PNNL-23925

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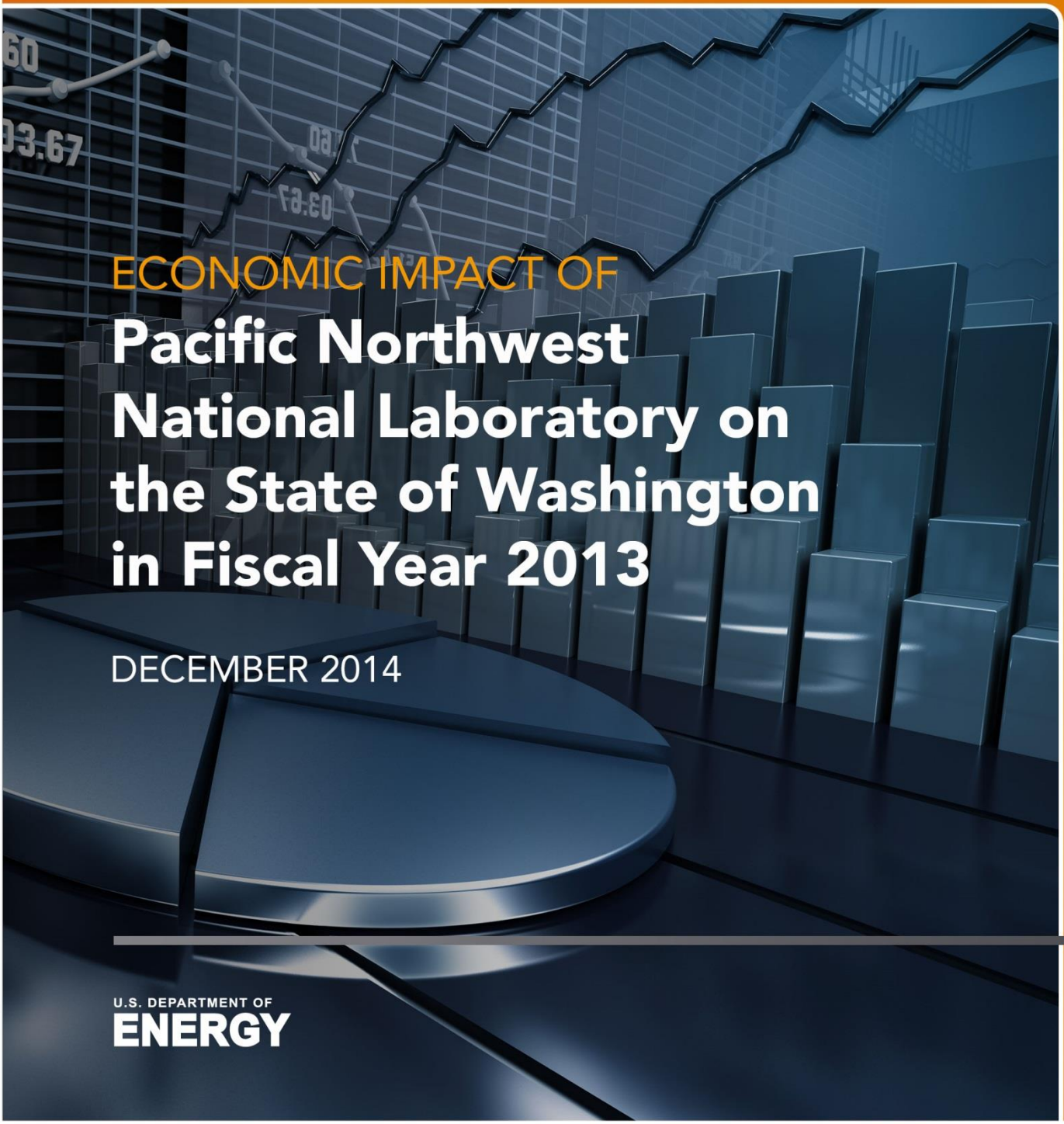

ECONOMIC IMPACT OF

Pacific Northwest National Laboratory on the State of Washington in Fiscal Year 2013

DECEMBER 2014

U.S. DEPARTMENT OF
ENERGY

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Economic Impact of Pacific Northwest National Laboratory on the State of Washington in Fiscal Year 2013

MJ Scott
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December 2014

Prepared for
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99352

2013 Highlights

$1.06 billion in annual funding; **$936 million** in total spending

4,344 employees

- **94% (4,101)** living in Washington State in 2013
- **23%** growth in employment 2000-2013

$401 million total payroll

- **$377 million** in Washington State

$305 million domestic purchased goods and services

- **$48 million** in Washington State

$22.8 million estimated taxes paid by PNNL and its employees to Washington State and local governments

196,700 total visitor-days at PNNL from university, industry, and governmental partners

- **$31 million** in related visitor spending
- **451 jobs** supported by visitor spending

Economic Impacts

$1.31 billion in total economic output supported by PNNL payroll and domestic purchased goods and services
$514 million in Washington State wage income
6,802 total jobs generated in Washington State

$1.21 billion total economic output supported by PNNL-related health care, spinoff companies, visitors, and retirees in Washington State
$459 million in Washington State wage income
6,437 total jobs generated in Washington State

108 PNNL spinoff companies still operating through 2013
76 in Washington State
$570 million estimated funding in Washington State
2,219 employees in Washington State

$1 million value of Battelle and PNNL employee cash contributions to philanthropic and civic organizations

$324,000 in-kind corporate support for STEM education

Executive Summary

Pacific Northwest National Laboratory (PNNL) is a large economic entity, with $1.06 billion in annual funding, $936 million in total spending, and 4,344 employees in fiscal year (FY) 2013 (the period of performance for this report includes PNNL's fiscal year of October 1 through September 30, as well as state data, which is reported for the calendar year [CY] of January 1 through December 31). Four thousand, one hundred and one (4,101) employees live in Washington State. PNNL directly and indirectly supported about $1.31 billion in economic output, 6,802 jobs, and $514 million in Washington State wage income from current operations. The state also gained more than $1.21 billion in output, more than 6,400 jobs, and $459 million in income through closely related economic activities, such as visitors, health care spending, spending by resident retirees, and spinoff companies.[1]

PNNL affects Washington's economy through commonly recognized economic channels, including spending on payrolls and other goods and services that support operations. Less-commonly recognized channels also have their own impacts and include company-supported spending on health care for its staff members and retirees, spending of its resident retirees, PNNL visitor spending, and the economic activities in a growing constellation of "spinoff" companies founded on PNNL research, technology, and managerial expertise.

PNNL also has a significant impact on science and technology (S&T) education and community not-for-profit organizations. PNNL is an active participant in the future scientific enterprise in Washington with the state's K-12 schools, colleges, and universities. Staff members are sent to the classroom and hundreds of students are brought to the PNNL campus to help train the next generation of scientists, engineers, mathematicians, and technicians. This investment in human capital, though difficult to measure in terms of current dollars of economic output, is among PNNL's important lasting legacies. Finally, PNNL contributes to the local community with millions of dollars' worth of cash and in-kind corporate and staff contributions, all of which strengthen the economy.

This report quantifies these effects, providing detailed information on PNNL's revenues and expenditures, as well as the impacts of its activities on the rest of the Washington State economy. This report also describes the impacts of the four closely related activities: health care spending, spinoff companies with roots in PNNL, visitors to the Laboratory, and PNNL retirees.

[1] Research programs at PNNL are dynamic and affected by levels of federal funding, so economic impact of PNNL's operations on Washington State will vary from year to year. For a comparison with selected other major technology entities in Washington State and with other DOE national laboratories, see Appendix B.

