



**Pacific
Northwest**
NATIONAL LABORATORY

ECONOMIC IMPACT

of Pacific Northwest
National Laboratory
on the State of Washington
in Fiscal Year 2020

U.S. DEPARTMENT OF
ENERGY

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ECONOMIC IMPACT

OF PACIFIC NORTHWEST NATIONAL LABORATORY ON THE STATE OF WASHINGTON IN FISCAL YEAR 2020

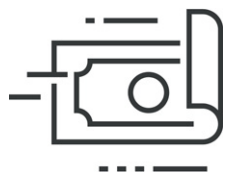
August 2021

JM Niemeyer
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Pacific Northwest National Laboratory
Richland, Washington 99352

HIGHLIGHTS



\$1.1B

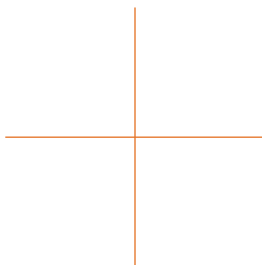
Annual spending



\$530M

Total payroll

\$485M in Washington State

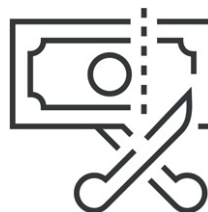


4,997

Staff members

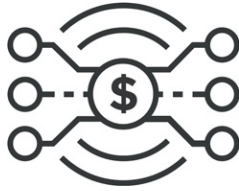
89.8% (4,486) living
in Washington State in 2020

42% growth in employment 2000–2020



\$27.6M

Estimated taxes paid by PNNL and its
employees to Washington State
and local governments



\$1.59B

Total economic output supported by PNNL payroll and domestic purchased goods and services

\$651M in Washington State wage income

7,580 total jobs generated in Washington State



\$459M

Domestic purchased goods and services

\$61M in Washington State



198

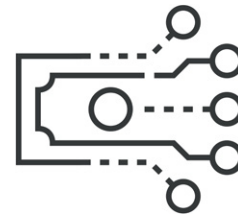
Companies formed with PNNL roots since 1965

In Washington State:

15 started in the last 10 years and are still in business


\$37.7M revenue

190 employees



\$1.08M

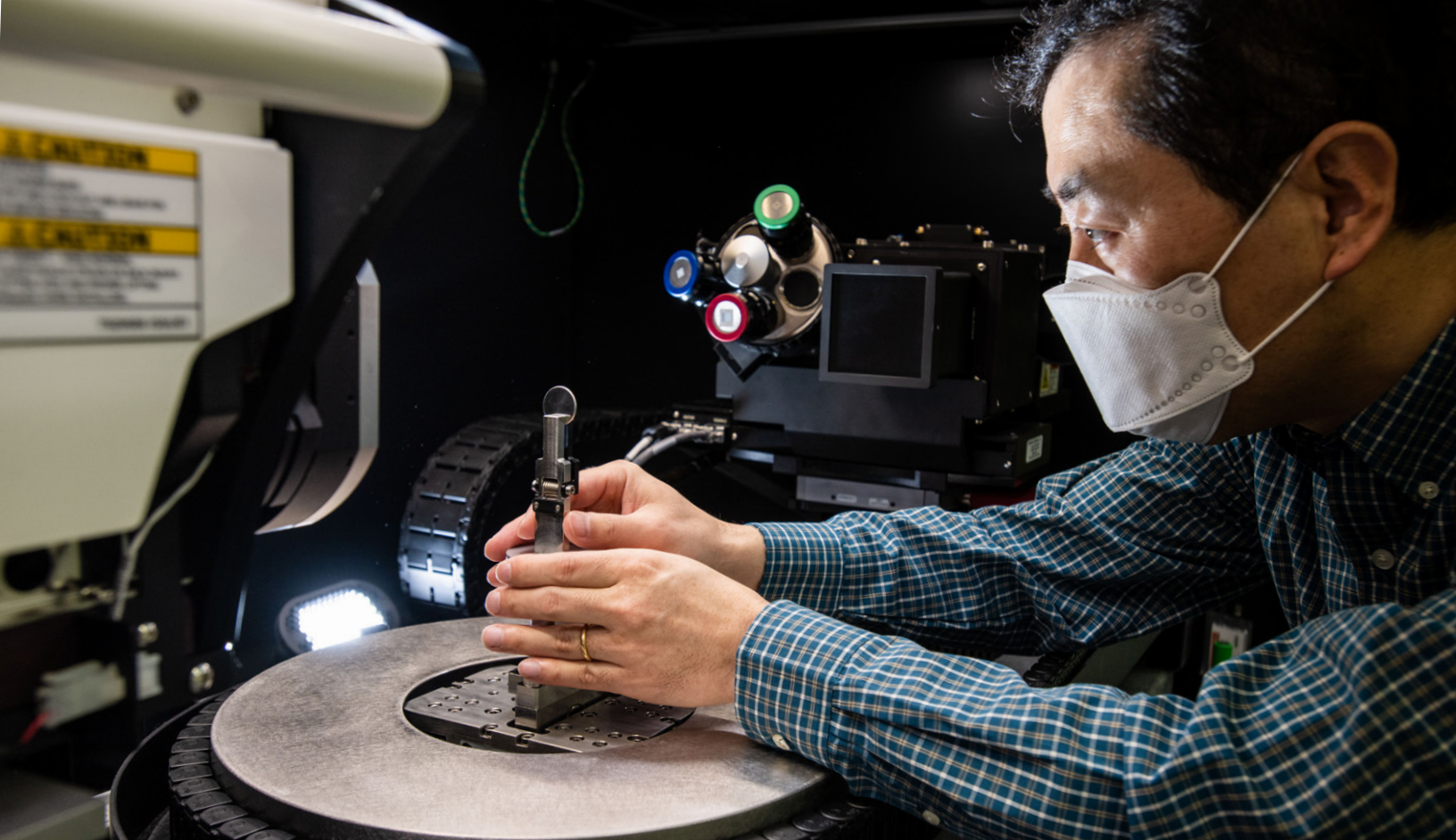
Cash contributions to philanthropic and civic organizations, including **\$690K** corporate support for STEM education, by Battelle



This report was stewarded by the Executive Director, Office of Performance Management, and Chief Risk Officer Dr. John P. LaFemina. The team was guided by Chris Larmey.

The following staff were key to gathering the data used within this report and providing reviews to ensure its accuracy: Dave Anderson, Karen Kniep Blanton, Peggy Braxton, Sean Clausen, Robin Conger, Ty Creer, David Davenport, Dani Deichman, Mindy Frankenfield, Kate Hankins, Jodi Hamm, Alison Hatt, Mark Hatstrup, Breanna Hughes, Melanie Johnston, Jarrod Jones, Karen King, Amanda Knight, Jennifer Knotts, Paula Linnen, Matt Little, Jim Mather, Jason Nanni, David Oates, Cory Pardini, Stacey Petersen, Melanie Roberts, Annette Schutzenhofer, Evangelina Shreeve, Bruce Simanton, Christie Sylvester, Shirah Thietje, Linda Wierenga, and Dawn Zimmerman.

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ACRONYMS AND ABBREVIATIONS

ARM.....	Atmospheric Radiation Measurement
B.....	billion
BER.....	DOE-SC's Biological and Environmental Research program
DOE.....	U.S. Department of Energy
EMSL.....	Environmental Molecular Sciences Laboratory
FY.....	fiscal year
GSP.....	Gross State Product

IMPLAN®	Impact analysis for PLANning
IP	intellectual property
K	thousand
M	million
OASI	Social Security Old Age and Survivors' Insurance
PNNL	Pacific Northwest National Laboratory
SC	Office of Science
STEM	science, technology, engineering, and mathematics
U.S.	United States
WA	Washington State



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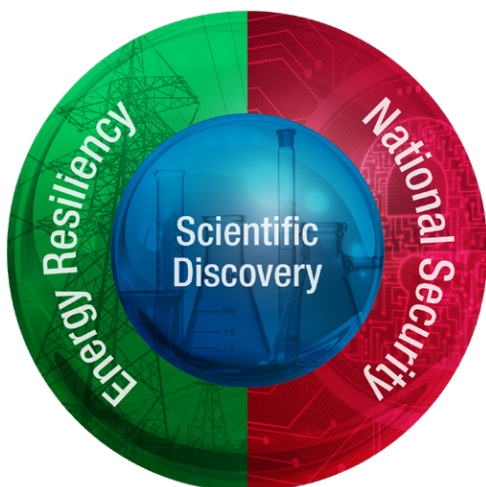
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WHO WE ARE

Founded in 1965, Pacific Northwest National Laboratory (PNNL) is operated by Battelle for the Department of Energy's (DOE's) Office of Science (SC), which is the single largest supporter of basic research in the physical sciences in the United States.



