

***THE ECONOMIC BENEFITS OF
THE U.S. DEPARTMENT OF ENERGY
FOR THE STATE OF TENNESSEE
FISCAL YEAR 1998***

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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. With an annual operating budget of \$2 billion, DOE has a significant impact on the state's economy 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 in 1998, the Center for Business and Economic Research at the University of Tennessee, Knoxville, conducted an in-depth study of the economic consequences of DOE payroll and non-payroll spending on the State of Tennessee.

Key findings include the following:

- **Spending by DOE led to an increase of more than \$1.9 billion in the State of Tennessee's gross state product in 1998.**
- **Total personal income generation in the State of Tennessee by DOE was nearly \$1.3 billion in 1998. Each dollar spent by DOE in the state translates into a total of \$1.91 in personal income for Tennessee residents.**
- **DOE spending supported 39,482 full-time jobs in the state in 1998, meaning that for every one DOE job, 1.9 additional jobs were supported in other sectors of the state economy.**
- **The average salary of employees of DOE and its affiliates was 38 percent higher than the statewide average.**
- **DOE and its affiliates attract a highly skilled and educated workforce including 1,005 employees with Ph.D. degrees. Additionally, 2,719 and 4,600 employees hold masters and bachelors degrees, respectively.**
- **DOE funded activities generated over \$43.3 million in state sales tax revenue and \$16.2 million in local sales tax revenue in 1998.**

A summary of findings from the report includes:

I. Direct Benefits of DOE

- **DOE and its contractors spent more than \$561.3 million on wages and salaries and employed 13,782 individuals in Tennessee during 1998**

DOE and its contractors paid more than \$561.3 million in wages and salaries and provided 13,782 full-time equivalent jobs in Tennessee, giving rise to an average salary of over \$40,000 annually. In comparison, the statewide average annual salary was \$25,090, and the statewide manufacturing average annual salary was \$29,695. In addition, significantly more than \$110.8 million in pension disbursements were paid to retirees residing in the state.

- **Non-payroll expenditures by DOE and its contractors in Tennessee topped \$336.5 million**

Acquisition of goods and services from Tennessee businesses by DOE and its contractors is substantial, totaling more than \$336.5 million in 1998. These expenditures give rise to income and support jobs in Tennessee establishments including construction firms, manufacturing plants, engineering and management consulting firms, and retail establishments such as hotels, motels and restaurants, just to name a few.

- **DOE and its contractors paid nearly \$16.6 million in state and local sales taxes in Tennessee during 1998**

The tax bases of state and local governments are enhanced by DOE operations in the state. In particular, state and local sales tax payments by DOE and its contractors on their purchase of goods and services totaled almost \$16.6 million in

Tennessee during 1998. Additionally, significant other tax payments—including payments-in-lieu-of-taxes and property taxes—were also paid by DOE and its affiliates.

II. Total Economic Benefits of DOE's Direct Spending in Tennessee

- **Direct spending led to an increase of more than \$1.9 billion in Tennessee's gross state product in 1998**

The payroll and non-payroll spending by DOE and its contractors led to a total output benefit of over \$1.9 billion for the State of Tennessee during 1998. This output impact represents the change in gross state product as a result of DOE activities in the state. The output multiplier was 1.90, meaning that for every \$1.00 of output produced by DOE in the state, a total of \$1.90 of output was produced statewide.

- **The total income benefit of DOE was nearly \$1.3 billion in 1998**

DOE operations in Tennessee in 1998 led to the generation of \$1,285.7 million in income for the state and its residents. In comparison, this was greater than the total personal income in each of 80 of the 95 counties in Tennessee in the previous year. DOE's generated income ranked between Sevier County's personal income (\$1,230 million) and Maury County's personal income (\$1,378 million).

- **The total number of full-time equivalent jobs supported by DOE operations in Tennessee in 1998 was 39,482**

The new income generated in Tennessee as a result of DOE operations supported a total of 39,482 jobs in the state. In comparison, this is greater than total employment in each of 84

counties and more than the 38,795 employed statewide by the motor vehicles and equipment industry.

- **The total state and local sales tax revenue attributed to DOE operations was more than \$59.5 million in 1998**

In Tennessee, the sales tax is the most prominent source of government revenue, and the presence of DOE in the state leads to significant increases in sales tax revenue. The total sales tax contribution for the state and local governments attributed to DOE was more than \$59.5 million with the state’s share being \$43.3 million. In comparison, total state sales tax collections for 1998 in Putnam County were \$44.8 million and \$42.3 million in Hamblen County. In fact, the total state sales tax revenue attributed to DOE and its contractors was greater than the total collections in each of 68 of 95 Tennessee counties.

- **Summary Table**

III. Qualitative Benefits

The presence of DOE gives rise to a vast array of indirect and qualitative benefits in the State of Tennessee. While several of these benefits are discussed briefly in this report, a second report will provide a more in-depth examination of the far-reaching benefits attributable to DOE. A preview of these benefits include:

- **DOE technology partnership programs provided \$196.7 million in revenue and added \$1.5 million in royalties**

During 1998, Cooperative Research and Development Agreements were executed that provided \$2.3 million in new revenue. Reimbursable Work Agreements added \$194.4 million in revenues. Licenses of DOE-developed technologies returned \$1.5 million in royalties.

- **The Department of Energy has committed \$48.8 million in community transition grant funds to the Oak Ridge region**

Table A: Summary of Economic Benefits of DOE in Tennessee, 1998

Impact	Direct	Total
Output	\$1,012.7 million	\$1,903.1 million
Income	\$676.1 million	\$1,285.7 million
State Sales Tax Revenue	\$12.1 million	\$43.3 million
Local Sales Tax Revenue	\$4.5 million	\$16.2 million
Employment	13,782 full-time jobs	39,482 full-time jobs

In order to mitigate the negative impacts of downsizing on Tennessee workers, DOE has committed \$48.8 million in community transition grant funds to the Oak Ridge region since 1993. Of this total, \$8.5 million was provided to the Community Reuse Organization of East Tennessee and communities in 1998 for projects such as training assistance, loans to businesses, development of new and existing industrial parks, support for the reindustrialization project, and grants to local governments.

- **Bechtel Jacobs Company LLC created \$13 million of new payroll in the Oak Ridge area**

The Bechtel Jacobs Company LLC has a contractual commitment with DOE to create \$427 million of new non-DOE-funded payroll in Anderson, Roane, Knox, Blount, and Loudon counties in Tennessee during the five and one-half years of its contract. More than \$13 million of new payroll was created in 1998 by firms receiving assistance from Bechtel Jacobs Company LLC.

