

SCIENCE AND TECHNOLOGY FOR THE NATION



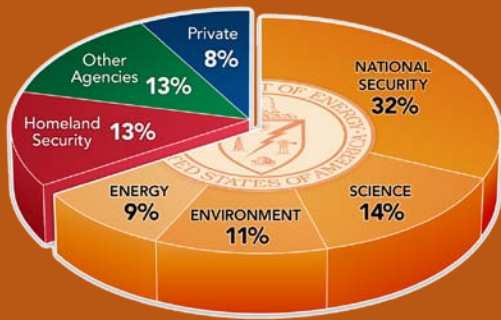
Pacific Northwest
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*



FAST FACTS

- Year established: 1965
- Management and operations contractor: Battelle
- Staff: More than 4,000, including 2,000 technical staff
- Annual budget outlay (allocated as shown in the pie chart): \$880 million



- Customers: Federal agencies including the Departments of Energy, Homeland Security, and Defense; National Institutes of Health; Nuclear Regulatory Commission; Environmental Protection Agency; the intelligence community; state governments; universities; and industry
- Named "One of the 20 great employers for new grads" by *Fortune* magazine
- Patents: More than 1,680 U.S. and international
- Licenses: More than 200 for technologies developed at PNNL
- Publications: More than 650 peer-reviewed journal articles annually

Facilities include:

- EMSL, a Department of Energy national scientific user facility
- Bioproducts, Sciences, and Engineering Laboratory—shared with Washington State University
- Electricity Infrastructure Operations Center
- Sequim Marine Sciences Laboratory
- Applied Process Engineering Laboratory—a research, development, and demonstration user facility and technology business incubator
- Radiochemical Processing Laboratory for nuclear science and engineering
- Biological Sciences Facility and Computational Sciences Facility—together, these facilities are valued at \$75 million. BSF conducts key programmatic research for DOE's Office of Science and National Institutes of Health, while CSF houses capabilities such as information analytics, high performance computing, and sensor analytics.

Solving America's Toughest Problems

Research is our business. With an unwavering focus on our missions, scientists and engineers at the U.S. Department of Energy's Pacific Northwest National Laboratory deliver science and technology. We conduct basic research that advances the frontiers of science. We translate discoveries into tools, and technologies in science, energy, the environment, and national security.

For more than four decades, our experts have teamed with government, industry, and academia to tackle some of the toughest problems facing our nation. The result: We're delivering the science, technology, and leadership our customers need to succeed.

New Discoveries, Compelling Insights

Through fundamental research, we create new knowledge and transformational tools for continued prosperity and security in the 21st century. We do this by integrating our strengths in biological, chemical, computational, environmental, and materials sciences.