Key Facts

- PNNL is managed by Battelle Memorial Institute, a non-for-profit, applied S&T organization under a contract with the United States (U.S.) Department of Energy (DOE).
- The PNNL data in this report generally are from October 1, 2012 to September 30, 2013 (PNNL's FY 2013), supplemented by some Washington State data from calendar years 2013 and 2012. Except where specifically noted, estimates reported are for PNNL FY 2013.
- PNNL's FY 2013 funding totaled $1.06 billion with $936 million in total spending during the fiscal year. Seventy percent (70%) of the total spending came from DOE and its other sites and contractors, 6% from the U.S. Department of Homeland Security (DHS), 17% from other agencies, and 7% from private parties and intellectual property.
- As of September 30, 2013, PNNL employed 4,344 staff members, with 94% (4,101) residing in Washington State.
- Employment at PNNL grew approximately 23% between 2000 and 2013.
- PNNL spent a total of $401 million on payrolls, $136 million on employer-provided benefits, and $305 million on domestic goods and services, to support operations.
- Expenditures in Washington State were approximately $377 million in payrolls and $48 million in purchased goods and services. Through multiplier effects, these direct expenditures supported $1.31 billion in total economic output in Washington State.
- PNNL's operations spending directly or indirectly supported a total of 6,802 jobs in Washington State, which includes PNNL's own 4,101 Washington State employees.
- Through collaborations with other government and private sector entities and hosting PNNL-related research and educational events, PNNL generated 196,700 visitor-days from out-of-town visitors in FY 2013 and an estimated $31 million in total visitor spending in Washington State.
- PNNL's research activities generated 264 invention disclosures, 60 patent filings, 36 patents granted, and 41 commercial and research license agreements issued.
- PNNL received $5.6 million in royalty income and license fees, which are reinvested in its S&T. Since 2000, PNNL has had 908 patent filings, 574 patents granted, 488 licenses, and $46.0 million in license revenue.
- PNNL employees and their households spent about $42 million in purchases of health-related services funded by PNNL health insurance (not personal income) in the Washington economy in FY 2013. Retired employees' health insurance (e.g., Medicare) spent over $22 million. These two sources together spent an estimated $64 million in FY 2013 in Washington State.

- Many former PNNL employees have chosen to retire in Washington State. Up to 2,032 retired employees were assumed to be living in the state in FY 2013. They received pension and Social Security benefits estimated at $89 million in income. Expenditures in Washington from that income supported an estimated 504 jobs in the state.
- Based on PNNL aggregate payrolls, purchased goods and services, and investments, Washington State and local governments received $22.8 million in tax revenue. This revenue was derived mainly from state and local sales taxes, use taxes, and local property taxes.
- PNNL plays a strong role in science, technology, engineering, and mathematics (STEM) education at the K-12 and post-secondary level. About 1,400 K-12 students participated in PNNL's education programs.
- A total of 716 undergraduate students, graduate students, post-doctoral students, and faculty participated in post-secondary fellowship and intern programs at PNNL in FY 2013. Teaching the teachers programs for the K-12 level generated 1,300-plus participants.
- PNNL conducted a large number of collaborative research arrangements with public and private partners. EMSL, the Environmental Molecular Science Laboratory, attracted 342 non-PNNL U.S. users and 70 foreign users. The Atmospheric Radiation Measurement (ARM) Program facilities attracted 983 scientific users.
- An estimated 451 Washington State jobs were supported by visitor spending.
- One hundred and eight (108) companies still operating through 2013 with gross annual sales of $804 million and 3,118 employees have their roots in PNNL. Of that total, 76 (70%) of these spinoff companies with $570 million (71%) of their sales and 2,219 (71%) of their employees reside in Washington State.
- Total economic impacts of the spinoff companies on the Washington State economy include an estimated 4,672 jobs (2,219 at the spinoff companies) and an estimated $991 million in total economic output in Washington State.
- PNNL researchers had a total of almost 1,200 peer-reviewed, published articles in FY 2013.
- A total of 20 staff members advanced to Fellow in scientific societies: two in the American Chemical Society, four in the American Physical Society, three in the Royal Society of Chemistry, four in the American Association for the Advancement of Science ,and one each in the American Geophysical Union, the Microscopy Association of America, the American Institute for Medical and Biological Engineering, American Ceramic Society, American Vacuum Society, Health Physics Society, and American Institute of Chemical Engineers.
- PNNL won one R&D 100 Award, bringing the cumulative total of R&D 100 awards to 90. From the Federal Laboratory Consortium, PNNL received three Excellence in Technology Transfer Awards, which brings the total of technology transfer awards to 78, more than any other federal laboratory.

Acronyms

ACT Agreement to Commercialize Technology

ANL Argonne National Laboratory

ARM Atmospheric Radiation Measurement

B billion

BER Office of Biological and Environmental Research

BNL Brookhaven National Laboratory

CRADA Cooperative Research and Development Agreement

CY calendar year

DHS U.S. Department of Homeland Security

DoD U.S. Department of Defense

DOE U.S. Department of Energy

EMSL Environmental Molecular Sciences Laboratory

FTE full-time equivalent

FY fiscal year

gsf gross square feet

GSP gross state product

INL Idaho National Laboratory

IP intellectual property

K thousand

LASER Leadership and Assistance for Science Education Reform

LBNL Lawrence Berkeley National Laboratory

M million

MESA Mathematics, Engineering, and Science Achievement

NAICS North American Industry Classification System

NREL National Renewable Energy Laboratory

OASI Social Security Old Age and Survivors' Insurance

ORNL Oak Ridge National Laboratory

PNNL Pacific Northwest National Laboratory

S&T science and technology

SEE Science and Engineering Education

STEM science, technology, engineering, and mathematics

TAP Technology Assistance Program

U.S. United States

WFO Work for Others

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1.0 Introduction

PNNL is a multiprogram, DOE Office of Science laboratory located in Richland, Washington, with a long-standing reputation for advancing scientific frontiers through world-class research and development. Established in 1965 with 2,200 employees and facilities supporting the Hanford Site operations, PNNL focused on expanding nuclear fuel cycle research, advanced reactor designs and materials, and novel reactor fuels. Today, PNNL has made significant scientific and technological advances. Examples include the Global Change Assessment Model, an integrated energy-economic framework widely used by scientists and policymakers around the world to understand global change; a Grid-Friendly™ Appliance Controller chip that allows appliances to respond to severe changes in the power grid; and a highly sensitive sampler/analyzer that detects trace quantities of materials associated with nuclear weapons. The vision for the Laboratory is to deliver world-leading S&T, especially in areas of chemical imaging of dynamic systems, advanced computing, biosystem dynamics and design, mesoscale science, climate and earth systems science, efficient and secure electricity management, and disruption of illicit nuclear trafficking.

One of PNNL's strengths is the ability to bring multiple capabilities to bear on complex scientific and technological challenges. As shown in Figure 1.1, the Laboratory has 10 core capabilities, each a powerful combination of people, equipment, and facilities nurtured through programs and institutional investments. Over the years, these core capabilities have matured into world-class research programs in catalysis, climate research, subsurface science, and radiation detection.

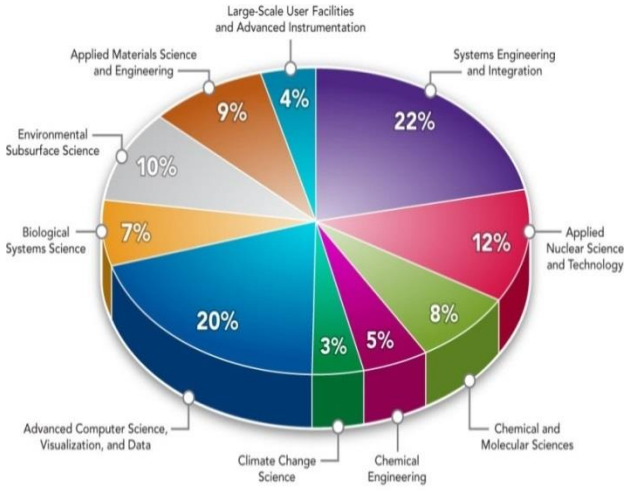

Figure 1.1. PNNL Technical Staff by Core Capability

These core capabilities are also critical to the success of the two national scientific user facilities in which we are significantly involved:

- EMSL, a DOE Biological and Environmental Research (BER) national scientific user facility managed by PNNL, is focused on pioneering discoveries and effectively mobilizing the scientific community to provide the molecular science foundations for BER's research priorities and our nation's critical biological, environmental, and energy challenges.
- The Atmospheric Radiation Measurement (ARM) Climate Research Facility provides the international research community with infrastructure for obtaining precise observations of atmospheric phenomena.

PNNL is operated by Battelle Memorial Institute, a private, not-for-profit, S&T enterprise that explores emerging areas of science, develops and commercializes technology, and manages laboratories.

2.0 PNNL as an Economic Entity

2.1 PNNL Revenues and Expenses

During fiscal year (FY) 2013, PNNL had funding of $1.06 billion (Figure 2.1) and total spending[1] of $936 million, as shown in Figure 2.2. The vast majority of the work that PNNL performs is for DOE, with the U.S. Department of Homeland Security (DHS), the U.S. Department of Defense (DoD), and other federal agencies playing major roles.