PNNL, based in Richland, Washington (WA), is one of DOE's 17 national laboratories. DOE's system of national laboratories grew out of the Manhattan Project, creating the unprecedented science and technology capabilities required to design and build the first atomic bomb. Los Alamos, Oak Ridge, and Hanford (which later evolved into PNNL) were created to meet this initial mission. As DOE's mission evolved, so did the network of labs.

Today, PNNL is proud to support DOE's missions in scientific discovery, energy, national security, and environmental stewardship. While each laboratory has its own unique scientific tools, facilities, capabilities, and projects, the

national laboratories engage in crosscutting scientific activities and collaborative projects that leverage their talents and assets. From basic research and scientific discovery to development and demonstration of advanced technologies and other innovations, these world-class institutions constitute the most comprehensive research and development network of its kind.

Fundamental research is the centerpiece of what we do at PNNL. With our distinctive strengths in chemistry, Earth sciences, biology, and data science, we take on some of the greatest research challenges to advance the frontiers of knowledge and scientific discovery.

We are also committed to sharing what we're learning and partnering across sectors to ensure that our discoveries and technologies benefit our nation and region. For example, our scientists and engineers are improving and modernizing U.S. energy systems, making them more efficient and more resilient in the face of extreme weather events, physical features, and cyberattacks. Our researchers work in many areas, including advanced power grid modeling, energy storage and renewable energy integration, and grid cybersecurity, to realize our vision of a U.S. energy system that is more efficient, flexible, and decarbonized.

PNNL develops science-based solutions that keep America safe. We are focused on securing our nation's critical infrastructure, combatting global terrorism, detecting and analyzing threats, and protecting our citizens from cyber, nuclear, chemical, and biological weapons of mass effect and other forms of proliferation and terrorism.

PNNL is home to more than 20 specialized research facilities, including dedicated laboratories for power grid operations, coastal sciences, data analytics, energy sciences, and atmospheric sciences. These resources equip researchers to expand the frontiers of scientific understanding and technological possibility in areas of national importance.

PNNL plays important stewardship roles in the management and operation of two DOE-SC user facilities, the Environmental Molecular Sciences Laboratory (EMSL) and the Atmospheric Radiation Measurement (ARM) user facility, which serve more than 2,000 researchers worldwide, annually.



LETTER FROM THE DIRECTOR

Pacific Northwest National Laboratory is known for its impactful record of scientific and technical contributions to our nation and the world, with a focus on advancing scientific discovery, enabling energy sustainability, and enhancing national security. You may be surprised to learn that we also are one of Washington State's most important economic contributors. PNNL and its operator, Battelle, have an enduring commitment to support the prosperity and growth of Washington State and the communities in which we are located.

2020 was a year of unprecedented challenge as the novel coronavirus swept the nation and world, putting our health and economic prosperity at risk. At PNNL, our first priority was the safety and well-being of our staff members, quickly transitioning most to telework to help protect those colleagues who needed to be on-site. We were extremely fortunate at PNNL. Due to the extraordinary efforts of our staff to stay productive, we were able to avoid furloughs and layoffs and, in fact, hired 371 staff, in addition to 521 interns, throughout the year to deliver on our commitments to our many sponsors.



The strong year we had at PNNL translated to positive economic impact for Washington State. Among other outcomes, the total economic output of PNNL's payroll and domestic goods and services exceeded \$1.59 billion (B), we generated 7,580 jobs, our annual spending was \$1.1B, and the contributions given to philanthropic and civic organizations from Battelle, PNNL, and the employees at PNNL totaled more than \$1 million (M).

I am extremely proud of the contributions that the innovative and dedicated staff at PNNL are making to our state, region, and nation. I invite you to read on to learn how their commitment to scientific discovery, innovation, and technology transition to the marketplace is advancing the economic vitality of Washington State.

Best regards,

Dr. Steven Ashby
*Director, Pacific Northwest
National Laboratory*

THE ECONOMIC IMPACT OF SCIENCE

Beyond our scientific impact, the economic impact of our presence in the state and community is significant. This includes the amount of revenue we receive; costs we incur, along with purchased goods, services, and investments; our staff and their spending in the communities in which they reside; and our direct and indirect economic activity.

\$1.25B

FY 2020 FUNDING

\$1.1B

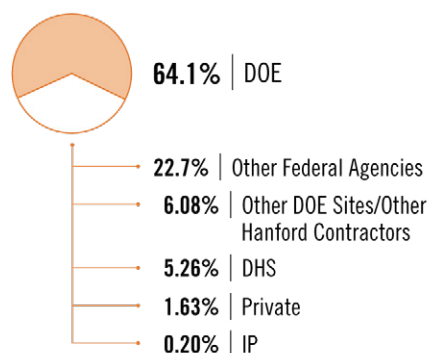
FY 2020 SPENDING

Funding and Spending

PNNL is a large and vital economic entity, with 4,997 staff, \$1.25B in total funding (see *Figure 1*), and \$1.1B in total spending (see *Figure 2*).

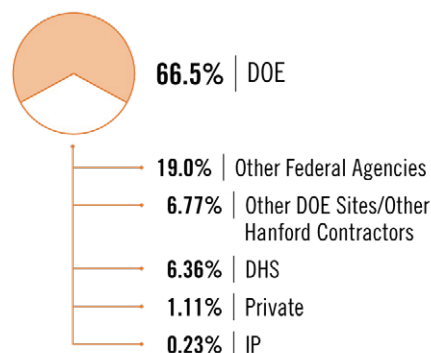
We use the term “funding” or “sales” to refer to the total revenue that was received for projects conducted at PNNL. It’s an indicator of the total amount of work that was done at the Laboratory over a given fiscal year (FY)—in this case, FY 2020. We use the term “spending” or “business volume” as a measure of total costs, or expenditures, charged to third-party clients, and it includes direct costs, such as labor, travel, and procurements, as well as some necessary overhead costs.

We perform the majority of our work for DOE. Our contract also allows us to perform work for several other federal and private agencies, as shown in *Figures 1 and 2*.



Detail may not sum to total due to rounding.

Figure 1 / PNNL's Funding in FY 2020



Detail may not sum to total due to rounding.

Figure 2 / PNNL's Spending in FY 2020



4,997
STAFF MEMBERS

371
NEW HIRES

521
INTERNS

Our Staff

Our scientific and technical accomplishments are a tribute to the expertise and experience of the 4,997 scientists, engineers, and support professionals who work at PNNL and who collectively hold 2,493 advanced degrees. Due to the extraordinary efforts of our staff to stay productive during the COVID-19 pandemic, we were able to avoid furloughs and layoffs and, in fact, hired 371 staff, in addition to 521 interns, throughout the year.

Our researchers and mission support professionals work side-by-side. Together, they enable the mission and success of PNNL. In FY 2020, more than ever before, we channeled our spirit, knowledge, and considerable scientific capabilities to aid our neighbors and fight the pandemic caused by a novel coronavirus. Under DOE leadership, staff at the 17 national labs worked together to identify near-term actions to address urgent needs, as well as longer-term research and development efforts to ready the nation for the next pandemic. This work is at the core of our mission—to keep the nation and the world safe and secure.

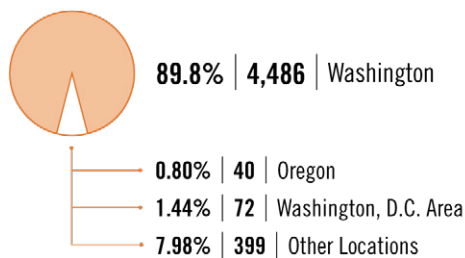
At PNNL, we recognize that our strength is in our people. We are committed to fostering a work environment that fully embraces and values diversity, equity, and inclusion. We believe that this diversity, depth, and breadth in our people enables the innovation and creativity expected of a DOE national laboratory.

We aspire to be a model organization and a valued partner in the communities where we live and work. Since almost 90 percent of our workforce, 4,486 people, are residents of Washington, working mainly on our Richland, Seattle, and Sequim campuses, a significant amount of corporate contributions were allocated to Washington.¹ Of those staff living in Washington, 79 percent lived in Benton County and 12 percent in Franklin County.²

We recognize that, while we did not experience any furloughs, not everyone in our community was as fortunate. Our staff stepped up and showed the community how exceptionally resilient and adaptable they are, as well as how committed we are to making the world a better place through our scientific contributions, economic impact, and the cultural values we bring to each community.

89.8%
(4,486)

EMPLOYED & RESIDING
IN WASHINGTON STATE



Detail may not sum to total due to rounding.

Figure 3 / Location of Staff Who Work at PNNL

1 Outside of Washington, 72 staff members reside in the Washington, D.C., area; 40 staff members reside in Oregon; and 399 staff members reside in other locations in the United States or in foreign countries.

