

Science.

Technology.

Innovation.

PNNL Solves Big Challenges with Tiny Technologies

Micro chemical and physical technologies

Smaller really is better. Tiny heat pumps, combustors, and other miniaturized devices can be used to create efficient, highly portable technologies. Pacific Northwest National Laboratory (PNNL) and our collaborators develop micro-technologies to solve our clients' tough challenges, from portable cooling systems for soldiers to highly efficient chemical manufacturing plants.

Highly Portable Devices

Scientists at PNNL are creating micro-scale heat exchangers, heat pumps, combustors, fuel processors, and other devices.



Developed to provide fuel for a return trip from Mars, the Reverse Water Gas Shift System is a tiny fuel plant with applications in the petrochemical industry and the hydrogen economy.

By reducing the size of a technology and improving the performance, PNNL creates portable power systems, chemical processors, and environmental cleanup technologies for the field. For example, soldiers must perform precise activities under extreme heat or cold. We routinely work with military clients to design systems that meet their rigorous requirements.

For the U.S. Army, we are designing a portable cooling unit that is 60% lighter than other systems. This technology could be used by individuals in the field as well as at mobile command and communications centers. This system is powered by a fuel processor that provides 10 to 100 W of base-load electric power for weeks or months.

For space travel to Mars, PNNL researchers have developed microtechnologies that will collect carbon dioxide from the Martian atmosphere, react it with hydrogen carried from Earth, and produce fuel (methane) and oxygen for the return voyage.

Fuel-Efficient Components

With concerns over pollution and fuel costs rising, automobile manufacturers, electronics manufacturers, and power companies need long-lasting, efficient ways to generate and distribute energy. To help our clients use gasoline, butane, and

**Pacific Northwest
National Laboratory**

Operated by Battelle for the
U.S. Department of Energy



Extensive Intellectual Property Portfolio

Since the early 1990s, researchers at PNNL have built an intellectual property portfolio of over 50 microtechnology-related patents or patent applications.

Battelle, which operates Pacific Northwest National Laboratory for the U.S. Department of Energy, holds these patents.



An R&D 100 award winner, the palm-sized MicroHeater can provide heat for indoor devices such as baseboard heaters and in-line water heaters.

other fuels more efficiently, PNNL has created compact microchannel combustors, steam reformers, and heat exchangers. One embodiment has a volume of 4.9 liters and can process gasoline or diesel to produce a hydrogen-rich gas that a fuel cell can use to produce up to 5 kW of power.

PNNL developed a prototype 0.2-kg palm-sized heater for residential and commercial buildings. Ten times smaller and lighter than conventional combustors, this heater can produce 30 W of heat per square centimeter of external combustor area. Distributed throughout a building, these heaters reduce ducting and zoning thermal losses by 45% while burning fuel more efficiently, lowering costs, and reducing emissions. Companion development work could provide cooling.

Customized Teams to Solve Your Unique Problems

To solve our clients' challenges, PNNL creates customized teams. The Laboratory does this by drawing upon expertise from a broad range of scientific and technical disciplines, including

biology, chemistry, chemical and mechanical engineering, computational science, and regulatory compliance. We also collaborate with universities and other institutions.

Easy Collaboration, Easy Contracting

Through our agreement with the U.S. Department of Energy, PNNL is able to work with government or private clients on proprietary and non-proprietary topics. For example, PNNL and Oregon State University have formed the Microproducts Breakthrough Institute in Corvallis, Oregon. The institute focuses on commercializing microtechnology-based products developed at both PNNL and OSU.

The institute is an integral part of the Oregon Nanoscience and Microtechnologies Institute (ONAMI), Oregon's first signature research center for growing research and commercialization to accelerate innovation-based economic development in the Pacific Northwest. ONAMI includes universities, state government, industry, and PNNL.

As part of our collaboration, PNNL can provide intellectual property provisions under standard or customized agreements. The Laboratory can license existing intellectual properties and, as warranted and mutually agreed, can manage jointly held OSU/PNNL properties.

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<http://www.pnl.gov/microproducts>
<http://environment.pnl.gov>