- **DOE, its contractors, and their employees contributed more than \$10.8 million in charitable gifts during 1998**

DOE, its contractors, and their employees made significant contributions to charitable causes in 1998 including United Way, donations of equipment, and matching educational funds just to name a few. In total, these gifts comprised more than \$10.8 million in charitable giving. It is important to note that in addition to monetary and equipment donations, staff and employees of DOE and its contractors are involved in communities throughout the state as they are active in various civic and volunteer organizations.

- **Reindustrialization of the former K-25 Site netted \$800 million in savings and resulted**

- **in the location of 19 companies at the newly established East Tennessee Technology Park (ETTP)**

Reindustrialization represents a first-of-a-kind reuse of a former nuclear facility in the U.S. This initiative has saved DOE more than \$800 million. In addition, the 19 companies have now located at the East Tennessee site, led to 685 jobs and \$19 million in personal income. The average salary paid by the companies located at the site were, on average, 13.3 percent higher than the average salary paid by comparable firms located elsewhere in Tennessee.

- **DOE and its contractors supply a highly skilled and educated workforce to Tennessee**

Higher-than-average salaries are an indication of the highly trained workforce employed by DOE and its contractors. In fact, 58.2 percent of the DOE workforce holds at least a bachelors degree, with 7.0 percent, or 1,005, holding Ph.D. degrees. In comparison, the percentage of the state's population aged 25 and older holding a bachelor's degree or higher is only 16.9 percent. For the state, the high caliber workforce of DOE supplies an attractive resource for other firms considering a move to Tennessee.

THE ECONOMIC BENEFITS OF THE U.S. DEPARTMENT OF ENERGY FOR THE STATE OF TENNESSEE, FISCAL YEAR 1998

I. INTRODUCTION

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. DOE facilities located in the state were established in the early 1940s and have evolved into a primary performer of DOE's science and technology, national security, and environmental management programs. With an annual operating budget of \$2 billion, DOE can be expected to provide a significant benefit to the state economy through the creation of jobs and income and expansions in the 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 of East Tennessee, the economic benefits accrue statewide as the initial impacts ripple through the economy. Additionally, benefits to the statewide economy arise as a result of the many different programs including technical assistance offered by the Department to companies located within the state, community transition assistance due to downsizing of government operations, and various aspects of the technology transfer program. The agency's far-reaching economic influence within the state is the focus of this report. Economic benefits arising from the Department and its contractors have accrued to the state continuously for over 50 years but have never been documented in any comprehensive fashion.

In order to detail the benefits attributed to DOE, the Center for Business and Economic Research (CBER) at The University of Tennessee, Knoxville conducted an in-depth analysis of the economic benefits of DOE payroll and non-payroll spending and selected other activities on the State of Tennessee. The project is divided into two components that will be detailed in two separate reports. This report details the economic benefits attributed to DOE and its major contractors through their spending in the state. In the second report, to be released at a later date, DOE's contribution to the state through programs such as technology transfer, educational activities, and other community-based programs will be examined.

The remainder of this report consists of three sections. First, in order to frame the discussion, the next section provides a brief history of the presence of DOE in the state. In addition, this section includes a brief synopsis of DOE funded operations in Tennessee. This is followed by a section presenting an overview of the economic impact model and a detailed economic impact analysis of the activities and facilities in the State of Tennessee directly funded by DOE. The economic impact analysis was conducted using RIMS II multipliers for the State of Tennessee¹ in conjunction with the Tennessee Industrial Location Impact Model (TILI), developed and maintained by CBER. This framework will provide a quantitative measure of the importance of DOE to the state's economy. The final section of this report briefly discusses important qualitative benefits which can be garnered from the presence of DOE and its subcontractors in

Tennessee, such as support for non-profit and charitable organizations.

II. PROFILES OF DOE ACTIVITIES IN TENNESSEE²

The DOE is present in Oak Ridge in two distinct capacities. First there is the Oak Ridge Operations Office (ORO), which is one of DOE's 10 major field offices. ORO uses several contractors in the management and operation of its facilities. In addition, there is 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.

Oak Ridge Operations

Based in Oak Ridge, Tennessee, the Department of Energy's Oak Ridge Operations Office (ORO) is 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 major DOE programs in science and technology, national security and environmental management and other activities. ORO's mission and values continue to change to meet the needs of a challenging future. Together these activities represent an important asset for the economy of Tennessee.

The DOE's 35,252-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;

Figure 1: Map of DOE Facilities in Tennessee



the Y-12 Plant; and the East Tennessee Technology Park. Also, located in the City of Oak Ridge are the Oak Ridge Institute for Science and Education and the American Museum of Science and Energy (see Figure 1). Together, these facilities represent a unique technological and educational resource and a major component of the growing East Tennessee Technology Corridor. Oak Ridge Operations 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 facility was a former uranium metal processing facility operated from 1957 to 1966, and is currently undergoing environmental cleanup.

For many years, ORO was responsible for uranium enrichment operations at large gaseous diffusion plants in Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio. The Oak Ridge Gaseous Diffusion Plant was shut down in 1985 and became the center for Oak Ridge environmental management activities. In 1997, this massive facility was renamed as the East Tennessee Technology Park. Also, in 1993, operations at the Paducah and Portsmouth facilities were transferred to the United States Enrichment Corporation (USEC). ORO remains responsible for cleanup of legacy wastes created as a result of past operations at these two sites and continues to administer the lease between DOE

and USEC under the provisions of the Energy Policy Act of 1992.

Environmental Management is the largest Oak Ridge program, with cleanup programs underway to correct the legacies remaining from up to 50 years of energy research and weapons production, as well as an aggressive effort to manage currently-generated wastes. ORO has also recently established a unique initiative to leverage valuable, but unused assets, to accomplish accelerated cleanup and to create private jobs to compensate for the expected loss of jobs as cleanup is completed. This initiative, known as Reindustrialization, has become one of the primary vehicles through which ORO is realizing its vision of transforming the Oak Ridge complex into an economically viable integrated science, education, technology and industrial complex operated in partnership with the private sector.

ORO's science and technology programs are conducted at the Oak Ridge National Laboratory, the Thomas Jefferson National Accelerator Facility, and the Oak Ridge Institute for Science and Education. Major research and development capabilities include energy production and end-use technologies and conservation technologies; biomedical and environmental sciences and technology; advanced materials synthesis, processing, and characterization; neutron-based science and technology; computational science and advanced computing; and instrumentation and control technologies.

National security activities include manufacturing and reworking nuclear materials components, dismantling nuclear weapons components returned from the national arsenal, serving as the nation's storehouse of special

nuclear materials, and providing special production support to other programs.