2 Of the staff members residing in Benton and Franklin Counties, 52.4 percent reside in Richland, 19 percent in Kennewick, 12.6 percent in Pasco, and 12.8 percent in West Richland, and the remaining 3.2 percent reside elsewhere in the two counties.



\$530M
IN PAYROLL

\$485M
PAYROLL FOR
WASHINGTON RESIDENTS

Payroll and Benefits

PNNL's payroll in FY 2020 was \$530M, of which \$485M went to staff members living or residing in Washington State.

At the end of FY 2020, the average annual wage for our Washington staff members was \$108,028; whereas, the state average occupational wage for the same time frame was \$62,974.³ Because we are a research and development organization, we have a large percentage of high-wage professions. As a result, staff members at PNNL likely spend at a higher level and have a larger impact on the state economy compared to the average Washington worker.

While not directly part of wages, benefits packages also contribute to PNNL's economic impact. PNNL provides a benefits package that costs \$122M per year and includes an employer-provided health insurance package, employer matching of a portion of employee 401K contributions, a defined-benefit pension plan, disability, tuition refunds, and group life insurance. Our benefits package not only helps us recruit and retain exceptional staff, but we also know that the health and well-being of our staff is vital to our collective scientific impact and, in turn, our ability to give back to our community.

³ Weighted average for all occupations that published both average annual wage and number of workers is \$69,313.



\$459M
IN GOODS & SERVICES
TO SUPPORT OPERATIONS

\$61M
IN PURCHASES FROM
WASHINGTON FIRMS

Purchased Goods, Services, and Investments

During FY 2020, PNNL spent \$459M on goods and services to support operations. *Table 1* shows the variety of goods and services purchased, including construction, small scientific equipment, and subcontracts with universities, consultants, and research firms. Of the total, 13 percent (\$61M) of the purchases were from Washington-based firms.

Table 1 | FY 2020 PNNL Purchased Goods and Services Spending
(total U.S. domestic and in Washington)

Type of Expenditure	Total (\$M)	In WA (\$M)
Construction	\$43.8	\$10
Finance, Insurance, Real Estate	\$27.5	\$5.8
Computers, Lab Equipment, Software, Services, Retail Trade	\$102	\$7.1
Utilities, Transportation, Publishing, Management, Business Services	\$147	\$14.4
Technical and Scientific Subcontractors	\$74.4	\$11
Medical and Health Services	\$1.8	\$1.4
All Other	\$62.7	\$10.8
Total*	\$459	\$60.5

**Detail may not sum to total because of rounding.*

\$1.59B

GSP FY 2020 PAYROLL
& NON-PAYROLL PURCHASES

7,580

JOB

\$651M

IN WASHINGTON WAGES

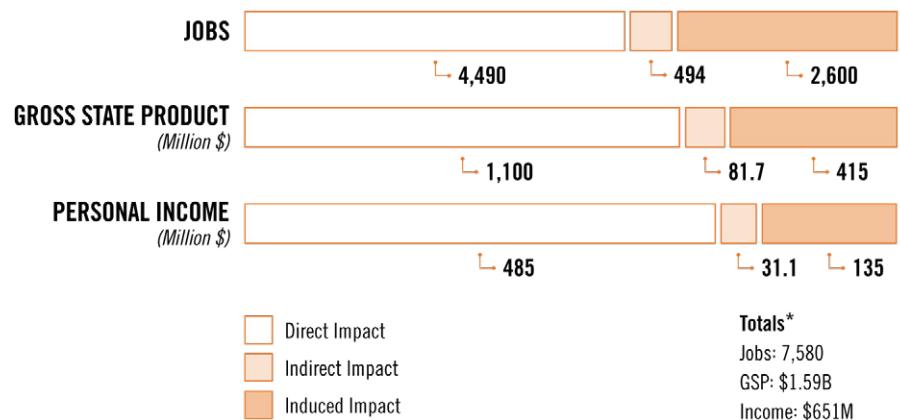
PNNL Operations

PNNL's output, employment, and wages are measurements of what are considered PNNL's *direct* economic activity. In turn, companies that supply goods and services to PNNL and its staff also buy goods and services, producing *indirect* economic activity. Since many of the indirect purchases are made in Washington, much of the indirect economic activity also occurs in the state. When employees of the firms who are either direct or indirect suppliers spend their wages on 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 the total impact on output, employment, or income. The total value of output (goods and services) produced in the state is also called Gross State Product (GSP), and the ratio of total to direct impact is called the multiplier effect.⁴

Figure 4 shows estimates of direct, indirect, induced, and total impacts of PNNL payroll and non-payroll procurement spending in Washington, based on the multiplier effect. The total impacts, including indirect and induced impact, are \$1.59B in GSP, 7,580 jobs, and \$651M in total wages for Washington.

Total Impacts of FY 2020 PNNL Payroll, Non-Payroll, Purchases, and Investment



*Detail may not sum to total because of rounding.

Figure 4 / FY 2020 Economic Impact of Washington Payroll and Purchased Goods and Services Expenditures by PNNL

4 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.



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CONSTRUCTION PROJECTS
SUPPORTED

Expenditures for New Construction and Renovations

Our primary campus, located in Richland, includes land owned by DOE, Battelle, and third parties.

PNNL's campus strategy is driven by a need to enable PNNL's major initiatives, sustain the health of our core capabilities, and support key programs and sponsors.

In FY 2020, construction of the \$90M, 140,000-square-foot Energy Sciences Center was underway. The facility, which will contain state-of-the-art instrumentation for fundamental research in chemistry, materials science, and computational science, will also house 200 staff and 50 collaborators. The Washington State Clean Energy fund invested \$16.3M over four years for the purchase of specialized equipment for the two major facilities that will advance Washington's leadership in basic and applied energy research, and provide collaborative spaces and equipment access for university and industry partners. This partnership between PNNL, DOE, and the state of Washington speaks to the significance of these shared priorities. The facility has a planned completion date for the fall of 2021.

\$4.7M

WASHINGTON-BASED
SUBCONTRACTOR
REIMBURSEMENTS

The Grid Storage Launchpad is another example of a large construction project on our campus. The \$75M facility, funded by DOE's Office of Electricity, will boost clean energy adoption and make the nation's power grid more resilient, secure, and flexible. In a partnership with Harvey/Harvey-Cleary and Kirksey Architecture, the firms were awarded a \$52.9M contract to design and build the facility at the PNNL-Richland campus. Construction could begin as early as fall of 2021.

Especially in these times of uncertainty, and particularly during the pandemic, it was exciting to see a vision begin to come to fruition and witness the infusion of jobs within the community enabling these major construction efforts.

We made investments in facilities and infrastructure worth \$31.5M (see *Table 2*). All major renovations were performed on buildings located in Washington State, and 74 percent (\$23.3M) included reimbursements to subcontractors working on PNNL buildings.⁵ Approximately 20 percent of the subcontractor reimbursements were earned by Washington-based subcontractors, at a total of \$4.7M.⁶ An estimated 24 construction projects were supported by in-state subcontractor construction spending and are included in the total impacts detailed in *Table 2*.

Table 2 | PNNL Construction Spending in FY 2020

FY 2020 Renovations	Total Spending (\$M)
PNNL Labor Costs	\$6.9
Miscellaneous Procurements	\$1.3
Disbursements to Subcontractors <i>Item: Disbursements to Washington Subcontractors = \$4.7M</i>	\$23.3
Total Renovation Spending	\$31.5

⁵ 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 Washington State's economy.

⁶ Total costs related to these renovations, other than PNNL labor, are included in the \$459M non-payroll purchases listed in Table 1.



State and Local Taxes

PNNL and its staff members paid \$27.6M in taxes, which includes business and occupation taxes (PNNL only), sales and use taxes, property taxes, and other types of taxes (e.g., motor fuel taxes).⁷ Employee taxes were based on the total \$485M in wages of employees at PNNL who work in Washington State (and for the purpose of this analysis, they are assumed to live in Washington) and the 2020 state and local governments' collection rates (for every dollar of personal income). The rates are an estimated \$0.027 in sales, use, and other production-related taxes by individuals; \$0.027 in state and local property tax collections; and \$0.002 in other taxes per dollar of personal income.

\$27.6M
TAXES PAID

⁷ PNNL paid \$947K in taxes, and its staff members paid an additional \$26.7M in taxes. Washington does not have a personal or corporate income tax. In addition, PNNL paid \$3.7M into the state's unemployment and workers' compensation insurance systems during the fiscal year. This payment is not included in the total, as it is not considered a tax.



\$297M
IN GSP

1,847
PNNL-DEPENDENT
EXTERNAL JOBS GENERATED

\$120M
IN LABOR INCOME

PNNL: BEYOND THE SCIENCE

While not strictly a PNNL activity, there are certain expenditures—such as spending on healthcare, the investments of our retirees, the visitors we attract, and the transfer and commercialization of technologies—that bolster the economy and would not occur in Washington State without our presence.

