The Promise of Fusion Energy

Development of a fusion reactor would deliver a carbon-free, abundant energy source that could eliminate electricity shortages as global demands for power increase. But harnessing the power of fusion energy—which has eluded scientists for decades—faces numerous technological hurdles in an attempt to bring the same reactions that power the sun to Earth.

Oak Ridge National Laboratory plays a significant role in fusion technology. As part of the ITER project, ORNL leads the US ITER project office and oversees US research and development contributions to ITER. ORNL also has a fusion science program to pursue challenges beyond ITER that need to be addressed to bring fusion power to the grid.

Paving a Path Forward

ORNL has established an integrated approach to investigate obstacles to fusion energy. This effort uses the laboratory's preeminent expertise across multiple scientific disciplines—from materials science and programmatic leadership to high-performance computing and nuclear engineering—to produce a significant impact on the future of fusion energy.

- **Materials**—Scientists are creating novel materials—through traditional and advanced manufacturing techniques—for potential use in future fusion reactors.
- **Computing**—Researchers at the Oak Ridge Leadership Computing Facility are using the world's fastest computers to develop new tools for modeling fusion devices.
- **Blanket Technology**—ORNL is establishing a program to develop first wall concepts and close the fuel cycle.
- **Plasma Measurement and Control** —Researchers are pursuing new tools and techniques to control and measure hot plasma—the heated matter created inside a fusion device.

2019
Launch of ORNL-led INFUSE, a program encouraging private-public research partnerships for fusion energy development

10
MW/m^2 heat flux produced by MPEX—similar to what spacecraft experience reentering Earth's atmosphere

1971
ORMAK, ORNL's first tokamak, begins operation in pursuit of fusion technology

79%
Increase in the global use of electricity by 2050

"Fusion is effectively trying to replicate the sun in a bottle. It's one of those world-changing things where everybody wins if we get it to work."

David Green,
Computational Physicist

OAK RIDGE National Laboratory
U.S. DEPARTMENT OF ENERGY | Office of Science

Collaborating with the Fusion Industry

Over the past few years, the United States has experienced a dramatic increase in private companies interested in fusion technology. To encourage collaboration in overcoming challenges, the Department of Energy's Fusion Energy Sciences program established the Innovation Network for Fusion Energy (INFUSE) program in 2019.

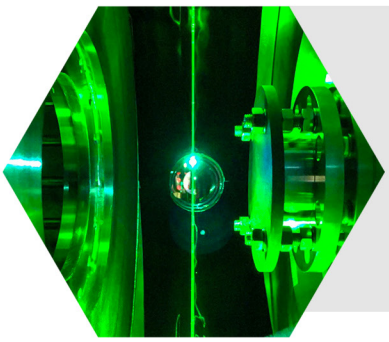
The ORNL-led program is focused on accelerating fusion energy development by funding private-public research partnerships between industry and DOE's national laboratory complex. As part of its first awards, INFUSE selected 12 projects to each receive between $50,000 and $200,000 in funding, with a 20% project cost share for industry partners. Additional rounds of funding are expected in 2020, with projects addressing various issues, including new and improved magnets, plasma diagnostic development, and modeling.

INFUSE | Innovation Network for Fusion Energy

The ORNL-led Innovation Network for Fusion Energy program, or INFUSE, is focused on accelerating fusion energy development through research collaborations between industry and national laboratories.

It's a Material World

Materials capable of withstanding the harsh environment inside a fusion power reactor remain a major hurdle to the future of fusion energy. ORNL is leveraging its decades of materials science and nuclear engineering experience to design the Materials Plasma eXposure Experiment facility. The facility will produce extreme heat fluxes to test materials that could be used in fusion energy devices. Currently, Proto-MPEX—the forerunner to the MPEX machine—is laying the foundation. With MPEX, fusion scientists will have access to a groundbreaking facility unlike anything else in the world.



Scientists use a laser to measure the temperature and density of the plasma created at the Proto-Materials Plasma eXposure Experiment. The facility is used to test materials that could protect the plasma- facing walls inside fusion reactors.

ORNL is performing research and development to overcome the various challenges in developing fusion energy technologies—from creating tools to better model entire systems to investigating promising new materials.

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