DOE and its Oak Ridge contractors manage a Technology Partnerships program that fosters innovative partnerships and new programs built on the strengths of the Oak Ridge Complex. Alliances are formed with other Federal agencies, the private sector, universities, state and local governments, and international partners. DOE and its contractors use a variety of mechanisms to carry out the program including Memoranda of Cooperation, Cooperative Research and Development Agreements, Technology Licenses, Reimbursable Work Agreements, User Facility Agreements, Personnel Exchanges, and an Entrepreneurial Leave Program. These partnerships support changing national priorities and promote a vibrant regional and national economy. Technology Partnerships is another primary vehicle through which ORO is realizing its vision of transforming the Oak Ridge complex into an economically viable integrated science, education, technology and industrial complex operated in partnership with the private sector.

Oak Ridge National Laboratory

The Oak Ridge National Laboratory (ORNL) is a multi-program science and technology laboratory managed for the U.S. Department of Energy by Lockheed Martin Energy Research Corporation. ORNL was established in 1943 to pioneer a method for producing and separating plutonium. Construction and operation of the Graphite Reactor for this mission provided the foundation for the development of later research and production reactors. Wartime capabilities in nuclear science and engineering, materials

research and development (R&D), and radiation biology were extended to foster the development of new energy sources, technologies, and materials and the advancement of knowledge in the physical, life, engineering, computational, and social sciences. Today, ORNL supports DOE missions by conducting basic and applied R&D to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; encourage energy efficiency and advance new energy sources; restore and protect the environment; and contribute to national security.

Y-12 Plant

Lockheed Martin Energy Systems (LMES) manages operations of the Y-12 Plant, which for five decades has been vital to our nation's security through the manufacture of weapons components. The end of the Cold War brought changes in national security needs. The mission of LMES is as follows

- Effectively re-manufacture, surveil, and assess all uranium, lithium, and secondary components in the nuclear stockpile while protecting people and the environment.
- Safely store, process, and disposition uranium, lithium, and secondary components associated with the nuclear stockpile.
- Perform complementary work that reduces DOE's burden in maintaining Y-12's capability while contributing to regional economic development.

The Y-12 Plant is also the home of the Oak Ridge Centers for Manufacturing Technology, a

partnership between Y-12 and ORNL, that solves tough manufacturing problems for industry and other Federal agencies. Y-12 is also the home of the National Prototype Center. The National Prototype Center is a place where government agencies and private industry find all the capabilities, skills, and resources needed to turn great ideas into innovative, affordable, manufacturable products. The unique designation of the Y-12 Plant as the National Prototype Center represents recognition by the U.S. Congress of the facility's diverse, integrated capabilities.

Oak Ridge Institute for Science and Education

The Oak Ridge Institute for Science and Education (ORISE) has been an integral part of the U.S. Department of Energy (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), a not-for-profit consortium of 87 colleges and universities. ORISE is a nationally recognized institution providing integrated scientific and technical training expertise to the DOE. Its customer base includes the Department, many of its field and operations offices, and most of its major laboratories. ORISE supports the mission of DOE and several other federal agencies by providing technical expertise in the following areas:

- Conducting research and training in workforce health, safety, and security
- Providing worldwide emergency preparedness, response, and training.

- Performing radiological hazardous site characterization and cleanup verification.
- Developing and implementing technical training systems.
- Developing and administering science education fellowship and research participation programs.
- Integrating scientific and technical resources to build multidisciplinary programs.
- Creating collaborative research partnerships.

Oak Ridge Associated Universities is a consortium of 87 doctoral-granting colleges and universities. ORAU serves the government, academia, and the private sector in important areas of science and technology. A private, not-for-profit corporation, ORAU undertakes national and international programs in education, training, health, and the environment. As a consortium, ORAU carries out active programs with and for its members, which include the Tennessee institutions; East Tennessee State University, Fisk University, Lincoln Memorial University, Maryville College, Meharry Medical College, Tennessee State University, Tennessee Technological University, the University of Memphis, the University of Tennessee, and Vanderbilt University.

Bechtel Jacobs Company LLC

The Bechtel Jacobs Company LLC is DOE's management and integrating contractor for the environmental management and enrichment facilities programs. The scope of work for this contract also includes reindustrialization. It is Bechtel Jacobs Company LLC's job to safely expedite cleanup, reduce costs, provide transition from a management and operations contract to a

management and integration contract, maximize subcontracting, transition the workforce to subcontracts, and make an investment in the community. The community investment includes charitable community contributions and job creation. The location for these activities are Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio.

Office of Scientific and Technical Information

The Office of Scientific and Technical Information (OSTI), as part of the DOE Headquarters Office of Science, supports the agency's R&D mission by collecting, preserving, and disseminating information resulting from its nationwide annual \$6 billion R&D investment. R&D is performed by DOE's national laboratories and 7,000 other research entities. The purpose of OSTI's mission, which dates back to the Manhattan Project of the 1940s, is to build on existing science by providing researchers with access to energy-related R&D information, both legacy and current and both foreign and domestic. While OSTI's mission—sharing knowledge—has remained constant, the method of accomplishing this mission has been revolutionized by information technology. Paper, microfiche, and user-fee bibliographic on-line systems have been replaced by free, full-text, internet-based collections that reach thousands more people at a lower cost per person served. Specifically, OSTI provides the DOE Information Bridge (www.doe.gov/bridge) which contains over 30,000 full-text R&D reports—over two million pages. In the future, OSTI will complete the foundation of a national virtual library of energy

science and technology by providing access to electronic full-text science journals, which will make any conceivable energy-related R&D information searchable and retrievable from a researcher's desktop.

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 the field. The presence of DOE also provides the state with national recognition as a leader in manufacturing, advanced materials, biological sciences and transportation technologies. With its research and development 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 laboratories provide an excellent resource to the University of Tennessee through expanded research capabilities and academic programs. While these qualitative impacts are important, the remainder of this report focuses on the quantifiable economic benefits attributed to the operation of DOE supported facilities in Tennessee through their direct spending in the state.

III. MEASURING THE ECONOMIC BENEFITS OF DOE IN TENNESSEE

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 the new firm itself. For example, the workers employed by DOE and its contractors represent the direct employment benefit of these facilities. Similarly, the firm's 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 American Museum of Science and Energy. 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.