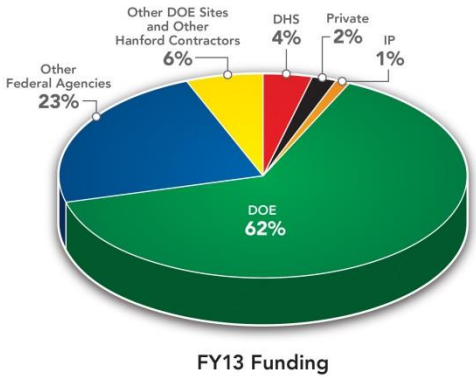

Figure 2.1. PNNL's FY 2013 Funding was Approximately $1.06 Billion

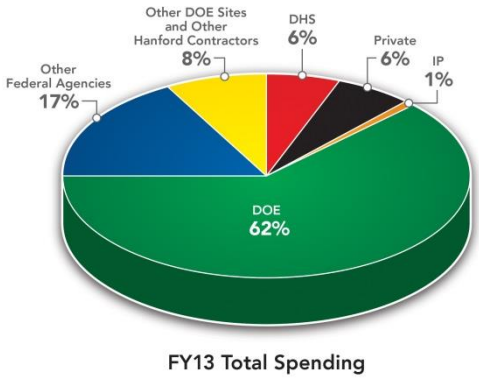

Figure 2.2. PNNL's Total Spending in FY 2013 was Approximately $936 Million

2.2 PNNL Employment, Payrolls, and Benefits

At the end of FY 2013, PNNL employed 4,344 people,[2] 4,101 of whom were residents of Washington State and worked in Richland, Seattle, and Sequim (Figure 2.3). In addition, there were 101 staff members in the Washington, D.C. area; 33 staff members assigned to work in Corvallis and Portland, Oregon and are assumed to live in Oregon; and 109 staff members employed at other offices in the United States or in foreign countries.

PNNL's total payroll during FY 2013 was $401 million, of which $377 million went to Washington State residents. PNNL competes nationally for scientists and engineers, who compose 38 percent of PNNL's workforce, versus 5 percent of the state's workforce. PNNL has a large percentage of high-wage professions (Table 2.1). As such, the average PNNL worker likely spends at a higher level and, therefore, has an above-average impact on the state economy compared to the average worker in the state.

[1] This total represents revenues expended on projects, adjusted for funds that may be committed in one fiscal year for a multiyear project, and funds that may arrive late in a fiscal year and may be spent in the next. Conversely, work is carried out on backlog at other times.
[2] In this report, employees are referred to as staff or staff members at PNNL.

The average annual wage for all PNNL employees at the end of FY 2013 was $91,100.[1] In 2013, the CY 2013 state average wage was $51,600.

While not directly part of wages, benefits outlays contribute to PNNL's economic impact. PNNL provides a benefit package that costs $136 million per year. Included are an employer-provided health insurance package, employer matching of a portion of employee 401K contributions, a defined benefit pension plan, and other items (e.g., disability, tuition refunds, and group life insurance).

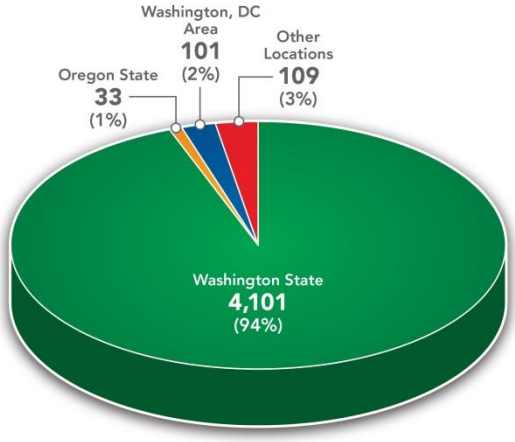

Figure 2.3. Locations of PNNL Employees

Table 2.1. PNNL Employment and Wages by Select Occupational Categories, Compared with State Average Wages in 2013

Selected Occupation Group	Number of PNNL Staff in Washington (April 2013)	Average PNNL Wage ($K Annually)	State Average Wage, CY 2013 ($K Annually)
Manager	387	$154	$ 108
Scientist	1,003	98	77
Engineer	552	104	95
Technician	240	44	57
Computer Occupations	386	91	88
Business and Financial Specialists	619	94	68
Administrative and Clerical	369	45	40
Construction Operations, Maintenance	231	71	47
Total (all listed occupations)	**3,787**	**93**	**61**
Total (all PNNL occupations)	**4,138**	**92**	**64**

2.3 Purchased Goods and Services and Investments

During FY 2013, PNNL placed domestic procurements for $305 million of goods and services[2] to support operations of the Laboratory. Table 2.2 shows that a wide variety of goods and services were purchased—from small scientific equipment to subcontracts with universities, consultants, and research firms. Of the total, 15.7 percent (or $48 million) of the purchases were made from Washington State firms.

[1] $91,100 includes student employees, which reduce the PNNL average. When student employees are excluded, the average pay increases to $97,600.
[2] Excluding purchases outside of the United States.

Table 2.2. FY 2013 PNNL Purchased Goods and Services Spending, Total U.S. Domestic, and in Washington State*

Type of Expenditure	Total ($M)	In Washington State ($M)
Construction	$18	$15
Finance, Insurance, Real Estate	$5	$1
Computers, Lab Equipment, Software, Services, Retail Trade	$68	$12
Wholesale Trade	$8	$2
Utilities, Transportation, Publishing, Management, and Business Services	$76	$8
Technical and Scientific Subcontractors	$17	$2
Medical and Health Services	$2	$1
All Other	$111	$6
Total	**$305**	**$48**

**Detail may not add to total due to rounding.*

2.4 Expenditures for New Construction and Renovations

PNNL is located in Richland, Washington, with several off-site locations. The main PNNL campus, located at the north end of Richland, consists of land owned by DOE, Battelle, and third parties. In FY 2013, PNNL's facility profile comprised 79 buildings:

- 19 buildings owned by DOE
- 32 Battelle facilities
- 28 leased facilities.

Large scientific enterprises like PNNL periodically must renovate their research facilities and procure major scientific equipment as their scope of work, scientific knowledge base, and responsibilities change. PNNL makes these investments through its capital budgets.

Physical Assets

- 79 total buildings
- 670 acres (combined DOE and Battelle)
- replacement plant value of DOE space: $410.4M
- 1,340,336 gross square feet (gsf) of DOE- and Battelle-owned, active, operating buildings
- 976,179 gsf in 28 leased facilities

Fiscal year 2013 was an active year for making capital investments, with major renovations worth $19 million (Table 2.3). All PNNL major renovations were performed on buildings located in Washington State. Of this total, 58 percent ($11 million) included reimbursements to subcontractors working on PNNL buildings in Washington State (including out-of-state contractors working on in-state projects).[1] Washington State resident subcontractors earned $8 million of this $11 million, or 73 percent. Total costs other than PNNL labor related to these renovations are included in the $305 million non-payroll purchases listed in Table 2.2. An estimated 55 construction jobs were supported by the $8 million in in-state subcontractor construction spending. These are included in the total impacts in the Section 2.6.

[1] Renovations of PNNL building space or other construction activities conducted in other states (Oregon; the Washington, D.C. area; and other places where PNNL may be conducting research or other activities) are assumed not to affect the Washington State economy.

Table 2.3. PNNL Construction Spending in FY 2013

FY 2013 Renovations	Total Spending ($M)
PNNL Labor Costs	$5
Miscellaneous Procurements	$3
Disbursements to Subcontractors	$11
Item: Disbursements to Washington State Subcontractors = $8	
Total Renovation Spending	**$19**

2.5 PNNL State and Local Taxes Paid

PNNL and its employees paid a total of $22.8 million in local and Washington State taxes. Taxes paid include sales and use taxes, property taxes, and a few others (e.g., motor fuel taxes).[1] Employee taxes were based on the total $377 million in wages of PNNL employees who are residents of Washington and the 2012 state and local governments' tax collections (for every dollar of personal income): an estimated $0.024 in sales, use, and other production-related taxes by individuals; $0.030 in state and local property tax collections; and $0.002 in other taxes per dollar of personal income. The estimated FY 2013 tax payments by employees are shown in Table 2.4. In total, PNNL paid $1.4 million in state and local taxes, and employees paid $21.4 million. In addition, the Laboratory paid $4.7 million into the state's unemployment and workers' compensation insurance systems during the fiscal year. However, this payment is not considered a tax and, therefore, is not included in the total.

