE IN TENNESSEE IN 2001	6
Doe Expenditure Data	6
Summary of Benefits	8
<i>Output Benefits</i>	8
<i>Income Benefits</i>	9
<i>Employment Benefits</i>	9
<i>Sale Tax Benefit</i>	11
Additional DOE Contributions to Tennessee	11
IV. LOOKING FORWARD TO THE FUTURE	12
Reindustrialization	13
Community Reuse Organization of East Tennessee	13
Bechtel Jacobs, LLC	13
Oak Ridge National Laboratory	14
BWXT Y-12 and Modernization	14
The Oak Ridge Institute for Science and Education	14
V. CONCLUSION.....	15
APPENDIX 1: OVERVIEW OF THE ECONOMIC IMPACT MODEL	17

Tables

Table A: Summary of Economic Benefits of DOE	iii
Table 1: DOE-Related Expenditures in Tennessee by Industrial Sector, 2001	7
Table 2: Summary of Economic Benefits of DOE in Tennessee, 2001	8
Table 3: DOE Output Benefit in Tennessee by Spending Source, 2001 (in millions)	8
Table 4: DOE Income Benefit in Tennessee by Source, 2001 (in millions)	9
Table 5: DOE Direct Employment Benefit in Tennessee by Entity, 2001	10
Table 6: DOE Employment Benefits in Tennessee by Source, 2001	10
Table 7: DOE Sales Tax Revenue Benefit in Tennessee, 2001 (in millions)	11
Table 8: DOE Community Charitable Contributions by Entity, 2001	12

THE ECONOMIC BENEFITS OF THE U.S. DEPARTMENT OF ENERGY FOR THE STATE OF TENNESSEE IN 2001

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 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 fourth annual study and presents the economic benefits of DOE for Fiscal Year 2001. 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 includes a brief discussion of future directions of DOE and its operations in the state.

II. PROFILES OF DOE ACTIVITIES¹

The DOE is present in Oak Ridge in three distinct capacities: 1) Oak Ridge Operations Office (ORO), which is one of DOE's 10 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 elements of every major DOE mission in science, energy resources, national nuclear security and environmental quality.

The DOE's 34,236-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 management and operation of the ORNL and ETTP. ORO is also responsible for the Thomas Jefferson National Accelerator Facility in Newport News, Virginia, and the Weldon Spring Site, located near St. Louis, Missouri. The Weldon Spring Site is a former uranium processing facility operated from 1957 to 1966, and is currently undergoing environmental cleanup. In addition, ORO is responsible for the cleanup of legacy wastes created as a result of past operations at 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 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 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 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>)

ETTP is getting a second life through a unique process called Reindustrialization. Parts of the vast complex are available for lease. Facilities, equipment, and reusable materials are available to companies interested in leasing, performing cleanup work, or recycling. ETTP is actually home to two distinct business centers - Heritage Center and Horizon Center. Heritage Center is a former gaseous diffusion facility encompassing 125 main buildings. Businesses locating at Heritage Center often rehabilitate space in these buildings for reduced lease rates and make use of existing machinery and other assets to reduce their operating costs. In contrast, Horizon Center is a new 1,000-acre greenfield site. The site is designed to provide building sites and amenities desired by high-tech companies while still preserving the area's scenic beauty.

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 592 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, 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 650 structures that contain more than 7.5 million square feet of floor space.

The Office of Scientific and Technical Information (<http://www.osti.gov>)

As one of the major science agencies, the DOE manages a \$7.5 billion annual investment in research and development (R&D). DOE's Office of Scientific and Technical Information (OSTI), as part of the DOE Headquarters Office of Science, leads DOE e-government initiatives for disseminating information resulting from and relevant to the department's R&D programs. OSTI manages the Technical Information

Management (TIM) program. The TIM program provides electronic access to worldwide energy, scientific and technical information to DOE researchers, U.S. industry, academia and the science-attentive citizen. The information is provided through a set of cutting-edge, Internet-based information products for technical reports, scientific journals and preprints -- the three main sources in which scientific and technical information is recorded. As shared knowledge is the enabler of scientific progress, OSTI helps promote scientific progress.