DOE Expenditure Data

The data used as input into the TILI model consisted of detail expenditure data for the 1998 fiscal year and were provided by the DOE, its major contractors and the Oak Ridge Federal Credit Union. Field offices of DOE located outside of the state but with expenditures in Tennessee provided ORO with a detail of those expenditures. Omitted from the data were several smaller contractors, three credit unions, a large number of business and general public visitors, and federal and selected contractor retirees. Therefore, the benefits detailed below are a conservative estimate of the actual benefits attributable to DOE's presence in Tennessee. Steps were taken in the data collection process to prevent double-counting of contracted and subcontracted spending. Expenditures were disaggregated into 37 industries for input into the model (see Table 1). The total direct DOE payroll and non-payroll spending in Tennessee was \$866.0 million in 1998, with an additional \$110.8 million in pension disbursements to ORNL and

Y-12 Plant retirees residing in Tennessee. Payroll spending was the largest category of expenditure, accounting for \$561.3 million or 64.8 percent of the total. The second largest spending category was business services with \$105.9 million, or 12.2 percent of the total expenditures. Figure 2 illustrates the breakdown of DOE expenditures (with exception of payments to state and local governments) in Tennessee by major sector for 1998.

The two largest DOE contracts in Tennessee are for Lockheed Martin Energy Research Corporation and Lockheed Martin Energy Systems for the operation of ORNL and the Y-12 Plant, respectively. Together these two contracts account for nearly \$669 million or 77.3 percent of the total DOE-related expenditures in Tennessee. Other major DOE contractors in Tennessee include Bechtel Jacobs Company LLC and Oak Ridge Associated Universities.

IV. ECONOMIC BENEFITS OF DOE IN TENNESSEE IN 1998

Overall Benefits

Direct spending by DOE in Tennessee in 1998 includes \$561.3 million in payroll spending, \$110.8 million in pension disbursements, \$336.6 million in non-payroll spending, \$16.6 million in state and local sales tax, and the creation of over 13,780 full-time jobs. This initial injection of money works its way through the state's economy to produce even more substantial impacts. Total benefits are summarized in Table 2 and will be discussed in more detail in the following sections.

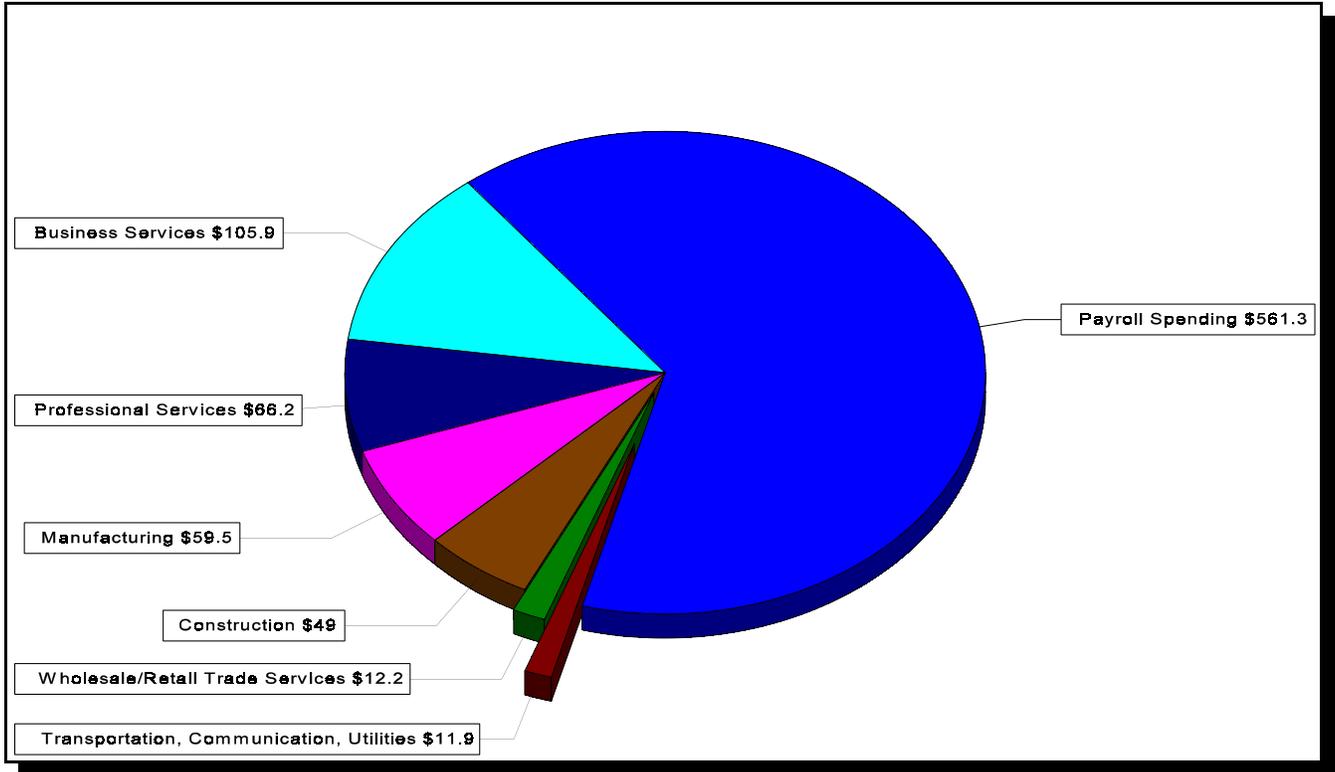
Table 1 : Expenditures of DOE and its Contractors in Tennessee for 1998