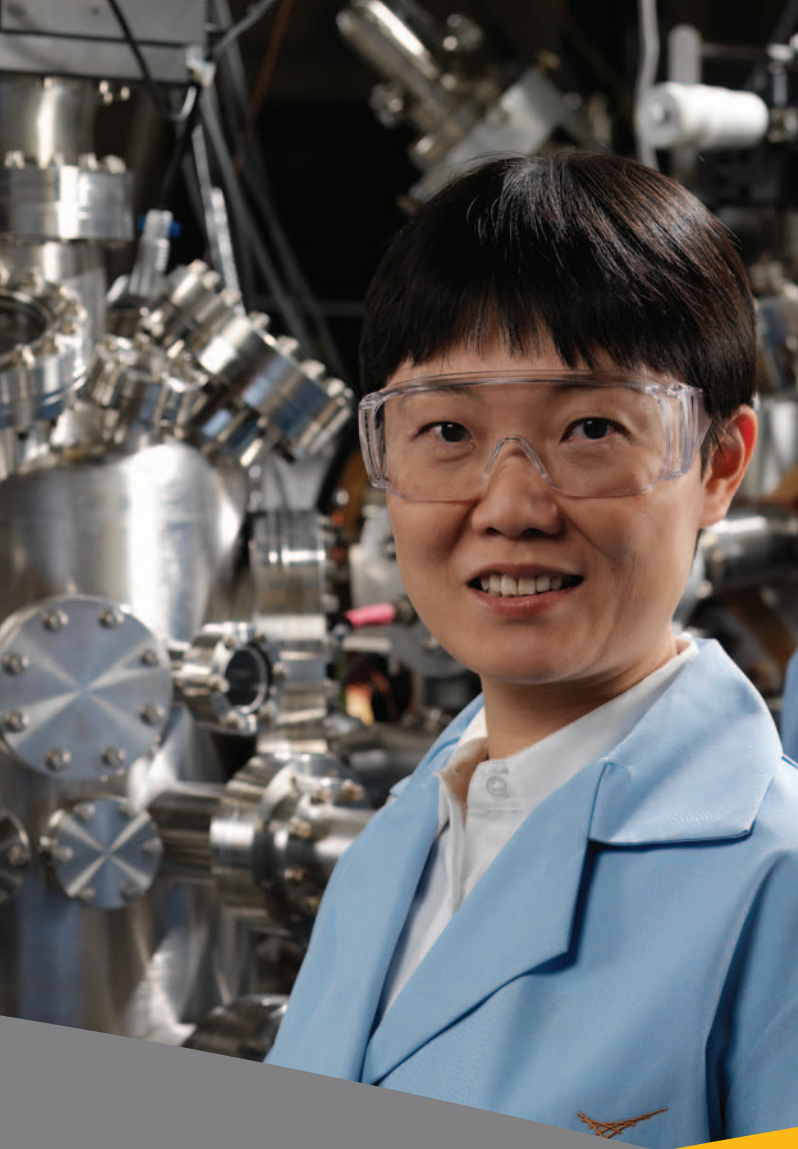
Eureka! Our researchers discovered that super-cooled ice generates an electrical charge, correcting a fundamental misunderstanding of water behavior and revealing insights about the formation of comets and planets. We are developing design principles to allow inexpensive, abundant metals to catalyze the production of new fuels. We revealed how a naturally occurring microbe

chemically changes a liquid contaminant in soil to a solid, non-mobile form. We demonstrated the scalability of new, parallel algorithms for high-performance computers and next generation multi-threaded computer architectures for knowledge discovery applications.

New knowledge often generates compelling insights for decision-makers. In 2007, more than 20 PNNL researchers contributed to the global efforts of the Intergovernmental Panel on Climate Change, which received the Nobel Peace Prize in equal part with former Vice President Al Gore.

Fundamental research in microbiology is revealing new knowledge for trapping greenhouse gases and cleaning up contaminants in soil. This work supports DOE's missions in energy security, environmental responsibility, and scientific discovery and innovation.





Benefiting Researchers around the World

DOE's EMSL—
the Environmental



Molecular Sciences Laboratory—a national scientific user facility located at PNNL, provides integrated experimental and computational resources for discovery and technological innovation in the environmental molecular sciences to support the needs of DOE and the nation.

EMSL's distinctive focus on integrating computational and experimental capabilities as well as collaborating among disciplines yields a strong, synergistic

Above: EMSL users generate results that advance DOE missions, including molecular-level understanding of the physical, chemical, and biological processes underlying critical environmental issues facing the nation.

Right: The ProVision™ Whole Body Imager, similar to the system shown here, is being used in airports and other high-security areas worldwide to help prevent terrorism.



scientific environment. Bringing together experts and an unparalleled collection of state-of-the-art instruments under one roof, EMSL has helped thousands of researchers from around the world develop a molecular-level understanding of the physical, chemical, and biological processes that underlie the most critical environmental and energy issues facing the nation. Become an EMSL user by submitting a proposal through www.emsl.pnl.gov. In general, researchers whose proposals are accepted per EMSL's peer review process will be granted access to EMSL's resources free of charge.