Table 2.4. FY 2013 Washington State and Local Taxes Paid by PNNL and its Employees

Washington Tax Category	Reported Paid by PNNL in FY 2013 ($K)	Estimated Paid by PNNL Employees in FY 2013 ($K)[(a)]
Sales and Use Taxes	$317	$9,217
Business and Occupation Taxes (less credits)	$102	--
Leasehold Taxes	$58	0
Property Taxes	$952	$11,386
Other State and Local Taxes	Negligible	$762
Total	**$1,429**	**$21,365**

[(a)] *Detail does not sum to total because of rounding.*

2.6 Economic Impact of PNNL Operations

PNNL's expenditures on operations (payrolls and non-payroll purchases) generate additional economic activity in Washington State. The dollar value of PNNL's output, its employment, and its wages are measurements of PNNL's *direct* economic activity. In turn, companies that supply the goods and services demanded by PNNL and its employees also buy goods and services. This is called *indirect* economic activity. Since many of the indirect purchases are made in Washington, much of the indirect economic activity also occurs in Washington State. Finally, when workers in the direct and indirect supplying firms spend their wages for goods and services, they *induce* additional output, employment, and wages in retail and services firms and their suppliers. The sum of direct, indirect, and induced impacts is usually called the *total impact* on output, employment, or income. The total value of output

[1] Washington State does not have a personal or corporate income tax.

(value of goods and services) produced in the state is also called *gross state product* (GSP). Finally, the ratio of total to direct impact is called the *multiplier effect*.[1]

Figure 2.4 shows estimates of direct, indirect, induced, and total impacts of PNNL payroll and non-payroll procurement spending in Washington State. The direct PNNL activity is shown in Figure 2.4 as the blue bars: $936 million contribution to GSP in Washington, 4,101 Washington jobs, and $377 million in Washington wages. Together with the indirect (red) and induced (green) impacts, the total impacts are $1,309 million in GSP, 6,802 jobs, and $514 million in total wages in Washington State.

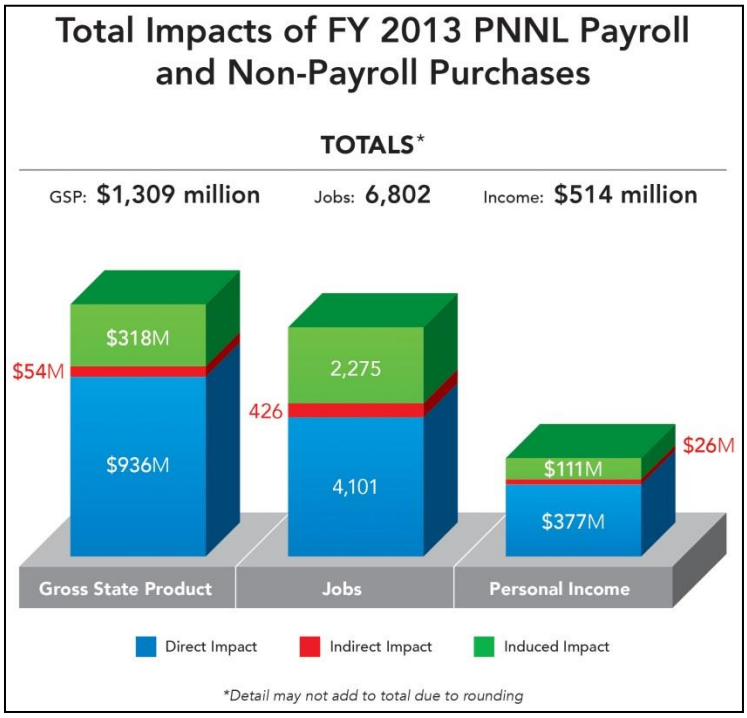

Figure 2.4. FY 2013 Economic Impact of Washington Payroll and Purchased Goods and Services Expenditures by PNNL

[1] This study uses the IMPLAN economic model (discussed in Appendix A) to estimate the indirect and induced impacts and total impact of PNNL direct payroll, benefits, in-state non-payroll purchases, and investment-related expenditures on Washington State gross state product, employment, and personal income.

3.0 Other Economic Influences of PNNL

This section provides estimates of the total impact of economic activity that, while not strictly PNNL activity, would not exist in Washington State without the presence of the Laboratory. These activities include health care insurance expenditures on behalf of PNNL employee and retiree households, spending by spinoff companies that have their "roots" in PNNL and likely would not be located in Washington State except for the presence of the Laboratory, spending by visitors to the Laboratory who are paid by other institutions, and spending by PNNL retirees.

3.1 Health Care Expenditures

Health insurance expenditures for PNNL's 4,101 Washington State employees, 2,032 retirees, and their households in the state of Washington totaled an estimated $64 million in FY 2013. PNNL's direct medical and dental insurance expenditures on behalf of employee households were reported as $44 million (about $42 million in Washington).

Total costs for retired households of over $22 million were based on Kaiser Family Foundation estimates of per capita expenditures by type for health care in Washington State in 2009, adjusted to 2013 dollars. While not directly related to current Laboratory activity because they are insurance payments, health care expenditures depend on the presence of Laboratory employees and have a substantial additional economic impact.

3.2 Technology Commercialization: New Products and Companies

Many of PNNL's research activities generate ideas and inventions (intellectual property) that have commercial value. PNNL prides itself on rapidly deploying this intellectual property into the marketplace in cooperation with new or existing firms. In the case of new start-up firms, PNNL also takes an active role in helping these businesses succeed.

Table 3.1. Companies with Ties to PNNL—Number, Estimated FY 2013 Funding and Number of Employees

	Total	Total in Washington State
Number of Firms	108	76
Estimated Sales ($M)	$804	$570
Employment	3,118	2,219

Table 3.1 shows that, as of FY 2013, a total of 108 companies had their technological or managerial roots in PNNL (these companies will be referred to as spinoffs). They had estimated funding of $804 million and 3,118 employees. The 76 Washington companies that have their roots in PNNL had estimated funding of $570 million. They directly employed 2,219 workers in Washington State.

Table 3.2. Technology Assistance Program Statistics

	Total	In Washington State
Number of Projects in FY 2013	54	60%
Cumulative Projects Since 1994	1,146	70%

PNNL's Economic Development Office's Technology Assistance Program (TAP) provides funding for researchers to work with a small business for up to a staff-week per project. Small businesses that use

PNNL's free TAP are eligible to receive a royalty-free license for intellectual property generated in the course of the project. Table 3.2 shows that PNNL conducted 54 TAP projects during FY 2013. Sixty percent of these were conducted for Washington-State-based companies.

These projects involved 1,781 hours of assistance at no cost to the small business. Since 1994, PNNL has completed 1,146 assistance projects—70 percent of them for Washington-State-based companies. Many fledgling companies in Washington State either directly receive in-kind assistance from PNNL or become partners with PNNL in identifying potential start-up funding or markets for their products and services. In many cases, the funding that they receive from others likely would not occur in Washington State if PNNL was not located there.

3.3 PNNL Visitors

PNNL hosts thousands of business visitors each year, many of whom are from outside the state of Washington and contribute their spending to the state's visitor economy. Direct impact of PNNL visitor spending was estimated from 2013 state-level per capita visitor spending statistics compiled by Dean Runyan Associates for Washington Tourism Alliance.[1]

Outside Users of PNNL Facilities (2013)

- 3 joint appointments
- 200 postdoctoral researchers
- 183 undergraduate students
- 167 graduate students
- 1,733 facility users (750 at EMSL, 983 at ARM)
- 66 visiting scientists (EMSL)

Table 3.3 shows the statistics for out-of-town visitors to PNNL facilities in 2013, identified through PNNL visitor badges.[2] Visitor badges are issued for a specific period of time, and the total requested number of days was used as an estimate of visitor-days. The estimate is intended to exclude local visitors, such as repair persons and vending machine operators who are required to have visitor badges to access most PNNL facilities, but are assumed not to contribute to tourism spending. Total

Table 3.3. Number of Out-of-Town Visitors and Visitor-Days to PNNL Facilities

	PNNL Visitor Statistics
Number of out-of town visitors	6,553
Estimated total visitor-days	196,687
Estimated tourism expenditures	$31.4 Million

[1] Dean Runyan Associates. 2014. Washington State Travel Impacts & Visitor Volume, Compiled for Washington Tourism Alliance, pp. 1991-2013.