SECTOR	ORO	ORNL	LMES	ORISE	BJC	OSTI	Oak Ridge Federal Credit Union	Germantown Operations	Albuquerque Operations	Chicago Operations	Idaho Operations	Ohio Field Office	Rocky Flats Operations	FLUOR Daniel Hanford	Battelle PNNL	Total Expenditures in Tennessee*
Farm products and agricultural, forestry and fishing	34,000	26,700	45,300	5,000	18,000											129,000
Construction	1,961,000	3,218,100	32,423,400	664,000	9,701,000	1,000,000										48,967,500
Food and kindred products and tobacco products				14,000												14,000
Apparel and other textile products			2,500		11,000											13,500
Paper and allied products		1,375,200	2,372,100		27,000		23,000									3,797,300
Printing and publishing		2,400	26,900	43,000		125,000	31,000								12,267	240,567
Chemicals, allied, petroleum and coal products	3,307,000	3,165,100	3,387,300	22,000	14,000											9,895,400
Rubber and misc. plastics products, leather products		17,900	38,500		59,000											115,400
Lumber and wood products and furniture and fixtures		171,200	621,700		2,000											794,900
Stone, clay, and glass products		516,400	44,600													561,000
Primary metals industry		345,600	809,000													1,154,600
Fabricated metals products		1,576,900	1,737,600		11,000											3,325,500
Industrial machinery and equipment		5,993,200	11,888,200	76,000	495,000											18,452,400
Electronic and other electrical equipment		2,249,900	3,143,000	678,000	47,000	521,000	25,000									6,663,900
Other transportation equipment			13,800													13,800
Instruments and related products		4,732,200	5,574,400	11,000	91,000										666,609	11,075,209
Miscellaneous manufacturing industries		18,100	2,800		6,000											26,900
Transportation		3,000	4,200	994,000	181,000	41,000									10,175	1,233,375
Communication	667,000			238,000	800,000	247,000	22,000									1,974,000
Electric, gas, and sanitary services	43,000	334,000	6,281,700	795,000	982,000	209,000	20,000									8,664,700
Wholesale trade		2,614,200	4,353,600	586,000	76,000											7,629,800
Retail trade		929,300	1,649,000	777,000	158,000											3,513,300
Depository and non-depository institutions				332,000												332,000
Insurance				121,000			88,000									209,000
Real Estate		1,355,800	864,800	497,000												2,717,600
Hotels and other lodging places, recreation services				117,000	300,000		10,000									427,000
Personal and repair services (except auto)		42,600	766,000	105,000	9,000	242,000	48,000								5,095	1,217,695
Business services	1,345,000	35,610,900	46,815,200	8,788,000	3,328,000	5,397,000	253,000	4,296,302					253,000	64,356		105,897,758
Eating and drinking places		168,500	183,500	6,000	275,000											633,000
Health services				1,356,000		17,000										1,373,000
Legal services				53,000			5,000									58,000
Engineering and management services	24,984,000	6,598,000	13,380,300	92,000	10,693,000							304,686		825,000	15,904	56,892,890
Miscellaneous services	1,287,000	1,900,500	2,340,500	167,000			86,000		64,463	25,743			775,078		9,448	6,655,732
Households	26348503	194017849	263358810	18907827	49812337	3846050	517995		4408194						69125	561,286,690
Total Tennessee Expenditures	59,976,503	266,983,549	402,128,710	35,444,827	77,096,337	11,645,050	1,128,995	4,296,302	4,408,194	64,463	25,743	304,686	775,078	825,000	852,979	865,956,416

* Does not include payments to local and state governments or charitable contributions

Any transfer of money or products between specified activities is counted only in the activity of the last receiving agency

Figure 2: DOE Expenditures in Tennessee by Major Sector 1998 (In millions)



In order to put these benefits into context, consider the following:

- The total income attributed to DOE was \$1,285.7 million in 1998 which was more than the total personal income in each of 80 of the 95 counties in Tennessee in the previous year. DOE generated income ranked between Sevier County (\$1,230 million) and Maury County (\$1,378 million).³
- The number of jobs supported by DOE activities—39,482—is greater than the total employment level in each of 84 out of the state’s 95 counties and more than the 38,795 employed statewide by the motor vehicles and equipment industry.⁴
- The *state* sales tax revenue attributed to DOE’s presence, \$43.3 million, is comparable

- to Putnam County and Hamblen County with \$44.8 million and \$42.3 million in state sales tax collections, respectively and was greater than collections in each of 68 of the 95 counties.⁵

To further illustrate the significance of DOE’s benefits, Table 3 compares these benefits to relevant statistics for Anderson County, one of the host counties of DOE’s primary activities.

Output Benefit

For the purpose of the current study the output benefit is defined as the increase in gross state product (GSP) brought about by the on-going operations of DOE facilities in Tennessee, including direct, indirect, and ripple effects. In 1998, the total increase in output attributed to

Table 2: Summary of Economic Benefits of DOE on the State of Tennessee, 1998

Output	\$ 1,903.1 million
Income	\$ 1,285.7 million
State and local tax revenue	\$ 59.5 million
Employment	39,482 full-time jobs

DOE funded activities was \$1.9 billion. The breakdown of this benefit by initial spending source is depicted in Figure 3. The payroll, non-payroll, and visitor effects account for the increase in output both directly and via the multiplier effect of expenditures in each respective category. Payroll spending had the most significant contribution to output (\$943.9 million) and non-payroll spending was close behind (\$928.5 million). The resulting output multiplier was 1.90, implying that each dollar of output *directly* produced by DOE in Tennessee results in \$1.90 of total output in the state.

Income Benefit

The income benefit of DOE in Tennessee in 1998 totaled nearly \$1.3 billion. As indicated in Table 4, the direct effect of DOE on income in Tennessee is measured by the level of payroll spending and pension disbursement in the state. In 1998, DOE's direct income effect in the state was \$672.1 million or 52.3 percent of the total income benefit. Indirect income benefits accrue via non-payroll expenditures (which support jobs and income in supplier firms) and visitor spending

while induced (multiplier) income effects arise as the generated income continues to permeate the state's economy. Together, these effects accounted for \$613.6 million in additional income for the residents of Tennessee. The personal income multiplier, derived by dividing the total income impact by the direct income impact, is 1.91 meaning that every dollar of direct income injected into the state's economy by DOE translates into an additional 91 cents of indirect and multiplier income in the state.

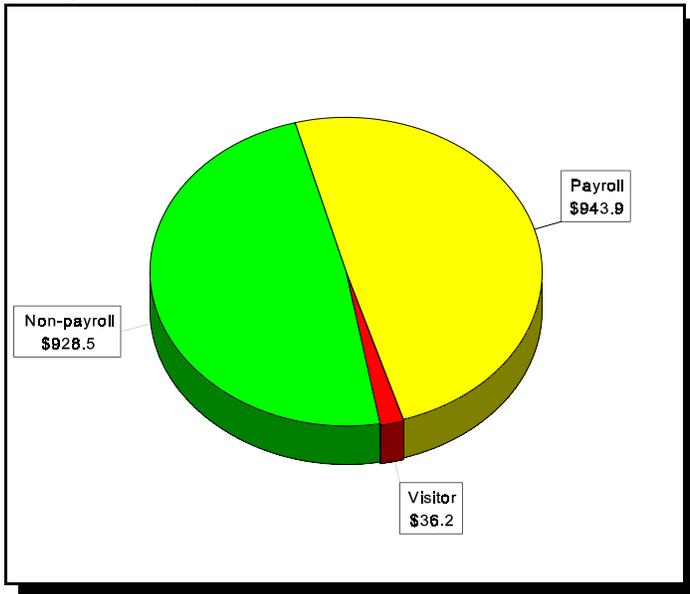
Employment Benefits

In 1998, DOE and its contractors employed 13,782 residents of the State of Tennessee. A decomposition of employment by contractor is provided in Table 5. The largest employers, LMER (ORNL) and LMES (Y-12 Plant), account for 80.7 percent of the jobs directly supported by DOE in the state. It is important to note that the average salary of DOE employees is well above the statewide average of \$25,090 and the statewide manufacturing average salary of \$29,695.⁶ The higher salary levels result in higher

Table 3: Statewide Economic Benefits of DOE Compared to Anderson County

Indicator	DOE	Anderson County	Index
Income	\$ 1.3 bil.	\$ 1.6 bil.	0.81
State sales tax	\$ 43.3 mil.	\$50.0 mil.	0.87
Local sales tax	\$ 16.2 mil.	\$15.5 mil.	1.05
Employment	39,482	38,732	1.02

Figure 3: Output Benefit of DOE in Tennessee, by Source in 1998 (In millions)



total economic impacts.