Economic Impact of Closely Related Activity

Spending in the four closely related economic activities—health-related services, retirees, visitors to PNNL, and the commercialization and transfer of technology—also creates significant additional economic activity in the state. Taken together, these activities directly employ 732 people and generate a GSP of \$112M. The IMPLAN® model calculates that, when the indirect and induced economic impacts are



taken into account, a total of \$297M in GSP, 1,850 jobs, and \$120M in labor income depend on these activities (see *Figures 5 and 6* for more detail) and can be attributed to PNNL.

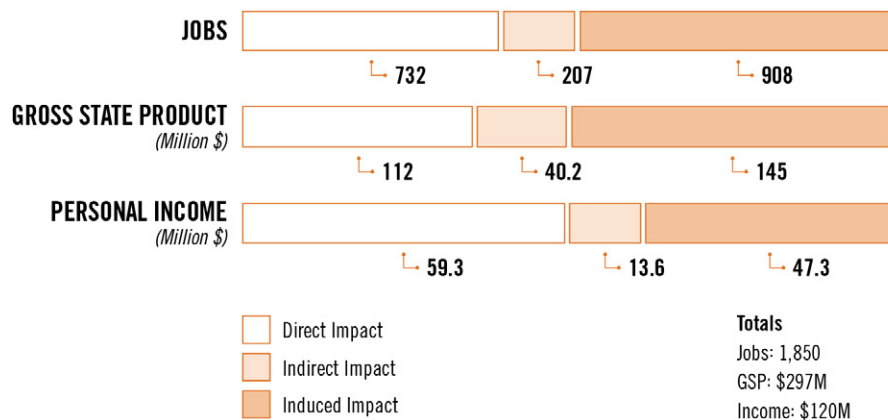


Figure 5 / Total Impact of Healthcare Spending, Companies with PNNL Roots, Visitor Spending, and Retirees on the Washington State Economy in FY 2020



\$79M
HEALTHCARE
EXPENDITURES

\$142M
GSP

941
JOBS

\$70M
LABOR INCOME

Healthcare Expenditures

Health insurance expenditures for our 4,486 staff members residing in the state, 2,156 retirees, and their households totaled an estimated \$79M in FY 2020.⁸ PNNL's direct medical and dental insurance expenditures on behalf of in-state employee households were estimated at \$51M (see *Figure 6*).

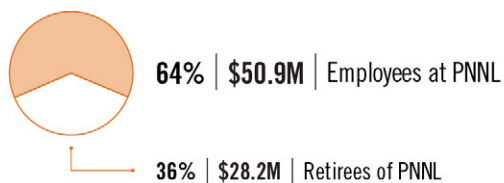


Figure 6 / FY 2020 Estimated Healthcare Spending of In-State Employees at PNNL and Retirees

⁸ Total costs of more than \$28.2M for retired households were based on Kaiser Family Foundation estimates of per capita expenditures by type for healthcare in Washington in 2014, adjusted to 2020 dollars.

Retirees

Seventy-two percent of our retired former employees continue to live in Washington.⁹ They represent a significant source of consumer spending in the 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 FY 2020, the Battelle defined-benefit pension plan for our employees paid a total of \$76M to 2,994 retirees and their beneficiaries. The PNNL pension benefit was an average of \$2,127 per month, per person, in Washington.

Information in *Table 3* assumes that our in-state retirees receive 1.38 times the OASI payment of the average retiree in the state, or about \$2,153 per month, for a total estimated \$56M.¹⁰ Combined, pensions and Social Security total \$154M, of which \$111M is estimated to be spent within Washington on goods and services.¹¹

\$110M

PENSION & SOCIAL
SECURITY INCOME

\$89M

GSP

555

JOBS

\$29M

LABOR INCOME

Table 3 | Estimated Washington State PNNL Retiree Income in FY 2020

Income Type	Estimated Average Retiree Monthly Income in FY 2020	Total Retiree Annual Income in FY 2020 Income (\$M)
Pension	\$2,130	\$55.0
OASI (Social Security)	\$2,150	\$55.7
Total	\$4,280	\$110.7

⁹ Direct data from the pension administrator on PNNL retiree locations for FY 2020 indicated that, of the 2,994 retirees, 2,156 had Washington addresses.

¹⁰ The estimated average monthly payment per OASI retired beneficiary in FY 2020 was \$1,559 in Washington. Because PNNL retirees have had salaries about 1.5 times the state average salary, Social Security calculator software shows that their average OASI payment would be 1.38 times the Washington average.

¹¹ No estimate is available for spending of personal savings by PNNL retirees.

\$1.7M
ESTIMATED TOURISM
EXPENDITURES

\$2.4M
GSP

23
JOBS

\$0.9M
LABOR INCOME

Visitors to PNNL

At PNNL, we host thousands of visitors each year, many of whom are from outside the state and contribute their spending to the state's visitor economy.¹² Unfortunately, due to the travel restrictions and safety precautions needed to keep our staff and visitors safe, we saw a reduction of more than 50 percent in visitors, total number of visitor days, and estimated tourism expenditures in FY 2020 compared to FY 2019.

Statistics for out-of-town visitors to our facilities in FY 2020 are shown in *Table 4*, identified through PNNL visitor badges.¹³ Visitors contributed an estimated \$1.7M to the state's economy based on statewide traveler spending averages, adjusted for Benton County's lower-than-average accommodation costs as a proportion of total spending.

Table 4 | Number of Out-of-Town Visitors and Visitor Days to PNNL

PNNL Visitor Statistics	
Number of out-of-town visitors	2,234
Estimated total visitor days	10,567
Estimated tourism expenditures	\$1.7M

EMSL Users

EMSL is a DOE-SC user facility sponsored by DOE-SC's Biological and Environmental Research (BER) program. It is operated by and located on the PNNL-Richland campus. Many of EMSL's users are from Washington companies or educational institutions.

¹² Direct impact of PNNL visitor spending was estimated from 2018 county-level per capita visitor spending statistics compiled by Dean Runyan Associates, 2019, Washington State Travel Impacts & Visitor Volume, 2000–2018p.

¹³ 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. A similar adjustment was made for badges issued to visitors such as university researchers working at PNNL or needing access to laboratory space. Direct impact of PNNL visitor spending was estimated from 2018 county-level per capita visitor spending statistics compiled by Dean Runyan Associates, 2019, Washington State Travel Impacts & Visitor Volume, 2010–2018p.



In FY 2020, EMSL supported 766 scientists from around the world who were able to take advantage of world-class laboratory space, expertise, and equipment to extend the frontiers of biological and environmental science. Sixty-two users were from foreign institutions, 704 users were from the United States, and 213 of the total users came on-site during the course of their work.

ARM Users

We also provide overall technical direction for ARM on behalf of DOE. ARM is a multi-platform scientific user facility designed to improve understanding and representation in climate and Earth system models, as well as clouds and aerosols, and their interactions and coupling with Earth's surface.



ARM provides the international research community with unparalleled infrastructure for obtaining precise observations of key atmospheric phenomena needed to advance scientific understanding of atmospheric processes and climate models.

In FY 2020, the 1,001 unique ARM scientific users included 512 from universities, 49 from industry, 170 from DOE laboratories, 73 from other governmental agencies, and 197 from foreign institutions. The vast majority of ARM users don't visit PNNL but interact with the facility by downloading data or by visiting one of the remote ARM field sites. Of the total users, 57 accessed ARM's on-site assets, 203 used off-site services, and 741 used data services. ARM employs approximately 60 people at PNNL, some of whom are less than full-time.



Technology Transfer

Technology Commercialization: New Products and Companies with PNNL Roots

Many of PNNL's research activities generate ideas and inventions (i.e., intellectual property [IP]) that have commercial value. PNNL prides itself on rapidly deploying this IP into the marketplace in partnership with new or existing firms. Our scientific discoveries can be converted into competitive products or solutions that contribute to creating new jobs, diversifying the U.S. economy, and making a positive societal impact.