Making America Safer

Securing the freedoms and way of life we've enjoyed in America is one of our highest priorities and greatest opportunities. But threats are more dynamic, severe, and complex than ever before. We face the threats of global terrorism, increased opposition to U.S. interests, proliferation of nuclear materials and weapons, and increased access by our adversaries to sophisticated technologies and materials.

PNNL is helping ensure America's security by developing tools to predict and prevent threats and respond effectively to disruptive events.

Threat detector. An airline passenger walks through a portal, receiving a whole-body screening that detects any concealed threats such as metals, plastics, or liquids.





This PNNL innovation is at work in airports, border crossings, and government buildings worldwide to locate weapons and contraband made of any type of material. Harmless radio waves pass through clothing, creating an image of any concealed objects while obscuring facial features. Sold by L-3 Communications as the ProVision™ Whole Body Imager, the product has been featured in *Time*, *Fortune*, and *Discover* magazines and has won numerous innovation awards. The same technology is being explored for other high-security situations.

Smugglers beware. Our nation's ports are getting more scrutiny these days as potential smuggling routes for weapons of mass destruction and "dirty bombs." PNNL experts are helping the U.S. government develop and deploy radiation portal monitors at all U.S. Customs and Border Protection points of entry. Radiation portal monitors safely and effectively scan traffic and cargo entering the United States for nuclear and radioactive materials, while maintaining a smooth flow of commerce. Nearly 3,000 radiation portal monitors are being installed nationwide at international mail and courier facilities, land and rail border crossings, international airports, and seaports.

Above: To protect our nation's borders and ports, radiation portal monitors (shown above) are scanning traffic and cargo entering the United States.

Right: When the award-winning Grid-Friendly Appliance™ Controller was installed in home washers and dryers, the electrical grid was less stressed during times of peak use.

Seek and destroy global threats.

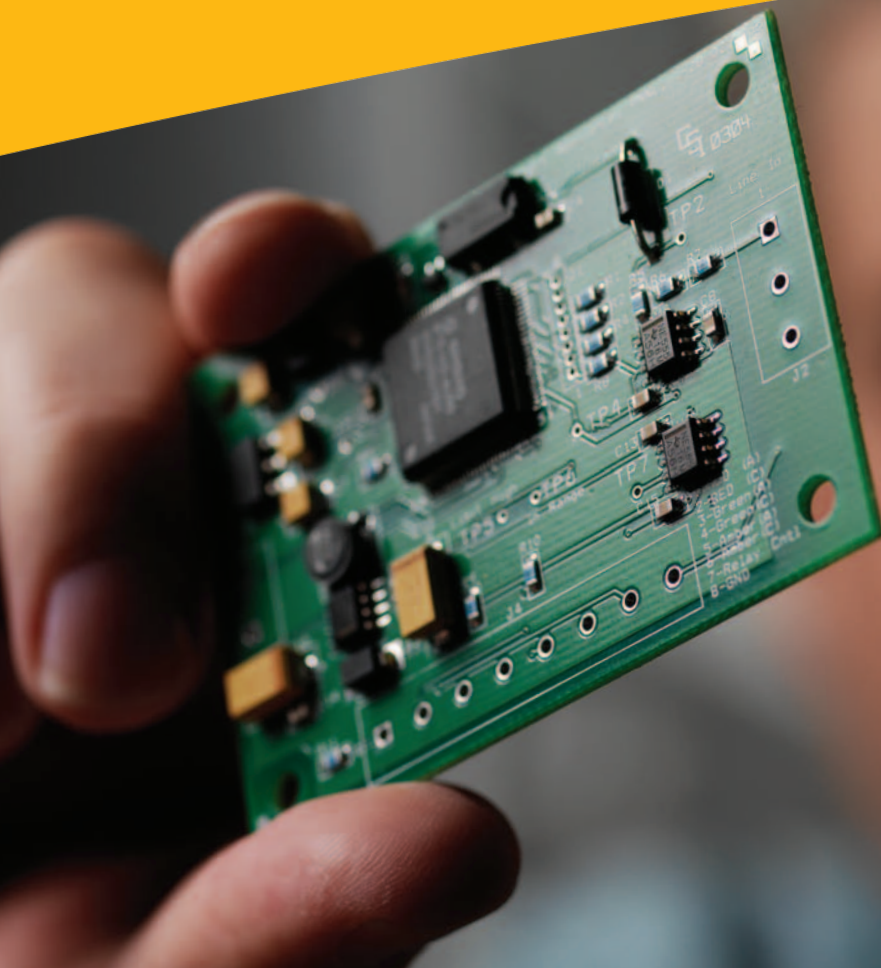
The National Visualization and Analytics Center™, which PNNL leads for the Department of Homeland Security, coordinates the development of new tools in the field of visual analytics to identify and stop terrorism. The Laboratory leads the Pacific Northwest Center for Global Security in Seattle, which collaborates internationally to reduce the threat of nuclear, chemical, and biological weapons. The Coastal Security Institute, on PNNL's Sequim, Wash., campus provides expertise to government customers charged with the security of near-shore regions. The Institute combines marine and environmental sciences, remote sensing, characterization, electronics, sensors, and integration capabilities.