The total employment benefit of DOE on Tennessee for 1998 was 39,482 full-time equivalent jobs supported statewide. Spending on payroll and pension disbursements supported 12,298 jobs as the income rippled through the state’s economy. Non-payroll spending supported an additional 12,752 jobs while visitor spending supported the remaining 650 jobs (see Figure 4). The resulting employment multiplier was 2.87 indicating that for every direct job provided by DOE, 1.87 additional full-time equivalent jobs are supported elsewhere within the state. This rather large employment multiplier (relative to the income multiplier of 1.91) reflects in large part the relatively high-wage jobs created by DOE.

State and Local Tax Revenue

The contribution of DOE on state and local tax revenue arises from several sources. First, there is

the direct payment of state and local sales tax by DOE and its contractors, as well as property taxes and payments-in-lieu-of-taxes (PILT). Additional taxes are paid by DOE and its employees, as well as visitors to their facilities. Finally, taxes accruing from the activities of businesses and workers supported through direct, indirect, and multiplier-generated income can be attributed to DOE.

The fiscal benefit highlighted here is the state and local sales tax revenue arising from DOE’s activities in Tennessee. Since the focus here falls on the sales tax, this means that the actual beneficial impact on state and local tax revenues will be understated.

In calculating the impacts on sales tax revenue several assumptions must be employed regarding expenditure patterns, savings, and tax rates. A list of the simplifying assumptions used in the analysis is provided in Table 6.

The total estimated benefit of DOE on state and local tax revenue for 1998 was \$61.2 million. As illustrated in Figure 5, \$43.4 million in state sales tax revenue was generated while \$16.2

Table 4: Summary of DOE’s Income Benefit on the State of Tennessee, 1998 (In millions)

Source	Amount
Direct	
Payroll	\$ 561.3
Pension disbursements	110.8
Indirect/Induced	
Payroll	226.3
Non-payroll	229.2
Pension/Retirees	44.6
Visitors	113.5
Total	\$1,285.7
Personal Income Multiplier	1.91

Table 5: DOE Employment in Tennessee by Contractor, 1998

Division/Contractor	Full-Time Employees
ORO	550
ORNL	4370
LMES	6753
ORAU	525
Bechtel Jacobs	1405
OSTI	92
ORFCU	23
DOE, Albuquerque	63
Battelle, Pacific Northwest National Laboratory	1
Total	13782
Average Salary	\$40,727

million and \$1.6 million were generated in local revenue in the form of local sales tax and PILT, respectively. A more detailed analysis of the sales tax contribution is provided in Table 7 and Figure 6. The total sales tax per job created in 1998 for DOE was \$1,509. In comparison, the state and local sales tax per capita in Tennessee for the fiscal year 1997/98 was \$999.⁷

V. OTHER BENEFITS OF DOE’S PRESENCE IN TENNESSEE

Aside from the obvious economic benefits of DOE’s presence in the state, there exist many avenues by which DOE and its contractors contribute to the well-being of the State of Tennessee. The following sections will briefly discuss these areas with a more in-depth analysis of these and other indirect benefits to be contained in a separate report.

Community Involvement

DOE, its contractors, and their employees made significant contributions to

charitable causes in 1998. The donations ranged from a national savings bond drive to local United Way campaigns to donations of equipment to area schools. In total, over \$10.8 million in charitable giving can be attributed to DOE operations in Tennessee. Table 8 provides details on donations by firm. Of course, community involvement extends beyond monetary and equipment donations as staff and employees of these firms are active in civic organizations and volunteer programs.

Technology Partnerships Program

DOE and its Oak Ridge contractors use a variety of partnership mechanisms to increase revenue into the Oak Ridge Complex and provide other benefits to the State. During 1998, Cooperative Research and Development Agreements were executed that provided \$2.3 million in new revenue, Reimbursable Work Agreements added \$194.4 million in revenues,

Figure 4: Employment Benefit of DOE in Tennessee by Spending Category, 1998

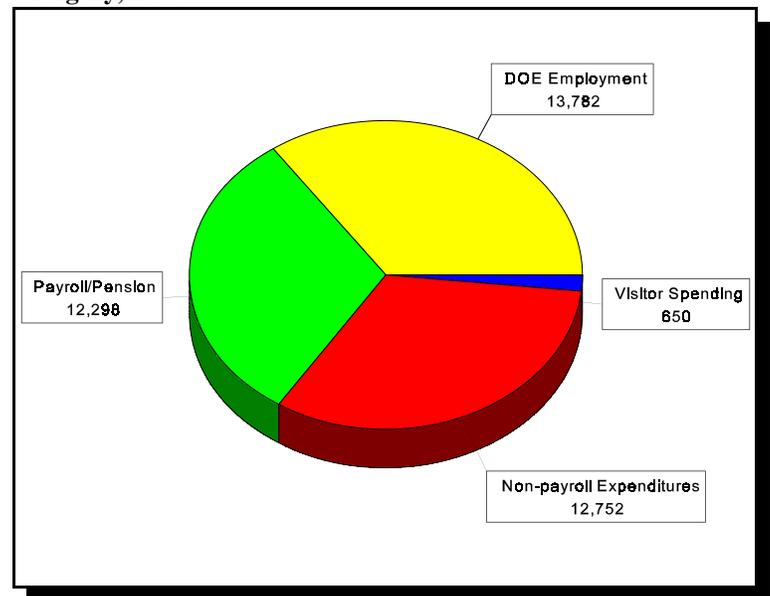


Table 6: Assumptions Used in the Calculations of the Sales Tax Impact of DOE in Tennessee

- 55 percent of employee income is spent on sales-taxable versus non-taxable goods and services. 45 percent of retiree income and 100 percent of visitor spending is spent on sales-taxable items.
- Adjustments to income are made for leakages of taxes, savings, and out-of-state spending.
- A weighted average local option rate of 2.25 percent was used in the calculation of local impacts.
- Sales tax benefits account for sales tax revenue arising from taxable purchases by business firm.

and licenses of DOE-developed technologies returned \$1.5 million in royalties. In addition, over 1,000 visiting scientists utilized the Oak Ridge National Laboratory's User Facilities to conduct research. More than 80 companies involving ORNL employees or technologies are located in the East Tennessee region. Memoranda of Cooperation have been executed with more than 10 Tennessee governmental entities.