[2] Several hundred individuals from DOE, other national laboratories, and subcontractors that visit PNNL each year have recognized credentials and do not require visitor badges. No count exists for visits by these individuals, but they also add to the economic impact. Badges are issued for a period of time that includes, but is not restricted to, the dates when visitors are actually at PNNL. This results in an overestimate of the number of days per visitor when visitors are present on site. In the case of badges issued for site tours and on-site meetings, the raw numbers of days were adjusted downward to better reflect the number of days that visitors actually spend on-site. No basis was available to adjust visitor days per visitor for badges issued to visitors such as university researchers working at PNNL or needing access to laboratory space. However, visitor days per visitor for these categories also appeared to be reasonable, so no adjustment was made.

costs of $31.4 million is based on state-wide traveler spending averages, adjusted for Benton County's lower-than average accommodation costs as a proportion of total spending.

3.3.1 EMSL and ARM Climate Research Facility Users

PNNL operates EMSL and provides the overall technical direction for the ARM Program Climate Research Facility on behalf of the Office of Biological and Environmental Research (BER). Both of these user facilities have a variety of users in the national and international science community. In the case of EMSL, the physical facility is located on the PNNL campus in Richland, Washington. Some users visit in person, while others access the facilities and their capabilities via remote portal. Many of EMSL's users are Washington State companies or educational institutions (shown in Table 3.4). With remote access, the group of outside users is broader.

Table 3.4. FY 2013 EMSL Users

	Total EMSL Users	Washington State Users
EMSL total users	744	388
Number of international (foreign) users	70	0
U.S. users	674	388
Non-PNNL U.S. users	342	56

The ARM Climate Research Facility is a multiplatform scientific user facility designed to improve the understanding and representation in climate and earth system models, as well as clouds and aerosols and their interactions and coupling with the earth's surface. ARM provides the international research community with unparalleled infrastructure for obtaining precise observations of key atmospheric phenomena needed to advance our understanding of atmospheric processes and climate models.

Environmental Molecular Sciences Laboratory

Through EMSL, scientists gain a predictive understanding of the molecular-to-mesoscale processes that affect climate, biological, environmental, and energy systems—a necessary step in the development of sustainable solutions to the nation's energy and environmental challenges.

Research focuses on understanding how soil organic carbon formation, cycling, and sequestration occur via microbial and plant interactions and geochemical and physical processes in terrestrial and subsurface ecosystems; how the formation and aging of aerosols alters atmospheric radiative forcing; how the physical and chemical properties at critical interfaces in energy materials affects their efficiency; and how to predict and control dynamic inter- and intracellular processes for the design of biorenewable chemicals.

EMSL provides a collaborative team research environment that includes high-performance computational capabilities linked directly to suites of state-of-the-art experimental instruments. By shortening the time required to gather, analyze, store, process, and disseminate experimental and computational data, EMSL users can accelerate their time to scientific innovation.

In FY 2013, there were 983 unique ARM scientific users: 415 from universities, 42 from industry, 238 from DOE laboratories, 99 from other federal agencies, 154 foreign, and 35 "other." One hundred and forty-five (145) users used ARM's facilities' on-site assets, 457 used off-site services, and 381 used data services. The vast majority of ARM users do not visit PNNL, but interact with the facility by downloading data or by visiting one of the remote ARM field sites. ARM has approximately 50 employees at PNNL, not all of whom are full-time.

Atmospheric Radiation Measurement Climate Research Facility

ARM is the first climate change field research facility to operate cutting-edge instrumentation on a long-term continuous basis and operates at fixed and varying locations around the globe. A global network of fixed, mobile, and aerial observatories for obtaining measurements of cloud and aerosol properties, precipitation, solar and thermal radiation, surface heat and moisture, and meteorological conditions exists. New instruments, including scanning radars and aerosol probes, greatly improve measurements of cloud properties and environmental factors and have been recently incorporated at ARM's long-term observation sites and in the ARM Mobile Facilities. These facilities allow sampling of other climate-critical regimes, such as the eastern Pacific cumulus-stratocumulus transition region and the Amazon rainforest. Diverse data sets are now being incorporated into integrated data products for scientists to use in evaluating high-resolution atmospheric process models and large-scale climate models. The data management site at PNNL generated few physical visitors in Washington.

PNNL is responsible for the overall technical direction of the ARM Facility's scientific infrastructure through a continual collaboration among nine DOE laboratories.

3.4 PNNL Retirees

Although they are no longer paid by the Laboratory, many former PNNL employees have retired in Washington State and represent a significant additional source of consumer spending in the state's economy. There are three principal sources of income that support this spending: pension benefits, federal Social Security Old Age and Survivors' Insurance (OASI) benefits, and accumulated personal savings. In CY 2012, the Battelle defined benefit pension plan for PNNL employees paid out $44 million to 2,117 retirees and other beneficiaries ($1,732 per month per person). These same values were assumed for FY 2013. For purposes of this report, 2,032 (96 percent) of all retirees were assumed to live in Washington[1].

The estimated average monthly payment per OASI retired beneficiary in December 2012 was $1,298 in Washington. This same monthly value was assumed for FY 2013. Because PNNL retirees have had salaries about 1.79 times the state average salary, Social Security calculator software shows that their average OASI payment would be 1.485 times the Washington State average. Information in Table 3.5 assumes that 2,032 PNNL retirees receive 1.485 times the OASI payment of the average retiree in the state, or about $1,928 per month, for a total estimated $47 million. Pensions and Social Security together total $89 million, $71 million of which is estimated to be spent in the state on goods and services. No estimate is available for spending of personal savings by PNNL retirees.

[1] Direct data were not available on PNNL retiree locations. However, U.S. Census Bureau data on migration by age for the Western Census region show that about 96 percent of all persons over 60 years of age lived in the same state in 2010 as they had in 2005, indicating very low interstate migration rates among older age groups.

Table 3.5. Estimated PNNL Retiree Income in FY 2013

	Estimated Average Retiree Monthly Income in FY 2013	Total Retiree annual Income in FY 2013 Income ($M)
Pension	$1,732	$42
Old Age and Survivors Insurance (Social Security)	$1,928	$47
Total	**$3,660**	**$89**

3.5 Economic Impact of Closely Related Activity

The spending by the four closely related economic activities (spending on health-related services, spending by spinoff companies, and spending by PNNL visitors and retirees) also creates significant additional economic activity in the state. Taken together, these activities directly employ 3,015 people and generate a gross product of $653 million. The IMPLAN model calculates that, when the indirect and induced economic impacts are taken into account, a total of $1.21 billion in gross state product, 6,437 jobs, and $459 million in labor income depend on these activities (see Figure 3.1).

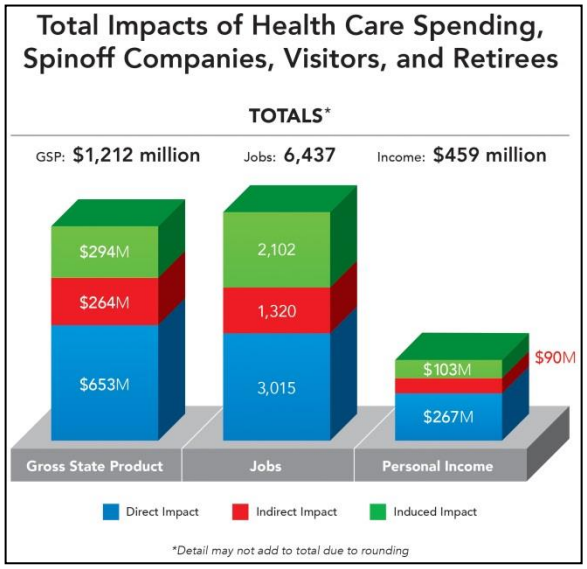

Figure 3.1. Total Impact of Health Care Spending, Spinoff Companies, Visitor Spending, and Retirees on the Washington State Economy in FY 2013

The impacts of the individual activities are estimated by the IMPLAN model, as follows. PNNL and its retirees' health insurance spent an estimated $64 million on health care in FY 2013, which produces an estimated state-wide total impact of 810 jobs, $107 million in gross product, and $52 million in labor income. The spinoff companies had an estimated in-state employment of 2,219 and estimated funding of $570 million. The spinoff companies as a group generated a state-wide total economic impact of $991 million in GSP, 4,672 jobs, and $367 million in labor income. The estimated in-state visitor spending of $31 million per year generated a total economic impact of $43 million in GSP, 451 jobs, and $16 million in labor income. Finally, the retirees received an estimated $89 million in pension and Social Security income in FY 2013, the spending from which generated a total economic impact of $71 million in gross product, 504 jobs, and $25 million in labor income.