A Secure Energy Future

In alignment with DOE's energy security goals, PNNL is driven to help increase U.S. energy capacity and reduce our dependence on imported oil, while reducing emissions released into the atmosphere. By collaborating with our partners, we are developing ways to use today's domestic energy sources more cleanly and efficiently while helping shift our nation to more renewable sources. Our research targets clean fossil energy, a reliable and secure electrical grid, safe nuclear power, and renewable energy. The results are helping the nation generate power more cleanly and efficiently, reduce dependence on imported foreign oil, and move toward a sustainable energy future.

"When I was investigating technologies for explosives detection, Pacific Northwest National Laboratory engineers were among the technical experts I called upon because of their expertise, broad technical insight, and the fact that they served as honest brokers in the discussion of their own and other technologies. The PNNL-developed millimeter-wave threat detection technology, now deployed worldwide, is playing a crucial role in the national strategy of securing transportation, critical infrastructure, and our public places from the threats of suicide bombers."

Dr. Lyle O. Malotky
Scientific Advisor
Transportation Security Administration
U.S. Department of Homeland Security





"Pacific Northwest National Laboratory has done a first-rate job of clarifying and integrating the risk management issues surrounding climate change, so that the policy community can make better decisions. PNNL has distinguished itself in technology assessment—helping us understand the role and timing of emerging technologies that are needed to transition to a less carbon-intensive future."

Rich Richels
Sr. Technical Executive
Electric Power Research Institute

Carbon shift. We will continue to rely on carbon-based fuels for the next 30 to 50 years, until renewable sources can scale up to displace them. PNNL's energy innovations are aimed at helping the nation transition from a carbon-based economy to one that is substantially fueled by domestic renewable energy and zero-emissions sources. We are providing the science, technology, and leadership to enable large-scale and environmentally neutral use of hydrocarbons, biomass, and expanded nuclear energy use.

Getting a grip on the grid. When the power goes out at home, it's a hassle. When the power goes out to an entire region, it's a crisis. The Electricity Infrastructure Operations Center at PNNL brings together industry-leading software, real-time grid data, and advanced computation in a fully capable control room. New technologies developed there will be transferable across the industry to address the national need for a reliable and secure energy grid that can meet growing demand and supports integration of renewable resources.

One such development was the GridWise® demonstration project, which put power into the hands of the consumer—allowing them to save money while helping the grid. As part of a study, small integrated circuits were installed in washers and dryers and water heaters in homes in Washington and Oregon. The controllers automatically detected and responded to stress on the

electric grid by temporarily turning off specific functions like the heating element in the dryer. The study found that the technology acted like a shock absorber for the grid and could help prevent or reduce the impact of power outages.