Using digital technology, OSTI has developed a set of internet-based information products for scientific and technical information. Collectively, these systems constitute the world's most comprehensive collection of physical sciences information and provide improved electronic access to full-text gray literature (literature not commercially available) and journal literature and preprints (through partnerships with academia and the commercial sector). Collectively, OSTI's Web-based information products accommodated over 5.9-million information transactions in FY 2001.

As a result of OSTI's advances using information technology in putting full-text research information on the Internet, it serves literally hundreds of thousands of people. This is the primary responsibility of OSTI - to ensure that the DOE and taxpayers receive a return on their research investment in the form of accessible information.

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. In addition, OSTI's mission applies to classified and sensitive information. OSTI provides a secure, active repository of 100,000 classified documents resulting from weapons research.

Also, as an international leader in the area of scientific and technical information, OSTI, on behalf of the DOE and the United States, acquires foreign research results in two international information exchanges. They are the International Nuclear Information System, under the auspices of the United Nations' International Atomic Energy Agency, and Energy Technology Data Exchange, under the auspices of the International Energy Agency.

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 2001

DOE Expenditure Data

The data used as input into the economic impact model consisted of detailed expenditure data for the 2001 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 37 major industrial sectors for input into the model. Table 1 displays DOE-sponsored spending in Tennessee by sector for Fiscal Year 2001. Total payroll, pension and non-payroll spending in the state in 2001 was \$1,179.6 million, a 22.7 percent increase over last year.² Payroll spending represented the largest expenditure category, accounting for \$489.4 million or 41.5 percent of the total spending in Tennessee. Other notable spending categories include business, legal and miscellaneous services.

DOE contracts out the vast majority of its operations to private companies. The two largest DOE contracts in Tennessee in 2001 were for BWXT Y-12, LLC for the operation of the Y-12 National Security Complex and UT-Battelle, LLC for the operation of the ORNL. Together these two contractors accounted for 67.2 percent of the total DOE-related expenditures in Tennessee. Other major contractors include Bechtel Jacobs Company, LLC, ORAU and Wackenhut Services Incorporated.

Table 1: DOE-Related Expenditures in Tennessee by Industrial Sector, 2001

Sector	Expenditures
Farm products and agricultural, forestry and fishing	1,000
Construction	2,248,500
Food and kindred products and tobacco products	1,000
Apparel and other textile products	1,713,000
Paper and allied products	1,800,800
Printing and publishing	159,800
Chemicals, allied, petroleum and coal products	4,265,000
Lumber and wood products and furniture and fixtures	91,000
Stone, clay and glass products	179,400
Primary metals industry	2,700
Fabricated metals products	755,500
Industrial machinery and equipment	13,908,100
Electronic and other electrical equipment	3,804,800
Other transportation equipment	145,300
Instruments and related products	3,946,800
Miscellaneous manufacturing industries	7,618,596
Transportation	1,581,900
Communication	2,133,500
Electric, gas, and sanitary services	13,151,000
Wholesale trade	11,701,200
Retail trade	5,858,100
Depository and non-depository institutions	730,000
Insurance	3,715,000
Real Estate	4,873,100
Hotels and other lodging places, recreation services	139,090
Personal and repair services (except auto)	287,000
Business services	138,937,754
Eating and drinking places	208,228
Health services	2,386,161
Legal services	45,000
Engineering and management services	45,033,843
Miscellaneous services	15,463,718
Payroll	489,372,008
Pensions	173,296,350
Health insurance	106,156,445
Metal mining	13,900
Motor vehicles	3,000
Total Tennessee Expenditure	1,179,622,953
Total Non-payroll Expenditures	516,954,595

Summary of Benefits

Direct benefits of DOE-funded activity in Tennessee in Fiscal Year 2001 include \$489.4 million in payroll spending, \$517.0 million in non-payroll spending, \$173.3 in pensions, \$12.4 million in state and local sales tax and 10,336 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 \$2,521.8 million increase in output or gross state product (GSP)³, a \$1,274.4 million increase in personal income, \$57.8 million in state and local sales tax revenue and the support of 37,660 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, 2001