Community Transition Assistance

Through September 1998, the Department of Energy has committed \$48.8 million in community transition grant funds to the Oak Ridge region

in order to mitigate the impacts of downsizing on Oak Ridge workers. Of this total, \$8.5 million was provided to the Community Reuse Organization of East Tennessee and communities in 1998 for projects such as training assistance and loans to businesses, the development of new and existing industrial parks, support of the reindustrialization effort, grants to local governments and aid for various new economic development projects which are based on Oak Ridge technologies.

Bechtel Jacobs Company LLC Jobs Creation

The Bechtel Jacobs Company LLC has a contractual commitment with DOE to create \$427 million of non-DOE-funded payroll in Anderson, Roane, Knox, Blount, and Loudon counties of Tennessee during the five and one-half years of its contract. More than \$13 million of payroll was

Figure 5: State and Local Tax Revenue Attributed to DOE in Tennessee in 1998

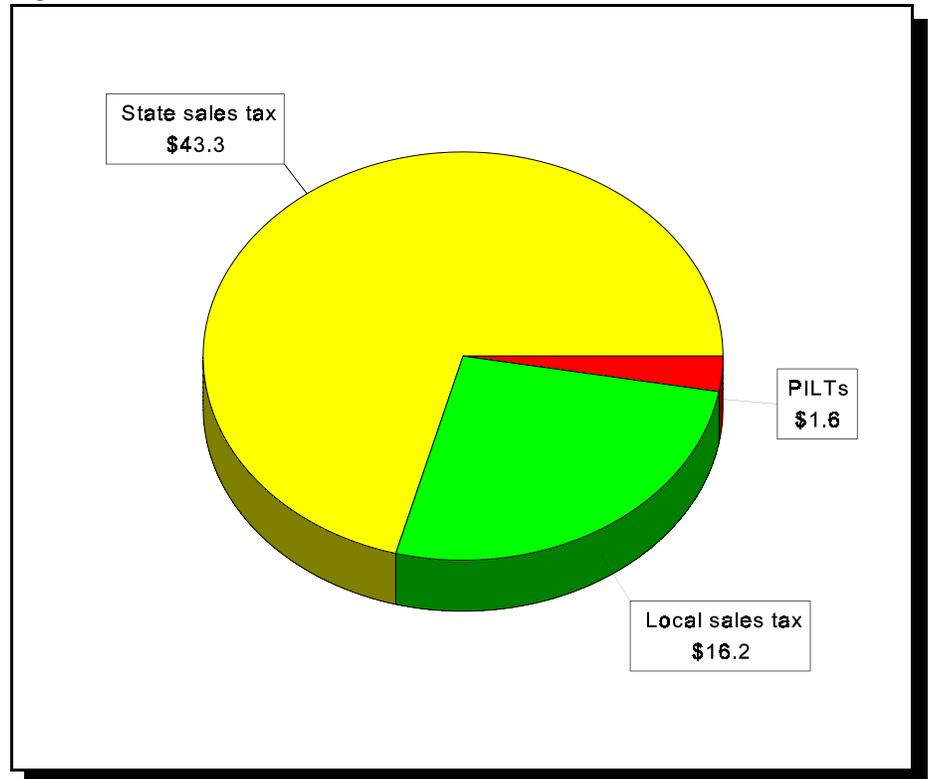


Table 7: State and Local Sales Tax Benefit of DOE in Tennessee in 1998

Source	Dollars (In millions)	
	State	Local
Direct payment	\$ 12.1	\$ 4.5
Sales tax accruing to:		
Payroll spending	12.9	4.9
Non-payroll spending	5.2	2.0
Multiplier income	9.8	3.6
Visitor effect	1.1	0.4
Retirees	2.2	0.8
Total	\$ 43.3	\$16.2
Sales tax per job created (actual dollars)	\$1,097	\$412

created in 1998 by firms receiving assistance from Bechtel Jacobs Company LLC.

Reindustrialization

Reindustrialization represents the first-of-a-kind reuse at a former nuclear facility in the U.S. The Oak Ridge Operations Office initiated efforts in 1996 to reindustrialize and defederalize portions of the Oak Ridge Reservation. The primary effort is focused on the East Tennessee Technology Park (ETTP), formerly known as the K-25 Site or Oak Ridge Gaseous Diffusion Plant. DOE has used a wide variety of methods to accelerate environmental cleanup and redevelop the site including leasing, bartering, and contracting. These efforts have resulted in over \$800 million in savings to the Department, and the companies currently located at the site now account for over 685 direct jobs and \$19 million in income. This methodology is being looked at by other foreign countries (e.g., Canada) as a potential tool for reindustrialization. ORO's