In another portion of the study, homeowners became active participants in managing

the energy grid. With automated control technology that responded to real-time pricing information, consumers customized their energy use based on their desired level of comfort and economy. The result: the peak demand for power dropped by 15 percent over the duration of the year-long study.

Left: PNNL researchers at the Sequim Marine Sciences Laboratory, on the coast of Washington state, investigate the effect of metals, mercury, and other contaminants on aquatic life.

Below: Using powerful supercomputers, researchers unleash the power of data to understand electrical grid patterns, underground contamination movement, climate change, and other complex problems.





Laboratory experiments confirm that carbon dioxide can be trapped when injected into basalt formations. Capturing carbon dioxide and other emissions from energy generation processes and storing them deep underground is one way to reduce the levels of greenhouse gases being released into the atmosphere.

Revolutionizing Environmental Science

We're developing science and solutions to predict and mitigate environmental effects, accelerate waste cleanup, and create a more sustainable future.

911 for H₂O. Water supports agriculture, hydropower, and recreation. But population growth and climate change are threatening water quality and quantity.

PNNL is tackling these problems by evaluating the effects of pollutants on marine life, identifying safe levels of trace substances in water, and restoring coastal habitats. We use satellites and other remote sensing techniques to map, measure, and model what happens in ocean and coastal environments. Our work also provides a scientific foundation for Pacific Northwest stakeholders to make better water allocation decisions.

A key asset is PNNL's Sequim Marine Sciences Laboratory, on the Olympic Peninsula of Washington state. There, we apply integrated earth and energy systems modeling, water treatment technologies, and scientific decision support systems.

Canary in the coalmine. Changes in the environment often show up in subtle ways. These changes, known as environmental biomarkers, may signal a biological response to pollution, changes in the environment, or deliberate release of toxic substances, such as terrorism. Environmental biomarkers are the next generation of risk assessment tools, a faster way to find changes in the environment. Our scientists are discovering and implementing environmental biomarkers to predict ecosystem change and damage.

From Lab to Market

As part of our mission to serve national needs, we know that innovation drives our nation's competitiveness. We understand the link between technology and business. After all, we've "seeded" more than 130 companies that use technology or leadership originating from the Laboratory. And we have received 69 Federal Laboratory Consortium awards for Excellence in Technology Transfer—by far the most of any DOE national laboratory.

We make it easy for industry to work with us. Businesses partner with us through collaborative research, license agreements, technology assistance, and Cooperative Research and Development Agreements.

Commercial solutions. One of PNNL's most important products is the intellectual property that its staff members generate almost daily. A familiar example is the compact disc. The fundamental technology algorithms for the CD were invented at PNNL and eventually licensed worldwide.

Today, companies are using our technologies to extract power from the environment to monitor critical structures and remove mercury from waste streams. Our technologies are also improving manufacturing efficiency at one of the world's largest food processors and creating custom-fitted clothing based on exact body measurements.

High-tech help. PNNL economic development programs have helped hundreds of technology businesses start and grow. With PNNL support, these companies have advanced products, acquired new customers and contracts, obtained access to funding sources and strategic partners, and secured specialized facilities and staff.

We participate in economic development programs because we believe a healthy technology economy is essential for U.S. competitiveness. As a national laboratory, it's also our responsibility. With access to government-funded resources, more high-tech businesses can start, grow, and thrive.

A national laboratory at your service.

Our annual budget outlay is approximately \$880 million. About 60 percent supports DOE missions in science, energy, the environment, and national security. About 30 percent comes from other federal agencies in security, defense, and other areas. We collaborate with industry and universities to advance fields such as bioproduct development, catalysis, atmospheric science, cybersecurity, and power grid operations.

"As an entrepreneur, I see working with a national laboratory as a unique opportunity to take innovative technologies already in existence and market them for commercial use. Pacific Northwest National Laboratory has a track record of developing viable technologies and shepherding them through the commercialization process."