3.6 Intellectual Property

While undoubtedly valuable as investments in the future or in Washington's current quality of life, there are other aspects of PNNL's presence in Washington State that are much more difficult to calculate in terms of the state's gross product or employment. The first of these is intellectual property (IP) created by PNNL research and development activities.

The discoveries and outcomes resulting from the research enterprise are the Laboratory's most important product. Table 3.6 shows results that are easily countable, but it is much harder to put a dollar value on a newly discovered fundamental principle in proteomics or calculate the future economic value associated with a new energy-saving approach, securing U.S. border crossings, or reducing greenhouse gases, let alone developing new ways to process terabytes of data or the discovery of a new organism. PNNL is transferring technologies—primarily through IP options and licenses—nearly once every 10 days, including 41 new license agreements during the fiscal year. PNNL won three Federal Laboratory Consortium Awards for technology transfer during FY 2013. PNNL leads all other DOE labs in implementation of Agreements for Commercializing Technology (ACTs), with 56 ACT agreements with 48 different clients. PNNL also had 8 new Cooperative Research and Development Agreements (CRADAs) and 135 new non-federal Work for Others (WFO) agreements. Table 3.6 provides additional highlights of these efforts, including invention disclosures, patent applications, patents issued, commercial options and licenses issued, and license revenues earned.

Licensing revenues totaled $5.6 million in FY 2013. A significant portion of these funds are reinvested at the Laboratory for additional commercialization-focused development work.

Table 3.6. PNNL Statistics on Inventions, Patents, Technology Transfers, and License Income

	Total FY 2013	Cumulative 2000-2013
Invention disclosures	264	3,377
Patent applications	60	908
Patents received	36	574
Commercial and research licenses	41	488
Total license revenue received	**$5.6 million**	**$46.0 million**

During FY 2013, PNNL research resulted in numerous awards for scientific excellence, including one R&D 100 Award for the CoMet platform for rapid ultrasensitive analyses of extremely complex materials, bringing the cumulative total of R&D 100 awards to 90.[1] PNNL won the 2013 Licensing Executives Society Deals of Distinction™ Award for redox flow battery licenses. From the Federal Laboratory Consortium, PNNL won three Excellence in Technology Transfer Awards, which brings the total of technology transfer awards to 78,[2] more than any other federal laboratory.

PNNL hosted national and international conferences and symposia: the nation's first Nuclear Power Plant Life Management Conference (attracting 40 nations and 300 participants) and the National Nuclear Security Administration Project on Nuclear Issues forum. PNNL researchers were invited to U.S. Frontiers of Engineering of the National Academy of Engineering and won an IEEE-USA State Department Engineering & Diplomacy Fellowship. In addition, PNNL had several staff members honored with scientific society awards, including 20 new scientific and engineering society fellows: two in the American Chemical Society, four in the American Physical Society, three in the Royal Society of Chemistry, four in the American Association for the Advancement of Science, and one each in the American Geophysical Union, the Microscopy Association of America, the American Institute for Medical

[1] Pacific Northwest National Laboratory. 2014. About PNNL: R&D 100 Awards. http://www.pnl.gov/about/rd100awards.asp. Last accessed 10-24-14.
[2] Pacific Northwest National Laboratory. 2014. About PNNL: Federal Laboratory Consortium Awards. http://www.pnl.gov/about/flcawards.asp. Last accessed 10-24-14.

and Biological Engineering, American Ceramic Society, American Vacuum Society, Health Physics Society, and American Institute of Chemical Engineers.

PNNL researchers also received one early career award from DOE, the Royal Society of Chemistry's Homogeneous Catalysis Award, the Ron Hites Award from the American Society for Mass Spectrometry, Presidency of the American Nuclear Society, and chairmanship of the Division of Analytical Chemistry, American Chemical Society. Four staff members were elected to the Washington Academy of Sciences. Staff members won the 2013 Community Earth System Model Distinguished Achievement Award, Association for Computational Mechanics' 2013 J. Tinsley Oden Medal, 2013 American Association for Crystal Growth Award, and membership in the Association of Energy Engineers' Class of 2012 Energy Managers Hall of Fame. PNNL researchers had a total of 1,168 peer-reviewed, published articles in FY 2013. Essential Science Indicators ranks PNNL among the top 1 percent of cited institutions in Biology and Biochemistry, Chemistry, Clinical Medicine, Engineering, Environment and Ecology, Geosciences, Materials Science, Microbiology, Molecular Biology and Genetics, and Physics.[1]

3.7 Science, Technology, Engineering, and Mathematics Education

PNNL is a trusted and valued collaborator in DOE's Workforce Development for Teachers and Scientists program and the region's efforts to improve science and engineering education. Through PNNL's Science and Engineering Education (SEE) program and the region's public education improvements, the Laboratory is committed to supporting science and engineering education from grade school to graduate school. SEE connects the world of research and education by linking academic learning to the world beyond the classroom and providing a forum for learning about important science issues.

These programs represent a long-term commitment and investment in the human capital of the nation's and state's future workforce. In FY 2013, the DOE Office of Science provided project funding and the Laboratory spent $913,100 for post-secondary student and faculty programs. In addition, PNNL spent $1,507,300 in overhead funds to support work-based learning programs (high school and post-secondary), STEM education, and outreach efforts (K-16).

During FY 2013, there were a total of 767 pre-college, undergraduate, graduate, post-graduate, and faculty researchers who participated in SEE programs or used PNNL's Intern and Fellowship Service Center. A total of 716 participants were post-secondary students or faculty. Employees are called either interns (students matriculating toward a degree) or research associates (post-graduates). Non-employees are called fellows, and they are undergraduates, graduate students, K-12 and university faculty, and visiting scientist appointments. Of these participants, 173 were fellows (non-PNNL employees) and 594 were interns or research associates. In FY 2013, 7 fellows and 216 interns/associates were from Washington State institutions.

[1] PNNL Business Facts.

PNNL also began to reinvigorate its collaboration with the Washington State Mathematics, Engineering, and Science Achievement (MESA) program. Together, Delta High School, Washington State Leadership and Assistance for Science Education Reform (LASER), MESA, and PNNL education leaders completed design work on the Mid-Columbia STEM Education Collaboratory, which is scheduled to formally launch in 2014. Delta is a small public high school in Richland, Washington that is focused on STEM integration. LASER is a public/private partnership whose vision is to make science an essential part of the education of today's students for tomorrow's world. MESA efforts are designed to increase the number of underrepresented students acquiring STEM degrees and working in STEM careers. The Mid-Columbia STEM Education Collaboratory is a collaboration between Battelle, PNNL, Delta, LASER, and MESA to design, implement, and mature a local STEM education collaboration zone that will not only amplify and accelerate existing Delta, LASER, MESA, and PNNL education goals and outcomes, but will realize changes in the STEM education system that the four collaborators cannot accomplish individually.

Other Science, Technology, Engineering, and Mathematics (STEM) Education Programs

PNNL has strong post-graduate research programs at the post-bachelor, master, and Ph.D. level. These programs include the PNNL National Security Internship Program and PNNL Post-Secondary and Post-Graduate Research Internship programs.

PNNL hosts several students each year in programs funded by outside sources or initiatives. These opportunities may require the student to apply to an outside program and request placement with PNNL. These include DOE Office of Science Community College Internships, Mickey Leland Energy Fellowships, Science Undergraduate Laboratory Internships, Visiting Faculty Program, and Department of Homeland Security Fellowship Program.

PNNL also hosts alternate-sponsored fellows and interns funded by home institutions and other sources, as well as the PNNL Pre-Service Teacher program. The Pre-Service Teacher Program provides Laboratory-based research experiences, combined with STEM teaching seminars designed to immerse undergraduates preparing to become teachers in the world of science and technology.

Other 2013 outreach efforts included 1) Siemens Teachers as Researchers (a partnership with the Siemens Foundation, Discovery Learning, the College Board, and Oak Ridge Associated Universities to provide middle and high school teachers with professional development in STEM through immersive experiences at a DOE national laboratory); 2) the High School Student Shadow Program, which allows staff at PNNL to volunteer to host students at the Laboratory as a way to connect academic learning to the world beyond the classroom; and 3) Sharing Science with Schools, where staff members at PNNL can volunteer to make classroom or after-school presentations about their work at the Laboratory in ways that enhance the school curriculum. In FY 2013, these K-12 programs involved over 1,400 students and over 1,300 educators, almost all of whom were from state of Washington institutions. Table 3.7 shows statistics on the STEM education programs.

