



Top: PNNL researchers are solving critical national issues in the remediation of contaminated soils and groundwater.

Bottom: The Marine Sciences Laboratory at Sequim, Wash., is a key PNNL science and technology resource. Researchers study issues such as pollution effects on marine and freshwater organisms, ocean processes, climate change, and habitat restoration.

### Nuclear regulatory support for energy and safety needs

A “nuclear renaissance” is under way in America and around the world as nations recognize the increasingly urgent need for carbon-free and relatively inexpensive electricity. In the United States alone, more than 30 new reactors are on the drawing board. That may not be enough. Nuclear energy currently provides about 20 percent of America’s energy mix. To maintain that level of production for our nation’s growing energy needs, it’s estimated more than 180 new reactors must come on line by 2050.

PNNL, a long-time partner of the U.S. Nuclear Regulatory Commission (NRC), stands ready to apply its environmental analysis and nuclear safety capabilities to help facilitate the construction of new reactors. We already play a leading role in the NRC’s environmental review process for siting new reactors, and will assist the NRC with application and license reviews, safety analysis reviews, and new reactor design certifications.

We also must continue to enable safe operation of the nation’s existing reactors. PNNL will provide expertise related to structural integrity, materials performance, and emergency preparedness. And, looking to the future, we will work with the NRC and the international community to identify research needs for safely extending reactor life. PNNL will support efforts to maximize

America’s fuel resources for nuclear reactors, focusing on the recovery and enrichment of uranium.

Our work on these fronts and others will help make it possible for the United States to add 30 gigawatts of nuclear generating capacity to its energy portfolio.

### PNNL: Leading the way in environmental research

For more than 40 years, our staff, facilities, capabilities, and approach to research have established PNNL as a premier science and technology enterprise. In the search for environmental solutions, we’re especially proud of our unique ability to marshal interdisciplinary research teams, collaborate with public and private partners, and leverage research funding to maximize results.

To learn more about Pacific Northwest National Laboratory and the resources we offer, contact:

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# SOLUTIONS FOR THE ENVIRONMENT



PNNL provides science, technology, and leadership to reduce environmental effects of human activity and create sustainable systems.



Above: Researchers at PNNL's Radiochemical Processing Laboratory, a Hazard Category 2 non-reactor nuclear facility, are advancing solutions in radioactive and hazardous waste cleanup, nuclear fuel processing and disposal, and medical isotope production.

Cover: PNNL's environmental research seeks to protect water resources. Water sampling is conducted in support of studies into groundwater and river interactions and the effects on river ecology.

## Environment, energy, and economics.

These factors, vital to a prosperous society, perhaps have never been so intertwined and interdependent. Globally, natural resources are harder to come by, energy use and carbon emissions are increasing, and economies, in response to these challenges, ebb and flow.

Environmental quality is an increasingly important component in the mix. Today, in America and many other nations, there is greater recognition that without clean air, land, and water it may not be possible to meet future energy demands, economic objectives, and expectations about quality of life. Concerns about climate change and the impacts of human activity on the planet's environmental health have increased the sense of urgency to find solutions that can be deployed quickly and economically.

Research at the U.S. Department of Energy's (DOE's) Pacific Northwest National Laboratory delivers solutions that protect the environment, provide new energy options, and strengthen economic viability for current and future generations. Specifically, PNNL is making a difference in the areas of environmental health and remediation, sustainable environmental systems, and safe expansion of nuclear power.

## Environmental health and remediation for legacy waste cleanup

PNNL's roots extend back to the 1940s. Early research laboratories at the Hanford Site in southeastern Washington State delivered science and technology for plutonium production processes, in support of the Manhattan Project. This groundbreaking work also yielded unique science and engineering capabilities in areas ranging from chemical separations and radiation detection to environmental monitoring.

Today, these world-leading capabilities, which have grown and evolved over time, are part of our science foundation at PNNL. We are known for our contributions and expertise in chemical and nuclear processing, subsurface science and remediation, radiation dosimetry (measurement of human exposure), and related disciplines. We have effectively applied these capabilities to the task of cleaning up radioactive waste at Hanford and other DOE sites. Environmental cleanup at Hanford remains a long-term challenge; PNNL is committed to delivering science and technology solutions to help ensure progress.

Noteworthy examples of recent PNNL work at Hanford include advances in vitrification science and technology, collection and analysis of subsurface geophysical data to predict earthquake ground-motion response, and delivery of hazardous waste processing knowledge. PNNL is developing an improved understanding of waste processing through scaled testing with actual waste in PNNL's Radiochemical Processing Laboratory, and via simulated waste testing at larger scales. All of these contributions have been important to the Hanford Waste Treatment Plant, a facility that will use vitrification technology to encapsulate radioactive and chemical waste in glass for long-term storage.

As part of our vision to deliver national impact, we not only will help solve the challenges presented by our past, but direct new science and technology solutions to current and future needs in critical areas such as nuclear energy and carbon management. For instance, we are studying methods to sequester carbon deep underground. The concept of injecting and storing carbon dioxide in subsurface basalt formations could provide a key carbon management solution.