Mike Lyons,
CEO, Future Point Systems and
Silicon Valley venture capitalist

The Power of a National Laboratory

PNNL has been called a national treasure in the Pacific Northwest and beyond. The Laboratory is headquartered at the main campus in Richland, Wash. Other offices are at the Marine Sciences Laboratory in Sequim, Wash., and in Seattle, Wash., Portland, Ore., College Park, Md., and Washington, D.C. Battelle, a global science and technology enterprise

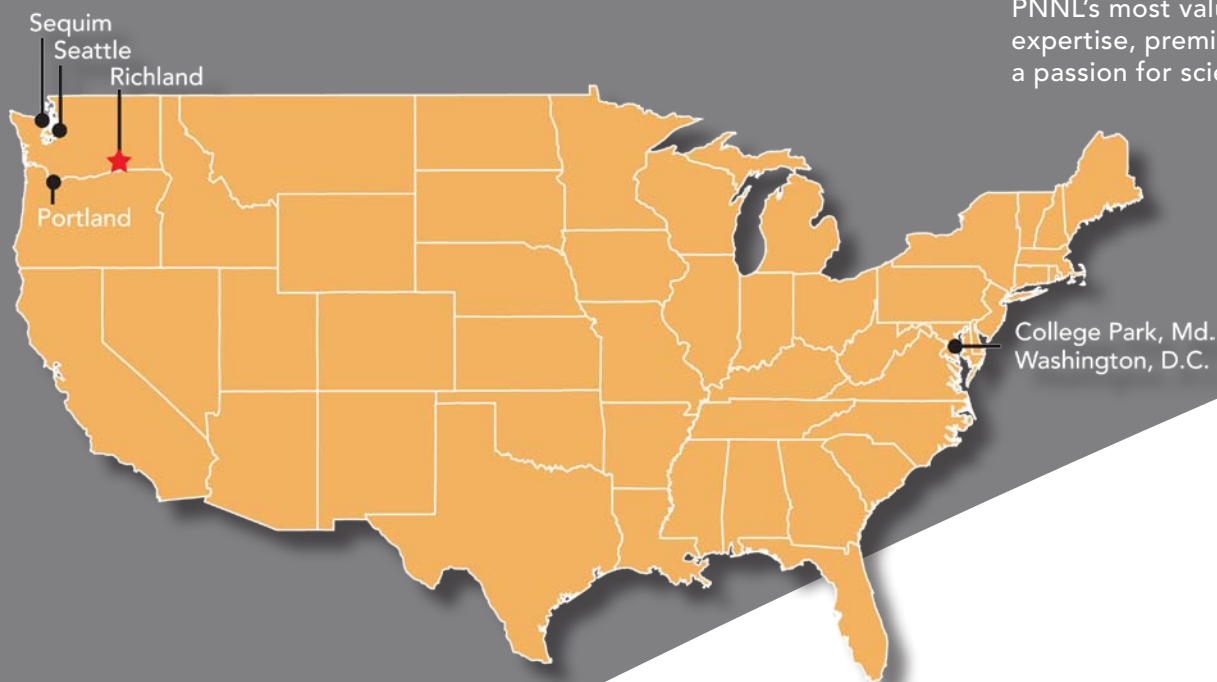
headquartered in Columbus, Ohio, manages the Laboratory for the Department of Energy.

Our scientists and engineers help resolve some of the nation's most difficult science, energy, transportation, homeland security, and environmental issues. We collaborate with other research organizations, universities, industry, and government agencies on efforts ranging from individual projects to formal joint research institutes.

Our researchers mentor hundreds of students annually, nurturing the next generation of scientists and engineers.

Since 1965, Battelle has given more than \$19 million back to the communities around PNNL, much of it to science education. These donations complement the Laboratory's work to transform the way science is taught in schools both regionally and nationally.

Everything we do promotes scientific discovery, provides educational opportunities, and benefits from PNNL's most valuable assets—our expertise, premier facilities, and a passion for science.



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