Table 3.7. Statistics on the PNNL STEM Education Programs during FY 2013

PNNL Programs in STEM Education	Participation in FY 2013
Post-Secondary Programs	
Four DOE Office of Science University Internship/Fellowship Programs	3 faculty, 86 students
Department of Homeland Security Fellowship	5 students
PNNL Post-Graduate and Post-Secondary Internships	432 students
PNNL National Security Internships	47 students
PNNL Alternate Sponsored Fellowships	130 students, faculty, and visiting scientists
PNNL K-12 STEM Teacher Programs	13 students
K-12 Student Programs	
PNNL High School Research Intern and Apprentice Programs	19 students
Young Women in Science	12 students
DOE Science Bowl	106 students
High School Shadow Program	11 students
Delta (STEM) High School Programs	21 faculty, 350 students
PNNL STEM Student Outreach Programs (MESA, Sharing Science with Schools)	910 students
K-12 Teacher Programs	
LASER	~1,300 educators
Siemens Science Teachers as Researchers Program	20 middle and high school teachers
K-12 Collective Impact Project	
Mid-Columbia STEM Education Collaboratory (Phase 1: Collaboratory Design)	30 educators, community members, and PNNL scientists, engineers, and STEM education staff

Battelle corporate invested $324,000 in STEM education in FY 2013. From the beginning of the founding community partnership in 2006, PNNL and Battelle have strongly supported Delta High School. Battelle cash donations of $1.5 million and PNNL in-kind support of $2.4 million to Delta totaled $3.9 million during FY 2007 to FY 2013. All donations in FY 2013 were in PNNL STEM education in-kind support and totaled $324,000.

PNNL has more than 25 staff members serving as adjunct or joint appointment faculty at colleges and universities through outside activity agreements. Sixteen of these staff members teach in Washington State colleges and universities. Many staff members also act as doctoral dissertation and master's thesis committee members, guest lecturers, mentors, or volunteers for education programs at both the collegiate and K-12 level.

3.8 Community Investments and Assistance

Since 1965, Battelle has invested more than $25 million to improve science, education, and quality of life in Washington State. Over the past 10 years, staff members at PNNL have volunteered more than 180,000 hours to community projects. Staff members at PNNL serve on the boards of many community organizations, including Washington State University Tri-Cities, the Tri-Cities Development Council, Tri-

Cities Regional Chamber (of Commerce), the Hanford REACH Interpretive Center, Delta High School Advisory Board, Association of Washington Business, and United Way of Benton and Franklin Counties.

Table 3.8 shows quantitative measures of PNNL and Battelle's community assistance, including corporate and individual financial giving and volunteer labor hours donated. Team Battelle projects during the fiscal year included Tri-Cities Food Bank, For the Love of Giving, Friends of Badger Mountain, Junior Achievement, Tumbleweed Music Festival, FIRST Lego, Math Club Mentors, and North Olympic Discovery Marathon.

Table 3.8. PNNL and Battelle Community Assistance Statistics for FY 2013

Washington State Community Assistance	
Battelle cash donations to health, human services, and other philanthropic and civic organizations*	$732,000
Staff contributions to United Way	$257,018
Team Battelle-volunteered hours FY 2013	22,818

**Includes the $324,000 donation to STEM education discussed in Section 3.7.*

PNNL also donated excessed computer equipment valued at $56,000 to schools and other not-for-profit organizations. Most of that amount went to Washington State schools and not-for-profit organizations.

4.0 Conclusion

PNNL is an economic asset to the nation and the state of Washington. Its scientists and engineers regularly contribute ideas, inventions, technologies, and processes to the nation's and state's body of scientific and technological knowledge that will build the economy of tomorrow. PNNL takes seriously its role in making this knowledge practical, actionable, and commercially viable, and has won numerous awards for interagency collaboration, technology transfer, and technology commercialization. The growing number of 76 commercial companies in Washington State is based on PNNL ideas and assistance, with 2,219 resident employees and an estimated $570 million in funding as proof of the success of the PNNL model.

PNNL's current operations constitute a large source of economic activity in Washington State, with $936 million in total spending, 4,101 resident employees, in-state payrolls of $377 million, and purchases from Washington businesses of about $48 million. This economic activity supports a total of $1.31 billion total economic output, total in-state payrolls of $514 million, and about 6,800 jobs through Laboratory operations in the state. An additional $1.21 billion in output, in-state payrolls of $459 million and over 6,400 jobs are supported through closely related activities, such as spinoff companies, Laboratory retirees, visitors to PNNL, and health care spending. Lastly, PNNL and its employees annually contribute millions of dollars and thousands of hours to education and community services, helping secure the future and making Washington a better place to live.

Appendix A

The IMPLAN Model

To calculate the economic impact of Pacific Northwest National Laboratory on the state of Washington, PNNL used IMPLAN® (IMpact analysis for PLANning)[1], a widely accepted economic input-output model, to estimate funding, employment, and labor income impacts. IMPLAN, a product of MIG, Inc. (formerly Minnesota IMPLAN Group, Inc.), contains highly disaggregated data on regional economic indicators based on data from a variety of sources, such as the U.S. Bureau of Economic Analysis, and then aggregates the entire economy into 440 sectors. It is based on social accounting between industries and within the distribution chain and contains numerous economic multipliers to quantify direct, indirect, and induced output, employment, and labor income impacts. Output from IMPLAN is in the form of direct, indirect, and induced economic output (gross funding), jobs, and labor income created or supported, as well as their associated multipliers.

Each sector that produces goods and services generates demand for goods and services in other sectors. This iterative process is the multiplier effect. Multipliers can be described through the following definitions:

- Direct effects are the initial change to the industry or institution in question.
- Indirect effects are the changes in inter-industry purchases as they respond to the new demands of the directly affected industries. The direct change creates increases in economic activity for downstream businesses that support these direct industries.
- Induced effects are the increases in household income expenditures generated by the direct and indirect effects.

The Washington State data file for 2012 was used in this analysis with gross domestic product deflators within the model used to convert impacts to 2013 dollars. PNNL data on purchases of goods and services, associated companies output, employee payroll, retiree income, visitor spending, and healthcare purchases were compiled and translated into IMPLAN inputs. Table A.1 characterizes the IMPLAN inputs.

[1] IMPLAN. Version 3.0. Davidson, NC: IMPLAN Group LLC, Inc. www.implan.com

Table A.1. IMPLAN Input Characterization

Expenditures	Input Characterization
Purchases on goods and services	Expenditures were assigned a NAICS code and then translated to their respective IMPLAN sector using the IMPLAN NAICS bridge. Expenditures were calculated as an industry change and retail margins used where needed. Purchases are dominated by the construction, real estate, engineering services, medical and diagnostic laboratories, computer systems design services, and university sectors.
Spinoff companies	Each company was assigned an IMPLAN sector. IMPLAN data were used to derive an output per employee and each company's output was subsequently calculated in IMPLAN. The dominant sectors were inorganic chemical manufacturing and environmental and technical consulting services sectors.
Employee salaries	Payroll data are calculated in IMPLAN as a change in employee compensation. IMPLAN derives the impact from the model's income expenditure patterns.
Healthcare spending	Healthcare expenditures from employees and retirees were assigned a NAICS code and translated to one of the five primary medical IMPLAN sectors and one retail sector supplying medical-related items and then calculated as an industry change. Margins were used for the retail sector.
Retiree income	Retiree income was calculated in IMPLAN as a change in employee compensation. IMPLAN derives the impact from the model's income expenditure patterns.
Visitor spending	Visitor spending was aggregated into day-visitor and overnight-visitor spending and calculated in IMPLAN as a change in sectors typically affected by visitor spending, such as accommodation, food establishments, and retail gasoline sectors.

IMPLAN = IMpact analysis for PLANning
NAICS = North American Industry Classification System

Appendix B

Benchmarking the Results

Many regions' private and public stakeholders care about the economic impact of major industries and industry clusters. This appendix reports on benchmarking reviews of economic impact analyses of a peer group that includes other large industries and companies ("peer entities") within the state of Washington and other national laboratories to show where PNNL "fits" on a number of economic dimensions assessed in this study. The other studies are all reasonably recent (within the last 10 years), but the studies were done at different times, for different scopes of activity, and use different impact assessment methods and variables,[1] so comparisons between peer entities are only an approximation.