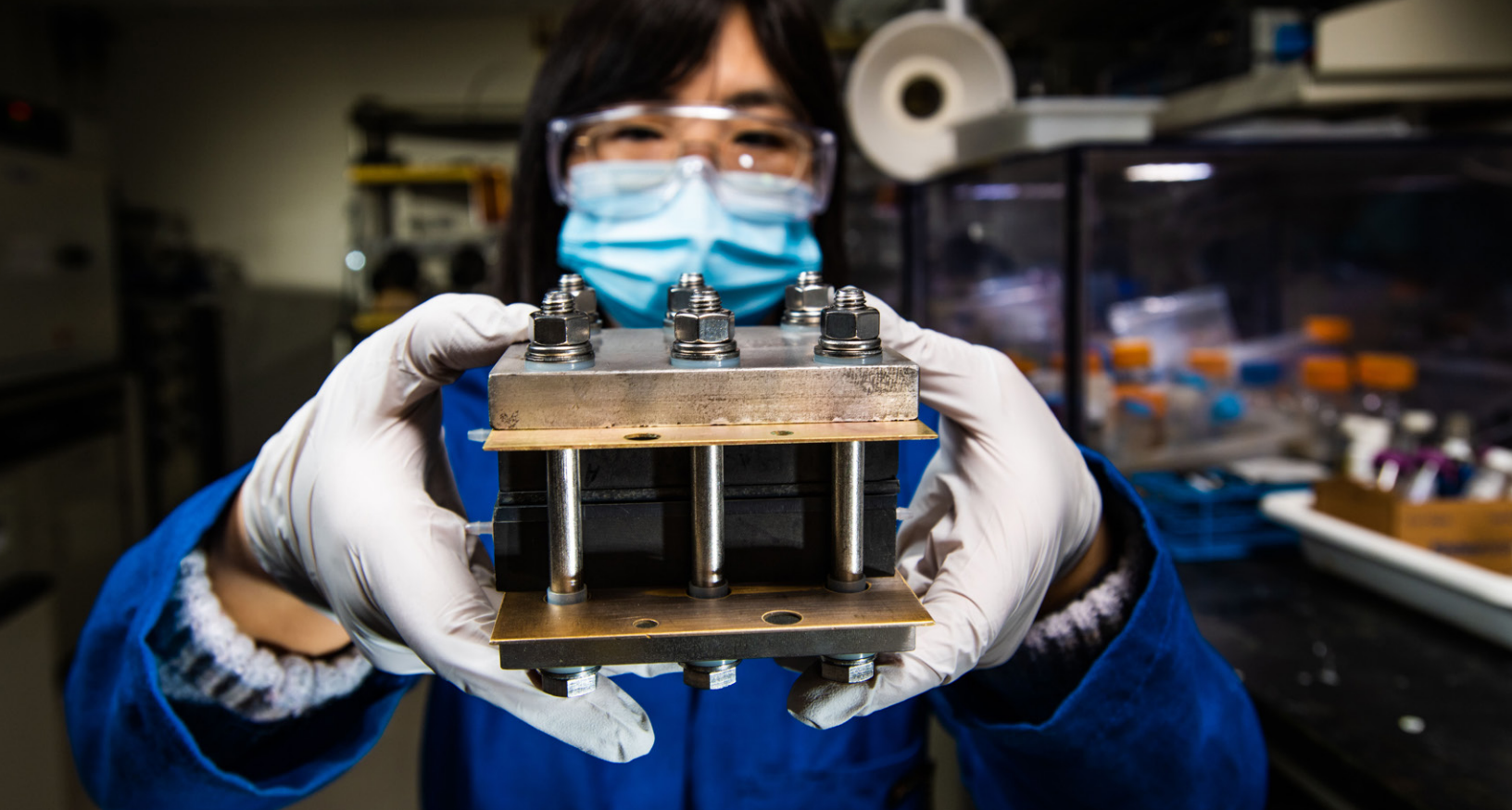
One important way that PNNL delivers both intellectual and economic value is through effective engagement with entities outside the Laboratory—through partnerships, collaborative research, and the transfer of licensing and technology. These relationships help assure that the nation derives as much return as possible from U.S. government investments of taxpayer resources. Our work with other government agencies and private companies also connects PNNL researchers with high-priority, real-world problems that allow them to develop a deeper understanding of current and emerging societal needs.

\$37.7M
ESTIMATED REVENUE

\$64M
GSP

328
JOBS

\$33M
LABOR INCOME



The partnerships we forge sharpen our science, attract talented staff, and inform the Laboratory's strategic priorities. PNNL pursues each partnership as an opportunity to advance the Laboratory's missions in scientific discovery, energy resilience, and national security, while maximizing the positive impact on the U.S. economy and protecting our critical intellectual assets.

To facilitate effective partnerships, PNNL provides several ways to work with the Laboratory, including the transfer of rights to use IP developed at PNNL, direct sponsorship of research, or engagement in Cooperative Research and Development Agreements.

Since 1965, 198 new companies were started that had technological or managerial roots at PNNL, and 100 of those are still in business today. *Table 5* provides a breakdown of the activity over the last 10 years. As a national laboratory, we patent and license our technology across the nation and the world. However, place matters when it comes to innovation, which is why almost half of the companies created within the last 10 years were located right here in Washington. Fifteen of the 32 companies still in business are located in Washington and collectively employ more than 190 people, with estimated sales of \$37.7M.

Table 5 | Companies with Ties to PNNL (established in last 10 years and still operating)

	Total	In WA
Number of Firms	32	15
Estimated Sales (\$M)		\$37.7
Employment	>340	>190

Intellectual Property

While there is undoubtedly value in investing in both our current and future quality of life, there are other aspects of PNNL's presence in Washington that are much more difficult to calculate in terms of the state's GSP or employment, such as the IP created by PNNL research and development activities. PNNL transfers technologies—primarily through IP options and licenses—at a rate of almost one technology licensed every 10 days, including 36 new license agreements in FY 2020.

PNNL continues to lead all other DOE laboratories in implementation of agreements for commercializing technology, having 90 agreements with 72 different private organizations. In FY 2020, we had 72 active Cooperative Research and Development Agreements and 268 non-federal Strategic Partnership Project agreements.

Often, federally funded research results in scientific and engineering solutions that have intellectual property value. *Table 6* provides additional highlights of our commercialization and technology deployment efforts, including invention disclosures, patent applications, patents issued, commercial options and licenses issued, and license revenues earned. In FY 2020, we collected \$2.5M in licensing revenue and reinvested a significant portion of these funds at PNNL for additional commercialization-focused development work.

Table 6 | PNNL Statistics on Inventions, Patents, Technology Transfers, and License Income

	New FY 2020	Cumulative 2000–2020
Invention Disclosures	340	5,010
Patents Granted	63	1,060
Licenses and Options	36	707
Total License Revenue Received	\$2.5M	\$73.9M

\$2.5M

COLLECTED IN
LICENSING REVENUE

1

TECHNOLOGY
LICENSED EVERY

10

DAYS



Battelle is a nonprofit, charitable trust that has operated PNNL for DOE since 1965. Giving back is in our culture. Whether it's through charitable giving—from employees or Battelle corporate dollars—or the numerous hours volunteered, it is making a difference.

Since 1965, Battelle has invested nearly \$30 million in our community. This includes investments in the arts and culture, as well as health and human services programs that are important to our community.

INVESTING IN THE FUTURE

Whether contributing to local organizations, facilitating community volunteerism and leadership, or furthering science, technology, engineering, and mathematics (STEM) education, PNNL has built a strong and enduring foundation of external engagement and outreach. Giving time, money, and talent to help others in the communities where we work and live is our culture.