Figure 6: State Sales Tax Benefit of DOE in Tennessee in 1998

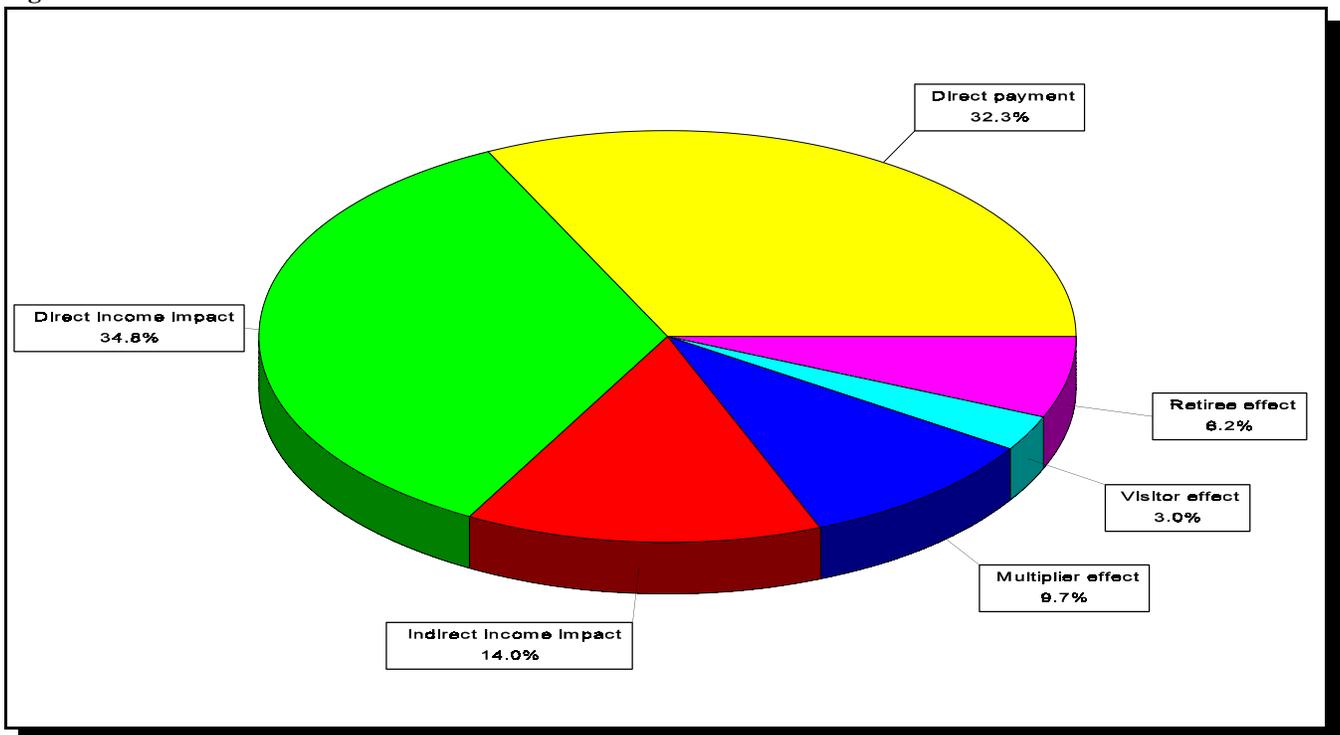


Table 8: Community Involvement of DOE and Its Contractors in Tennessee, 1998

	ORO	Lockheed Martin ¹	ORAU	BJC	OSTI	Total
Corporate involvement		\$1,870,000				\$1,870,000
United Way, CFC, etc.	\$47,882	1,140,000	\$25,000	\$49,061	\$9,135	1,271,078
Savings Bond drive	231,775	4,454,000	32,015	191,170	5,200	4,914,160
Charitable contributions		644,000	70,000	392,534		1,106,534
Donations of equipment		549,000	778,000		59,539	1,386,539
Matching educational funds		275,000				275,000
Total	\$279,657	\$8,932,000	\$905,015	\$632,765	\$73,874	\$10,823,311

1. Totals for ORNL and Y-12 Plant.

successes have resulted in a number of DOE sites attempting their own version of this initiative, and some environmental, safety, and health issues have surfaced in the course of implementation.

In 1998, reindustrialization resulted in 19 companies locating at ETTP, many of which may not have chosen Tennessee as a location site in the absence of this program. In addition, these companies offer higher paying jobs with salaries above the Tennessee average for other firms in the same industries. For example, seven industries are represented by the current tenants. The statewide average annual salary for these seven industries is \$28,258 and the average annual salary paid by the tenants is \$38,009.⁸

Quality Workforce

DOE and its contractors have a highly skilled and educated workforce as evidenced by the above average salaries. As seen in Figure 7, 58.2 percent of the DOE workforce in Tennessee holds a

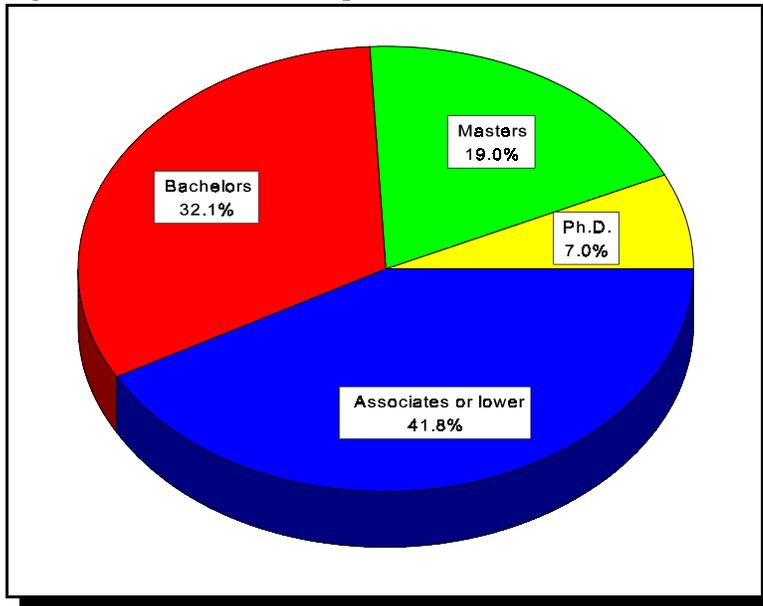
bachelor's degree or higher. More specifically, 4,600 employees have bachelors degrees, 2,719 have masters, and 1,005 have Ph.D. degrees. In comparison, the percentage of the state's population aged 25 and older holding a bachelor's degree or higher is only 16.9 percent.⁹ In addition to attracting highly qualified personnel, the DOE and its contractors provide training and tuition reimbursement for employees. For the state, the high caliber workforce provides an attractive resource for other firms considering a move to Tennessee.

VI. CONCLUSION

The Department of Energy has been a contributing force in the economic development of Tennessee since its earliest presence in the 1940s. Its economic benefits to the state's economy started with the initial investment of \$3.4 billion at start-up and continues today

through the annual operations of the Department and its contractors. Up to this point, the economic benefits had not been inventoried nor quantified. Overall benefits to Tennessee include over \$1.9 billion in additional output, \$1.3 billion in new income, and \$59.5 million in state and local sales tax revenues. Additionally, 39,482 full-time equivalent jobs are supported in Tennessee as a result of DOE's activities in the state. With an annual budget of \$2 billion, the DOE will continue to be a driving force in enhancing the economic viability of Tennessee. The beneficial impacts are not limited to economic effects, but extend into a wide range of services including community involvement, economic development through reindustrialization and technology transfers, and training and education of its workforce. A second report, to be released at a later date, will focus on the vast array of these qualitative benefits DOE brings to Tennessee.

Figure 7: Educational Makeup of DOE in Tennessee, 1998



6. Tennessee Department of Employment Security, "The Labor Market Report," Nashville, TN: September, 1998.
7. Data used in calculation obtained from Tennessee Department of Revenue and U.S. Census Bureau.
8. Data for statewide calculations obtained from Tennessee Department of Employment Security, "Occupational Wages," January, 1998.
9. U.S. Census Bureau, Current Population Survey, March 1998.

ENDNOTES

1. RIMS II multipliers are from an input/output model developed and maintained by the Bureau of Economic Analysis, U.S. Department of Commerce.
2. Profiles provided by DOE and its contractors.
3. U.S. Department of Commerce, Bureau of Economic Analysis.
4. U.S. Department of Commerce, Bureau of Economic Analysis.
5. Tennessee Department of Revenue, Revenue Collections, June 1998.