We will continue to use our scientific and technical expertise to address environmental threats, such as contamination, to water resources. We have provided solutions for

water quality issues impacting the Columbia River, which traverses the Hanford Site and remains a key regional source of hydropower production, irrigation, and municipal water. As this work continues, we will transfer the knowledge we gain to protect other water resources, regionally and nationally.

We're also exploring advanced radiation dosimetry techniques that will lead to next-generation tools for measuring radiation exposure in internal organs and tissues, with applications in workplace and public safety.

## Sustainable environmental systems to protect precious natural resources

Environmental sustainability is the ability of Earth's natural resources to continue to support human life for the indefinite future. Natural resources are critical not only to life itself, but to energy development and other human needs. For many years, environment research at PNNL has provided technology and management solutions to the stewards and users of the nation's natural resources.

As part of the nation's growing attention to safeguarding environmental quality and sustainable development of natural resources, water is of particular concern. Future energy development and economic growth relies on clean water supplies, the efficient management of hydropower systems, and exploration of new waterpower energy systems, such as wave, tidal, and in-stream generation.

Toward this aim, we will marshal our capabilities to better understand water behavior and management issues, and tap our strengths in resource forecasting, environmental analysis, and environmental engineering to help ensure sustainable use of water resources for electrical generation. We also will identify methods to maximize water supplies and promote practices, such as efficiency and advanced water

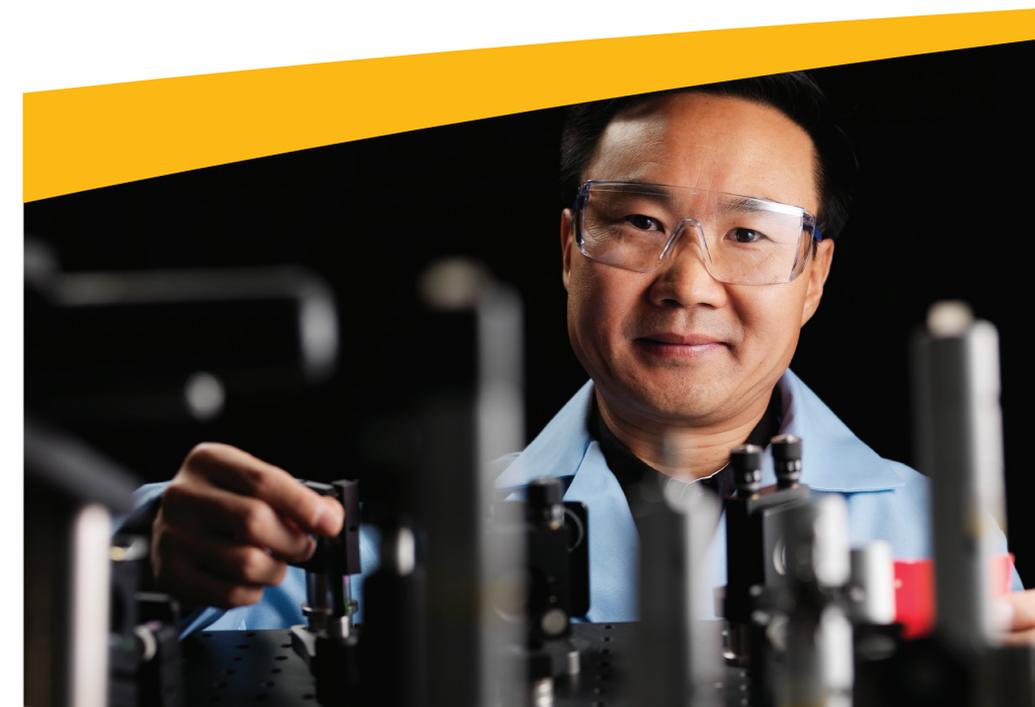
treatment, that decrease water demand. As new waterpower sources are explored and deployed, we will place emphasis on understanding and mitigating the environmental effects of those developments.

Technologies such as our award-winning Functionalized Nanoporous Thin Films (FNFTF) represent one innovative approach for helping to ensure abundant, clean water supplies. FNFTF offers the ability to test water for virtually every heavy metal that could harm human health or the environment.

For broader environmental concerns, we will apply advanced sensor systems and data fusion to assess the condition of natural resources. We also will perform environmental modeling that combines interrelated factors, such as climate, hydrology, biology, and economics, to gain a better picture of environmental impacts from population growth,

resource exploitation, and other issues—helping inform important future resource decisions.

Along with sensor and modeling capabilities, our efforts to protect environmental resources will be reinforced by signature capabilities in subsurface and surface science, as well as expertise in environmental effects analysis and prediction, computational fluid dynamic modeling, process chemistry and engineering, and marine sciences. PNNL's Marine Sciences Laboratory at Sequim, Wash., DOE's only marine research facility, is delivering new knowledge and solutions for freshwater and saltwater environs. A key focus of MSL capabilities will involve predicting and mitigating the impacts of tidal and ocean wave/wind energy systems on coastal ecosystems.



The Environmental Molecular Sciences Laboratory, a DOE national scientific user facility located at PNNL, offers many research resources, including the Environmental Spectroscopy and Biogeochemistry Facility. Here, researchers investigate the biogeochemical reactions of contaminants to solve environmental remediation challenges.