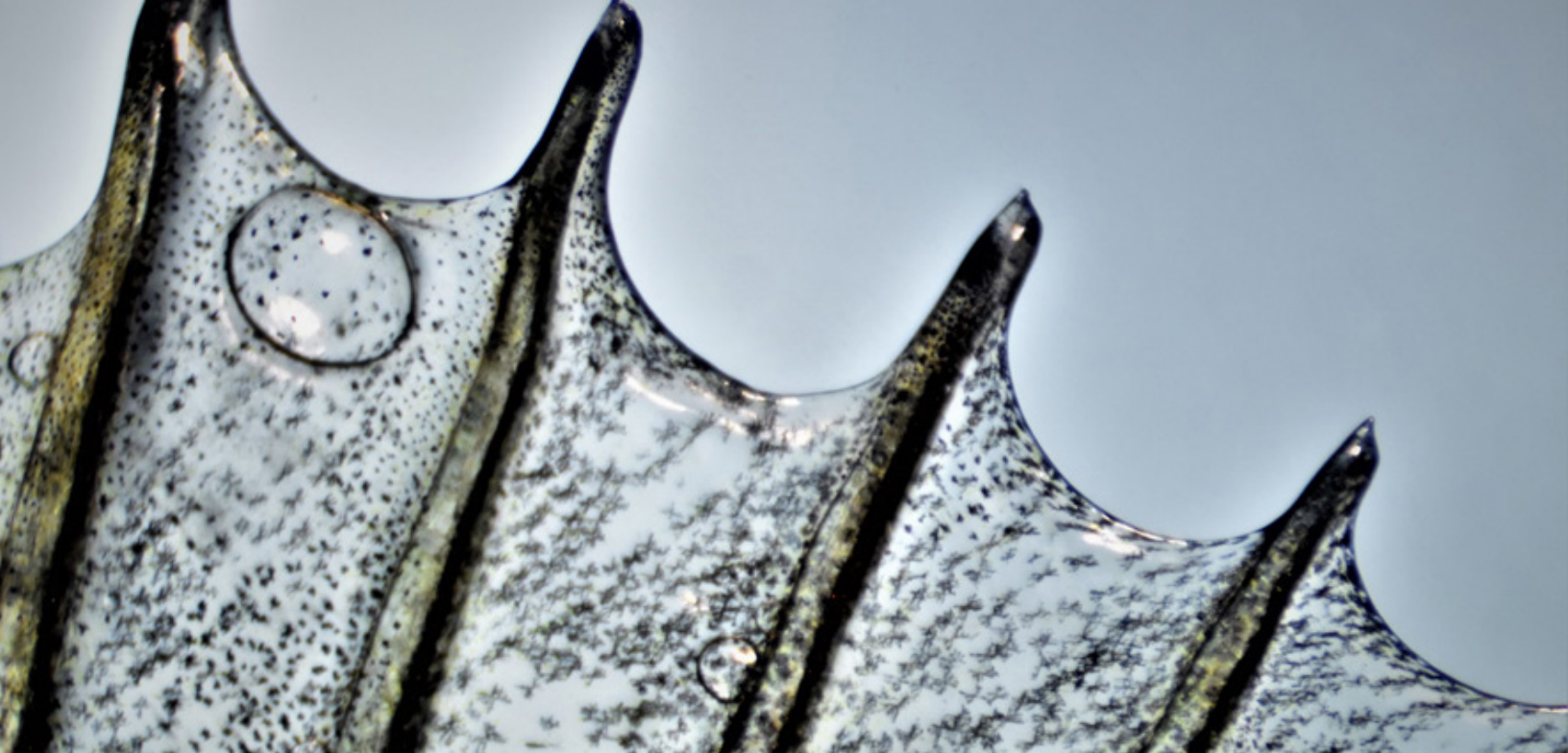


STEM Education

The Office of STEM Education aligns PNNL's education efforts with national, state, and local initiatives to spearhead change in STEM education and address workforce challenges in the Pacific Northwest and beyond. In partnership with DOE's Office of Workforce Development for Teachers and Scientists, we connect our resources with community, regional, and national STEM education stakeholders to help meet the research, diversity, and education priorities of DOE. We focus on building and expanding relationships with educators, educational and community-based foundations, government sponsors, and others to improve and accelerate the growth of STEM education and workforce preparation.

In FY 2020, PNNL, in response to the global pandemic, pivoted to remote delivery and execution for all signature efforts, including STEM outreach, internships, and professional development. We seized the opportunity to provide leadership in our community during a period of uncertainty. Most notably, PNNL successfully developed the infrastructure and transitioned our high-caliber, multi-faceted, traditionally on-site internship program to a remote internship experience for the summer of FY 2020.

As a DOE national laboratory, PNNL helps fulfill DOE's commitment to train, support, and inspire scientists, mathematicians, and engineers.



CASE STUDY

STEM Education During the COVID-19 Pandemic

Digital STEM Outreach Takes Center Stage

Typically, PNNL STEM education ambassadors engage in activities like classroom visits and local STEM events. 2020 was not a typical year, however. With schools and events disrupted for an unknown duration during the pandemic, PNNL worked quickly to move several STEM resources online and to roll out a STEM campaign via its Facebook, Twitter, and Instagram channels.

PNNL Materials Scientist and STEM Ambassador Charmayne Lonergan, who made her debut on Instagram TV as part of this digital campaign, said, “I love the ability to engage with people face-to-face at in-person events, but this IGTV session showed us that recorded engagements can allow us to be quite versatile and adaptable. It proves PNNL’s passion for outreach is greater than the challenges we’re facing.”

“Our STEM ambassadors enjoy being out in the community, and we were pleased to find a way to facilitate that connection when many on-site opportunities were derailed due to COVID-19,” said Evangelina Shreeve, director of PNNL’s Office of STEM Education.

PNNL uploaded its STEM ambassador tabletop posters to its website, designed new posts depicting their work for use on social media, created a new STEM Education YouTube playlist, and heavily promoted the Team Battelle Math Tutors—a weekly online homework session connecting teens and parents to some of PNNL’s most brilliant math minds.

Instagram TV—long-format video—allows for more detailed content. In Lonergan’s IGTV segment, she didn’t just talk about her work in materials science, she answered questions that were previously submitted by students, teachers, and community members via social media. It was so successful that PNNL began planning additional IGTV segments.

“This situation has forced us to be a little more creative with our STEM outreach, and the more creative we are, the more people we can reach,” said Shreeve. “Adding these robust digital and social media components has been great for our program and fun for our researchers.”

Eighty-five percent of internships were preserved with participation from more than 900 PNNL limited-term employees and research associates. Despite the challenges and impact of COVID—not only to our community, but especially our education ecosystem—PNNL identified and implemented solutions that continued to inspire and engage the next generation of STEM professionals, while also fulfilling the workforce development priorities of DOE and PNNL.

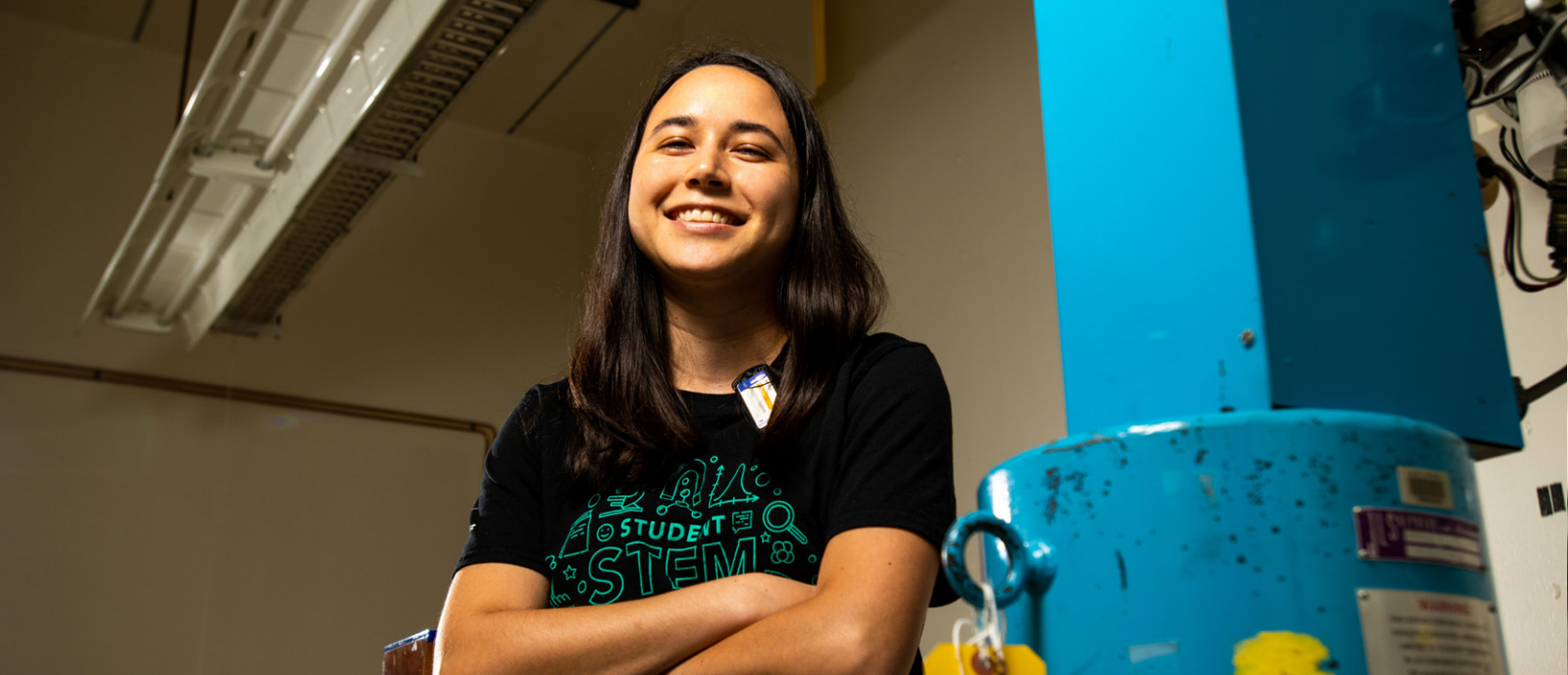
In July 2020, Battelle made the first installment of \$500K toward a \$1M gift to the Washington State STEM Education Foundation to support STEM education efforts and accelerate impact in the Mid-Columbia region. The foundation has been a partner, key collaborator, and catalyst for expanding opportunities in the Mid-Columbia region for underserved students. The STEM Nexus Initiative is a community-engaged approach to develop STEM proficiency and awareness of STEM careers among underserved students in the Mid-Columbia region.