Output (GSP)	\$ 2,521.8 million
Personal Income	\$ 1,274.4 million
Sales Tax Revenue	\$ 57.8 million
Employment	37,660 full-time 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 2001, the output benefit totaled \$2,521.8 million. Table 3 provides a breakdown of the total benefit by initial spending sources. The leading source of output benefits was non-payroll spending which accounted for \$1,578.3 million or 62.6 percent of the total output effect. Payroll spending contributed an additional \$682.2 million or 27.1 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 2.14. This indicates that for every dollar spent by DOE in Tennessee, the state's GSP is increased by \$2.14.

Table 3: DOE Output Benefit in Tennessee by Spending Source, 2001 (in millions)

Non-Payroll Spending	\$ 1,578.3
Payroll Spending	\$ 682.2
Pension Disbursements	\$ 241.6
Visitor Spending	\$ 19.7
Total Output Benefit	\$ 2,521.8

Income Benefits

The total increase in personal income in Tennessee attributable to DOE spending was \$1,274.4 million in 2001. 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 2001, these effects accounted for more than \$662.7 million, a 5.6 percent increase over the same period last year. 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 2001, non-payroll expenditures accounted for \$330.2 million in indirect and multiplier income benefits. Visitor spending gave rise to \$14.9 million in income benefits. The remaining \$266.6 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 2001.

Table 4: DOE Income Benefit in Tennessee by Source, 2001 (in millions)

Direct Effects	
Payroll Spending	\$ 489.4
Pension Disbursements	\$ 173.3
Indirect/Multiplier Effects	
Non-payroll Spending	\$ 330.2
Visitor Spending	\$ 14.9
Payroll Spending	\$ 196.9
Pension Disbursements	\$ 69.7
	\$1,274.4
Total Income Benefit	

The implicit income multiplier, which is calculated by dividing the total income benefit by direct spending on income, is 1.92. In other words, every dollar of income paid directly to the employees of DOE or its contractors results in the creation of \$1.92 in total state income.

Employment Benefits

The total employment benefit of DOE-related expenditures in Tennessee for Fiscal Year 2001 was 37,660 full-time equivalent (FTE) jobs. The direct employment of DOE and its

major contractors was 10,336. 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 4,135 and 3,824 employees residing in Tennessee, respectively. Combined, these two contractors accounted for 77 percent of the total direct employment effect.

Table 5: DOE Direct Employment Benefit in Tennessee by Entity, 2001

	FTE jobs
BWXT Y-12, LLC	4,135
UT-Battelle, LLC	3,824
Bechtel Jacobs Company	719
Wackenhut Services, Inc.	592
DOE, ORO and NNSA's Y-12 Site Office	527
ORAU	388
DOE, OSTI	75
DOE, Albuquerque Operations	76
Total Direct Employment	10,336

In addition to the more than 10,000 jobs directly created by DOE, 27,324 additional jobs were supported through the purchase of goods and services within the state and through visitor spending and the induced effects of DOE employees spending their income in Tennessee. A breakdown of the employment impacts by source is provided in Table 6. Induced effects from non-payroll spending gave rise to the largest employment benefit, supporting 14,857 full-time equivalent jobs in Tennessee.

Table 6: DOE Employment Benefit in Tennessee by Source, 2001

	FTE Jobs
Direct Effects	
DOE-related Employees	10,336
Indirect/Multiplier Effects	
Payroll Spending	8,955
Non-payroll Spending	14,857
Pensions	3,171
Visitor Spending	341
Subtotal	27,324
Total Employment Benefits	37,660

The employment multiplier for DOE-related activities in Tennessee for Fiscal Year 2001 is 3.64 which means that for every job directly created by DOE an additional 2.64 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 primarily to the higher than average salary of \$47,349 received by DOE-related employees.