PNNL is a medium-large economic entity that consistently delivers at or above its weight compared to its peers. The dimensions that are compared across peer entities are:

1. Scale of the peer's direct economic activity, as measured by total spending or funding, resident employment, purchases of other goods and services, average annual wage rates, and total payroll
2. Impact on total state economic activity, as measured by state gross product, employment, and wage income
3. Within PNNL's scientific peers (and where available), relative impact on science and technology, as measured by publishing, invention disclosures, patents, and commercial licenses.

Because the other studies did not look at all of the dimensions examined in this study, the comparison is limited to the dimensions discussed above.

PNNL's Washington State science and technology peer group includes Boeing, Microsoft, the University of Washington, and Washington State University. Although they are not science and technology companies, comparisons were also done on the first two dimensions for three other large high-profile employers in the state for which economic impact information is available: the military, life sciences, and wine sectors.

PNNL's national laboratory peer group includes: Argonne National Laboratory (ANL), Lawrence Berkeley National Laboratory (LBNL), Brookhaven National Laboratory (BNL), National Renewable Energy Laboratory (NREL), and Idaho National Laboratory (INL). An economic benefit study was done in 2008 of all of DOE activities in Tennessee, including Oak Ridge National Laboratory (ORNL), but it was not possible to isolate the effects of ORNL alone.

[1] Many of the studies used the version of the IMPLAN model current for the state at the time the analysis. Where that occurred, the first column in Tables B.1 and B.3 show the word "IMPLAN;" otherwise, the word "Other" appears.

B.1. Washington State Peer Economic Comparisons

Company/ Sector, Impact Model, & Year of Data	Sales ($B)	Employment (WA)	Average Wages per Worker ($K)	Total Washington Payroll ($B)	Other Purchased Goods and Services in State ($B)	Impact on Gross State Product ($B)	Impact on Employment	Impact on Total Wage Income ($B)
PNNL (IMPLAN, FY 2013)	$1.1	4,101	$91.1	$0.38	$0.048	$1.3	6,802	$0.514
Boeing Commercial (Other 2012)	$48.9	83,200	$114.2	$9.5 (including benefits)	$5.0	$69.9 billion (sales)	208,800	$16.4
Microsoft (IMPLAN, 2011)	$72.1 (global)	40,300	$184.8	$7.5	$2.5	$34.3	243,000	$19.4
University of Washington (Other, FY 2008-2009) Research Only	$1.3 (spending)	9,050 (FTE)	NA	NA	NA	$3.0	22,600 (FTE)	NA
Washington State University (Other, 2011) Programs Only	$0.783	NA	NA	NA	NA	$2.3	NA	NA
Military (IMPLAN, 2009)	$8.7 (output)	103,400	$49.5	$5.1	$2.8	$12.2	191,600	$10.5
Life Sciences (Other, 2008)	NA	22,300	$77.8	$1.7	NA	$5.7	76,900	$5.4
Wine Industry (IMPLAN, 2009)	$3.6	14,200	$30.1	$0.428	NA	$7.4	29,100	$1.2

B.2. Washington State Science and Technology Comparisons

Company and Year	Invention Disclosures	Patents Applications Filed	New Licenses and Commercialization Agreements
PNNL(2013)	264	60 (36 awarded)	41
Boeing (2010)	NA	(360 awarded)	NA
Microsoft (2010)	NA	(2,844 awarded)	NA
University of Washington (FY 2009)	349	262	220
Washington State University (2011)	NA	60	NA

B.3. National Laboratory Peer Economic Comparisons

Laboratory, Impact Model, and Year of Data	Funding ($B)	Employment	Average Wages per Worker ($K)	Total Payroll in State ($M)	Other Purchased Goods and Services in State ($M)	Impact on Gross State Product ($B)	Impact on Employment in State	Impact on State Total Wage Income ($B)
PNNL (IMPLAN, FY 2013)	$1.06	4,101 (WA State)	$91.1	$377	$48	$1.31	6,802	$0.51
ANL (Other, FY 2010)	$0.67	2,700 (FTE)	$72.3	$165	$195	$0.70	4,900	$0.21
LBNL (IMPLAN, FY 2009)	$0.70 (total cost)	3,200	$80.4	$259	$227	$0.80	6,900	$0.49
BNL (IMPLAN, FY 2009)	$0.57	2900	$86.4	$250	$120	$0.70	5,300	$0.48
NREL (FY 2011)	$0.47 (total cost)	2,100	$93.3	$199	$233	$0.83	6,300	$0.42
INL (IMPLAN, 2009)	$1.6 (in Idaho)	8,000	$85.6	$685	$299	$3.5	24,000	$2.00

Other Studies Reviewed

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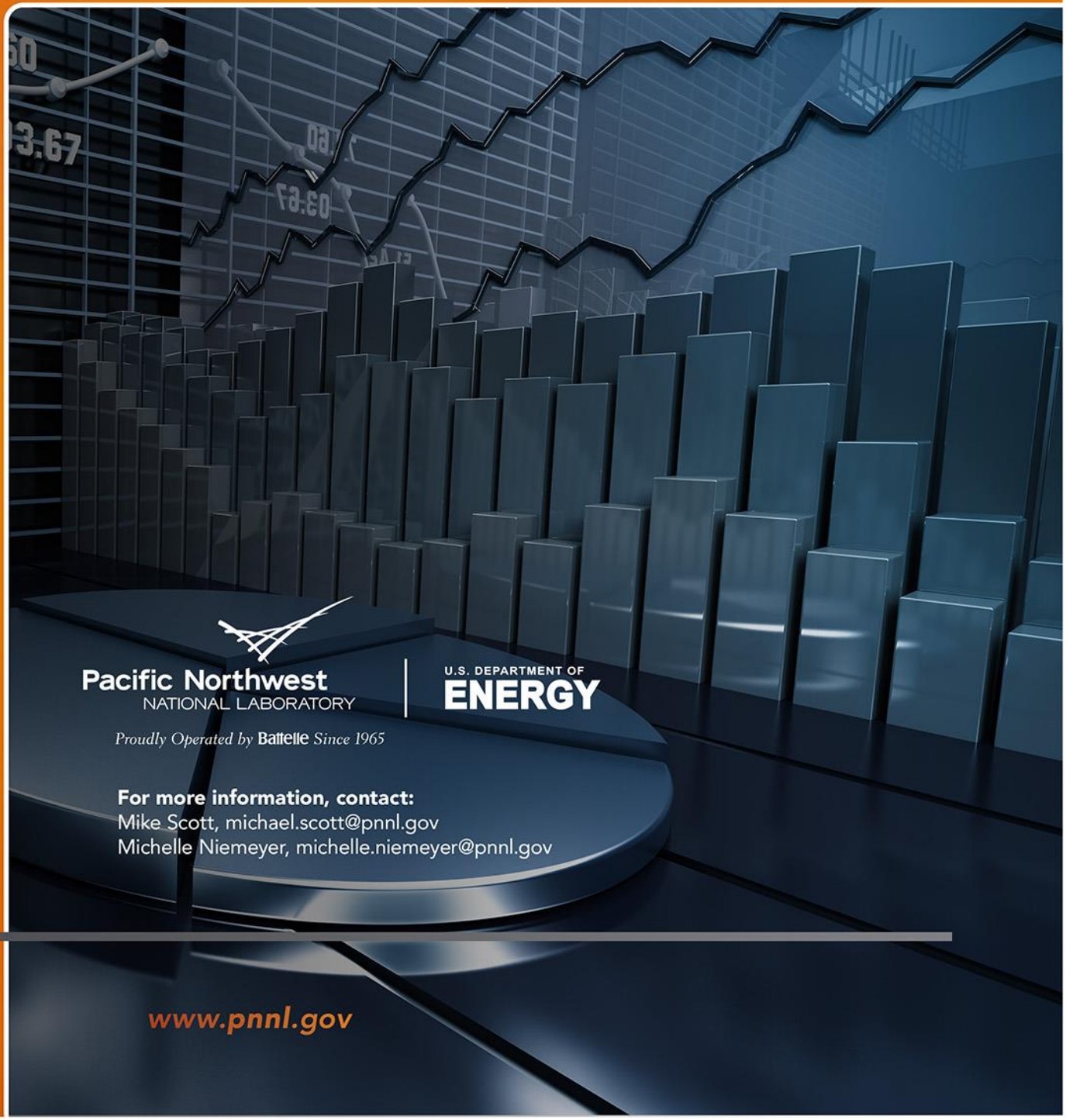

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