Throughout FY 2020, PNNL continued to deliver STEM programs that provided immediate impact and assistance while demonstrating our near- and long-term commitment to our community and the value DOE places on building our future workforce. Notable efforts included:

- Leveraging social media and the widespread adoption of virtual platforms to design and deliver virtual STEM outreach opportunities. Due to this virtual outreach, our impact was amplified, allowing us to extend our reach beyond our local communities and into more remote, rural areas.
- Providing leadership to DOE's Office of Workforce Development for Teachers and Scientists Working Group to develop a remote mentoring guide and toolkit to assist national laboratories across the DOE network in the delivery of remote internships.
- Partnering with the Washington State STEM Education Foundation to launch and provide community stewardship for the STEM Nexus strategy that will develop and fund experiential learning programs for underrepresented students in rural communities. As a result, funds were awarded to several community organizations (LIGO, WSU-Tri-Cities, Columbia Basin College) and three school districts.

STEM Nexus Initiative

In July 2020, Battelle invested a \$1M gift to support STEM education efforts in the Mid-Columbia region and the Sequim community—located near the PNNL's Marine and Coastal Research Laboratory. The gift is being stewarded by the Washington State STEM Education Foundation to accelerate impact and engage the community to bolster STEM education among historically underserved student populations. As local schools pivoted to remote learning for the 2020–2021 school year, the STEM Nexus Initiative team created, assembled, and distributed 4,200 Microscopy STEM Kits for sixth grade students. The kits included an accompanying lesson plan aligned with math common core and next-generation science and engineering standards. Students and teachers from a local tribal school, the Mid-Columbia region, and Sequim all received these Microscopy STEM Kits. Looking ahead, the STEM Nexus Initiative is investing in local STEM education organizations across the K–16 system to provide students with online and in-person STEM learning experiences.



PNNL and the national laboratories collectively train and educate more than 250,000 K–12 students, 22,000 K–12 educators, and over 11,000 undergraduate, graduate, and postdoctoral researchers annually, creating tremendous impact to the nation's future STEM workforce.

- Designing and delivering workshops to expand best practice models, including “STEM Ambassador Management Fundamentals” training and leading “Virtual Internship Fundamentals” for national laboratory STEM directors.
- Expanding STEM ambassador participation, growing the reach and impact of STEM education outreach to the community.

In FY 2020, DOE-SC provided project funding, and PNNL invested \$942K in post-secondary student and faculty programs. PNNL’s Intern and Fellowship Management and Administration pool was \$1.77M. PNNL spent \$1.05M in overhead funds to support STEM workforce development and outreach efforts (K–16). In FY 2020, 17,600 pre-college, undergraduate, graduate, post-graduate, and faculty researchers benefited from STEM education efforts or participated in PNNL’s STEM workforce.

PNNL continues to deliver on a strategy that promotes visibility and impact, STEM leadership, thriving partnerships, and a sustained investment in the people in the region. We are incredibly proud of the impact we had in FY 2020, especially during a global pandemic. Our success is extremely important to Battelle, DOE, and the many students, teachers, and partners we serve each year. We look forward to continuing to deliver transformative STEM programs that provide value to DOE and our community.



\$29.5M

INVESTED BY BATTELLE
SINCE 1965

Community Investments and Assistance

Since 1965, Battelle has invested nearly \$30M to improve science, education, and quality of life in Washington. Over the past 10 years, staff members at PNNL have volunteered 334K hours to community projects.

In FY 2020, with the start of the COVID-19 pandemic, we saw our community in need and stepped up. Battelle and PNNL contributions to philanthropic and civic organizations, including corporate support for STEM education, totaled \$1.08M. This includes a donation from Battelle, the first of two \$500K investments, to support STEM efforts in Washington State.

Our staff gave of their time, talent, and resources to many organizations, including Mid-Columbia Science Fair, Science Bowl, United Way, and the Three Rivers Community Foundation—a community endowment whose mission is to strengthen and improve the quality of life in the Tri-Cities community by supporting and enhancing philanthropy and charitable activities—all of which played critical roles within our community during the pandemic.

As would be expected, the number of volunteer hours in FY 2020 decreased dramatically, due to the pandemic and an abundance of caution for the safety of our staff and the recipients. However, the

\$1.08M

IN COMMUNITY
ASSISTANCE FROM
BATTELLE & PNNL

334K

HOURS VOLUNTEERED
BY STAFF AT PNNL
OVER THE PAST 10 YEARS



CASE STUDY

The Spirit of Giving

Battelle Supports Washington Communities

Throughout the COVID-19 pandemic, Battelle has donated almost \$200K in pandemic-related relief to communities in Washington State.

In March 2020, Battelle directed more than \$103K to organizations in the Mid-Columbia region, as well as Sequim, Washington, to feed those at risk of going hungry during the pandemic. A majority of the donation went to Second Harvest in Pasco, which provided food to some of the food banks and meal centers in its distribution network. Additional money went to Meals on Wheels and the food banks in Prosser, as well as Sequim, WA, where we manage the Marine and Coastal Research Laboratory, DOE's only marine research facility.

"We are helping address a critical need arising from the COVID-19 pandemic," said Steve Ashby, PNNL director and Battelle senior vice president. "It's one way we can support the communities where we live and work—and those who have been so supportive of us over the years."

Battelle also diverted more than \$8K in funds normally reserved for expenses associated with hosting visitors and events at PNNL, directing them instead to hire six local caterers to deliver over 560 meals to 15 front-line organizations, including police, fire, emergency service, and senior living facilities in Washington's Benton and Franklin counties.

This was followed up with another \$80K to nonprofit organizations in August, providing support for those dealing with food insecurity or in need of pandemic-related mental health assistance. The donation went to the United Way of Benton and Franklin Counties and the Three Rivers Community Foundation.

Because both donations were made through All In WA, a statewide COVID-19 relief effort, they received matching contributions in FY 2021.

"This is a difficult time for all of us, but some in our communities are facing special challenges," said Ashby. "Many have been hard-hit financially and are struggling to afford basics, such as food and healthcare, while others are combating fear, anxiety, and stress. Battelle and its staff at PNNL have been an integral part of the Tri-Cities community for over 55 years, so when there are needs such as there are now, we feel it personally, and we desire to help where it is needed most."

The spirit of giving extended to individual employees at PNNL, as well. Many made personal financial donations, in addition to donations of food, clothing, and other items to help Tri-Cities-area residents. Likewise, both the PNNL and Battelle Fellows, a status designated to our most distinguished researchers, scientists, and engineers, collectively donated \$10K through All in Tri-Cities.

financial contributions more than doubled as we made donations to the many health and human service organizations hit hard by the pandemic. These donations included hardware to support the virtual learning environment needed by Washington State University Tri-Cities, Columbia Basin Community College, West Sound STEM Network (in Sequim), and the Pacific Science Center (in Seattle), as well as support for the Mathematics, Engineering, Science Achievement program (Yakima Valley/Tri-Cities); Visit Tri-Cities; Senior Life Resources-Meals on Wheels; Second Harvest; American Red Cross; several emergency food initiatives; and Tri-Cities food banks.

In addition to monetary donations, staff at PNNL also donated their time throughout the community. One way they did this was through serving on community boards, including the Tri-Cities Regional Chamber of Commerce, Association of Washington Business, Washington Roundtable, Washington State University Tri-Cities Advisory Committee, Tri-Cities Development Council (TRIDEC), The REACH Foundation, Washington State STEM Education Foundation, and West Sound STEM Network.