Sales Tax Benefit

The total contribution of DOE-related activities to state and local sales tax revenue in the state of Tennessee for Fiscal Year 2001 is estimated to be \$57.8 million. Of that total, approximately 72 percent or \$41.7 million accrues to the state’s sales tax coffers and the remaining 28 percent or \$16.1 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 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 7 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 7: DOE Sales Tax Revenue Benefit in Tennessee, 2001 (in millions)

Direct Payments	
State	\$ 8.9
Local	\$ 3.7
Indirect/Multiplier	
State	\$32.8
Local	\$12.4
Total Sales Tax Revenue Benefit	\$ 57.8

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 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 improving 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 2001. The donations ranged from local United Way campaigns to donations of equipment to area schools. In total, nearly \$12 million in charitable contributions can be directly attributed to DOE operations in Tennessee. A detail of the donations by firm is provided in Table 8. 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 8 understate the overall benefits.

Table 8: DOE Community Charitable Contributions by Entity, 2001

	Corporate Contributions	United Way, CFC, etc.	Other Charitable Contributions	Donation of Equipment	Matching Funds for Education	TOTAL
ORO		58,770				58,770
UT-Battelle	1,415,636	659,982		1,812,732		3,888,350
BWXT Y-12, LLC	161,731	559,311	126,050	5,682,877	3,010	6,532,979
Bechtel Jacobs		200,160	1,004,072		7,330	1,211,562
Wackenhut Services Inc.	67,845	6,545	2,650			77,040
ORAU	208,000	45,200		22,667		275,867
OSTI		10,373		7,774		18,147
TOTAL	\$1,853,212	\$1,540,341	\$1,132,772	\$5,815,033	\$10,340	\$12,062,715

IV. LOOKING FORWARD TO THE FUTURE⁴

DOE has undergone significant changes in the last few years. All of these changes will affect the conduct of DOE's missions today and the future direction of DOE operations in Tennessee. Some of these changes hold the prospect for even greater technology 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 and the Y-12 National Security Complex. Progress continues on

reindustrialization initiatives and new scientific and facility initiatives are being undertaken at ORISE.

Reindustrialization

ORO leverages valuable but unused assets to accomplish accelerated cleanup, reduce environmental risk and create private sector jobs to compensate for the expected loss of jobs as cleanup is completed. Through the Reindustrialization Program, DOE has achieved \$802 million in cost avoidance and savings. A total of 6,218,000 square feet of plant floor space has been transitioned via innovative contracting and leasing models, with the added benefit of creating 1,329 jobs. Much of DOE's effort in this program has been focused on cleaning up formerly-used buildings at Heritage Center for reuse by commercial companies that will diversify the local economy. The Community Reuse Organization of East Tennessee acts as the leasing agent for Reindustrialization properties and has consummated 76 leases with over 36 diverse companies on the Oak Ridge Reservation.

The Reindustrialization Program also includes a technology transfer component that is focusing on commercializing technology developed in the gaseous diffusion program. The Inorganic Membrane Technology Laboratory is successfully providing technologies in the field of inorganic membranes for commercial use. Thus far 13 inorganic membrane products have been approved for commercial manufacture, and a major private sector company has leased manufacturing space and is now producing these membranes at the ETTP in Oak Ridge.

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

Through September 2001, 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 386 jobs were created or retained during FY 2001 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

As part of its contract with ORO for environmental management, Bechtel Jacobs committed to spend corporate funds to create \$427 million of non-DOE-funded payroll in Anderson, Roane, Knox, Blount, and Loudon Counties over the 5-1/2 year contract. A separate division, Bechtel Jacobs Development Company was established to meet these commitments. More than \$155 million of payroll was paid during Fiscal Year

2001 and the company provided assistance to 30 companies. Bechtel Jacobs Development Company works closely with a wide variety of regional economic development agencies to create new payroll through a combination of growing local businesses, attracting businesses to the area and stimulating new businesses.

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

Progress continued on several major ORNL initiatives during the period. Construction of the Spallation Neutron Source project continued on schedule and within budget, and full Congressional funding was obtained for a new mammalian genetics center (“Mouse House”). A large-scale modernization effort also got under way with the selection of a developer; the construction of five new parking lots; and the securing of funding for major new facilities, including a computational sciences building, engineering technology facility and the Joint Institute for Computational Sciences – Oak Ridge Center for Advanced Studies.