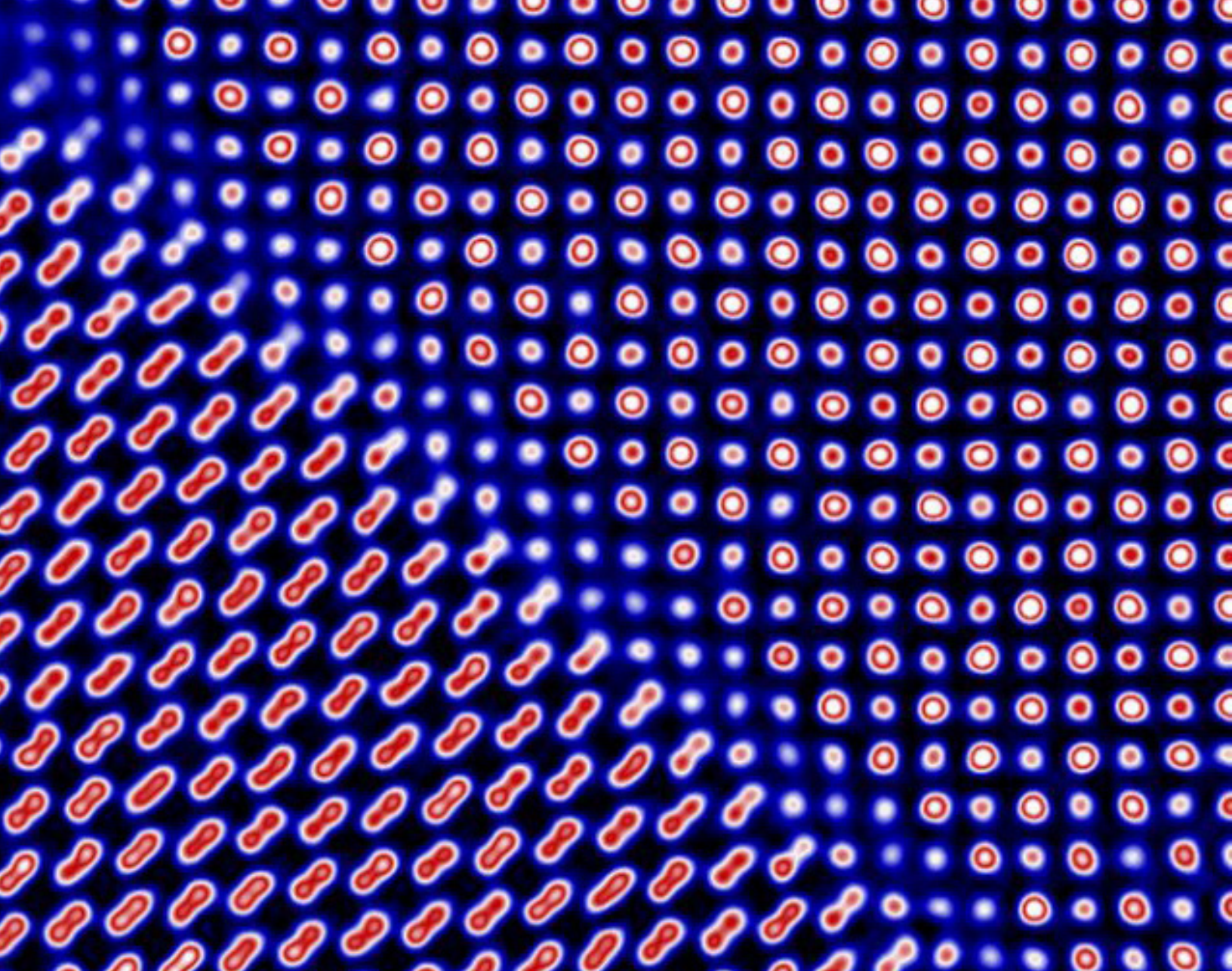
Battelle also provided financial support and sponsorship for a number of community events and projects, including the Tri-Cities Diversity Summit, the Association of Washington Business Federal Affairs Summit, and the Pacific NorthWest Economic Region Summit.

Table 7 | PNNL and Battelle Community Assistance Statistics for FY 2020

Washington State Community Assistance	Total (\$K)
Battelle memberships and cash donations to health, human services, and other philanthropic and civic organizations*	\$984
PNNL memberships/projects in Washington civic organizations	\$96
Total**	\$1.08M

*Includes \$690K in donations to STEM education

**Detail does not sum to total because of rounding.



CASE STUDY

PNNL Leads the Way: Transforming the Way We Work

At PNNL, leadership prioritizes the health and well-being of staff. That has never been truer than in 2020, when the Laboratory Leadership Team committed to doing everything in their power to avoid pandemic-related furloughs and layoffs—and, together, we succeeded.

In March, the Laboratory pivoted to allow roughly three-quarters of our employees to telework,

enabled by strong, existing information technology infrastructure and a targeted effort to adapt and reinforce capabilities for the increased number of employees accessing those systems simultaneously.

Limiting the risk of virus spread in facilities at PNNL was critical to providing a safe environment for the approximately 1,200 mission-critical staff who remained on campus, as well as the community

in which they lived. Leadership from both DOE and PNNL met frequently to assess the situation, make changes based on new understanding and guidance from the U.S. Centers for Disease Control and Prevention, collaborate with community and state health officials to share best practices, and implement new requirements to do our part to limit community transmission and keep our staff and community safe.

“It absolutely has been a hallmark of this laboratory to lead,” said Deputy Laboratory Director of Operations Mike Schlender. “We need to continue even more now than we have in the past, with the virus on the move all around us.”

A defense-in-depth approach was developed with enhanced safety measures, including face coverings, hand washing, and adhering to defined acceptable personnel levels—or APLs—that designate the number of staff allowed in a workspace while maintaining appropriate social distancing. Staff members were also given the opportunity to obtain vaccinations on campus, voluntarily disclose their vaccination status, and asked to complete daily health checks to maintain increased awareness of symptoms.

“As an Office of Science national lab, I think we have a duty to follow the best practices and standards that were set, even if they’re inconvenient and awkward,” said David Manz, principal cybersecurity scientist. “Because it’s what the science is telling us, it’s what policy is telling us, and we want to be good role models for those who might observe us.”

The commitment to keeping staff safe and informed included a strategic communication plan increasing the frequency of virtual senior management meetings, which were recorded and made available to all staff members; maintaining online Frequently Asked Questions and an up-to-date, informational website; and hosting educational webinars—about the virus and how to stay safe—for staff and the community.

Leadership used all resources at their disposal to maintain a “people first” posture, including increased work schedule flexibility. Adjusting work hours to best support staff members’ individual situations was particularly useful when caring for sick family members or for parents accommodating childcare obstacles and new at-home learning requirements.

Online community forums were stood up, offering support and advice to anyone struggling with the “new normal,” as well as opportunities to reestablish work culture through virtual communities. The Laboratory also found ways to help staff members who needed assistance augmenting their home office environment, such as providing webcams and other computer peripherals.

“We really want to be able to make it through this, so we have to keep making healthy choices so that we can come back together in the way that we like to be connected,” said Chief Human Resources Office April Casteñeda.

Despite the countless obstacles to productivity, PNNL rose to the challenge. Not only did we meet our obligations and goals as a laboratory, but we even continued hiring by implementing robust, virtual onboarding programs.

By the close of FY 2020, PNNL was still in a maximum-telework posture but preparing the transition back to normal operations, not by returning to the way things were before, but by embracing a new, hybrid workplace to create an even more exciting future—one where staff members can choose how much time they prefer being on campus, customize the type of work environment they want, and maximize work-life balance possibilities.

In a message to all staff members, Laboratory Director Steven Ashby stated, “I knew that we had great people, but this crisis has shown me and others that we are exceptionally resilient and adaptable, committed to what we are doing to make the world a better place, and incredibly caring. I am extraordinarily proud to be associated with this Laboratory and the people who make it great.”



\$1.59B

TOTAL ECONOMIC
OUTPUT SUPPORTED
BY PNNL PAYROLL
& DOMESTIC PURCHASED
GOODS & SERVICES

\$651M

WASHINGTON STATE
WAGE INCOME

7,580

TOTAL JOBS
GENERATED IN
WASHINGTON STATE

CONCLUSION

Where scientific innovation and economic impact meet, you'll find PNNL. Scientists, engineers, and support professionals at PNNL contribute scientific knowledge, new ideas, novel inventions, innovative technologies, and processes that help make the world safer, cleaner, and more prosperous. From advancing scientific discoveries to enabling sustainable energy and enhancing national security, PNNL is committed to addressing critical national and global challenges. As we advance scientific understanding and technological solutions, we are also building the economy of tomorrow for the nation and the state of Washington.

In FY 2020, PNNL positively impacted the economic activity in Washington with \$1.1B in total spending, 4,486 resident employees, in-state payroll of \$485M, and approximately \$61M in purchases from Washington businesses. This economic activity, in turn, supports a total economic output of \$1.59B, as well as in-state payrolls of \$651M and 7,580 jobs throughout the state.

The growing number of commercial companies in Washington that were formed based on PNNL ideas and assistance has added more than 194 employees and an estimated \$37.7M in funding, proving the success of our model for interagency collaboration and technology transfer and commercialization, all of which has won numerous awards. An additional \$297M in output, in-state payrolls of \$120M, and 1,847 jobs are supported through closely related activities, such as companies with PNNL roots, retirees, visitors, and healthcare spending.

FY 2020 has been an extraordinary time, not just for PNNL in the communities where we live and work, but across the nation and the world. At PNNL, we've been fortunate. Our staff were able to remain productive, with 90 percent of our staff teleworking and our essential workers on campus employing a defense-in-depth strategy to keep ourselves and our community safe. We avoided furloughs. We hired 371 new staff and provided 521 internship opportunities to expose the next-generation workforce to the caliber of expertise offered only at a national laboratory. We contributed scientific knowledge that helped to advance approaches to diagnose, treat, and prevent COVID-19. And we humbly recognized that others in our communities were not as fortunate. To that end, we donated more than \$1M to community assistance programs within Washington.

Now, more than ever, it is important for PNNL to continue to be a vital component of our state's economy. That's exactly what happens when impact and innovation converge.



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