In the community-service arena, a major UT-Battelle, LLC initiative began with the funding of science laboratories at five East Tennessee schools including Oak Ridge High School, Clinton Middle School, Coalfield School, Midway High School and Vine Middle Performing Arts and Sciences Magnet School. The company will continue to fund at least five schools each year, with a commitment of up to \$10,000 per school.

Technology transfer and economic development continued at an exciting pace in Fiscal Year 2001. Some highlights include:

- ◆ 14 new companies were established to commercialize licensed technologies, 8 of which are located in Tennessee;
- ◆ 17 client companies were assisted by the Center for Entrepreneurial Growth; and
- ◆ ORNL staff provided technical assistance to 25 businesses.

BWXT Y-12 and Modernization (<http://www.y12.doe.gov>)

Modernization of the Y-12 National Security Complex will ensure the continuation of a vital national security resource and economic mainstay of Tennessee. Plans for Y-12 modernization include construction of new Y-12 storage and production buildings uniquely designed for handling special nuclear materials. Construction of new facilities will serve the local economy as Y-12 modernization creates construction jobs and ensures long-term employment. In addition to focusing on these two large capital projects, an extensive Y-12 Strategic Plan includes redefining critical skills for the future and creating a comprehensive 10-year plan, including a new master site plan and vision for 2020.

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

As lead agency in a new collaborative partnership, ORISE’s Medical Education and Outreach (MEO) program is working with faith-based organizations to initiate a project called Consumer Health Resource Information Services (CHRIS). The goal of the program is to disseminate consumer health information that addresses health disparities throughout inner-city churches with predominately African American congregations.

Work has already started on this demonstration pilot project. MEO hopes to engage six to eight inner-city churches in the Knoxville area. Available funding, geographic location and size will be factors in determining the number of churches that participate. In addition to serving as project lead, ORISE will provide information resources to church nurses and teach them how to access medical information on the Internet.

Addressing health disparities is already a national goal of Healthy People 2010, a program laid out by the department of Health and Human Services. The goal of the program is to increase both the quality and years of healthy life while eliminating health disparities by 2010 through educating and raising awareness of resources and health tests.

Sharing in the mission to address minority health disparities through community outreach services are CHRIS project partners -- Tennessee Department of Health, Office of Minority Health; the Knoxville Minority Health Coalition; the Knox County Health Department; the Baptist Health System of East Tennessee's Parish Nursing Program; and the Chi Eta Phi Nursing Sorority, Inc., Upsilon Chi Chapter.

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 2001, the presence of DOE led to the creation of more than \$2.5 billion in gross state product, \$1.3 billion in personal income and over 37,660 full-time equivalent jobs for residents of Tennessee. In addition, state and local governments benefited from the generation of \$57.8 million in sales tax revenue. While these quantitative benefits are significant, perhaps the most important investment in the well-being of the state in both the present and the future is the vast array of other activities supported through DOE.

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, helping to build on Tennessee's economic advantages. While it is not possible to accurately quantify the total benefits in terms of income, jobs or tax revenue, it is evident that these programs significantly enhance the prosperity of the Tennessee regional economy.

Endnotes:

¹ Profiles provided by U.S. Department of Energy and its contractors.

² See "The Economic Benefits of the U.S. Department of Energy for the State of Tennessee in 2000," Center for Business and Economic Research, University of Tennessee, Knoxville.

³ Due to changes in the way in which the U.S. Department of Commerce, Bureau of Economic Analysis calculates and applies output multipliers, the total output impact reported for FY 2001 is not directly comparable to output benefits reported in earlier years. Specifically, the benefits reported in earlier reports, while thought to be correct at the time of publication, understated the actual benefits if calculated using the new modeling technique.

⁴ Descriptions, including job calculations, are provided by DOE.

Appendix 1: 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 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 also 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 to 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 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.

