$20.3 MILLION

DOE Funding at Vanderbilt in FY 2019

Vanderbilt research is helping to shape the future of American manufacturing

Vanderbilt is playing a key part in the multistate, $259-million Institute for Advanced Composites Manufacturing Innovation that is led by the University of Tennessee–Knoxville. The institute is funded by the Department of Energy and is developing cost- and energy-efficient composite materials and technologies for high-volume production industries, such as automotive manufacturing. Much of Vanderbilt's work for the institute is taking place at the Laboratory for Systems Integrity and Reliability. The goal of Vanderbilt's work is to develop systems that automatically diagnose and fix quality control issues in composites manufacturing processes, including 3D printing, recyclable composites, and carbon fiber production. Vanderbilt has designed and deployed a Mobile Lab composed of state-of-the-art instrumentation and data analytics tools to address the needs in manufacturing quality control of its composites institute's partners across the country.

Partnering with Oak Ridge National Laboratory

ORNL is the largest national laboratory in DOE's system. Vanderbilt is one of the UT–Battelle Core University Partners, a select group of seven southeastern universities that work closely with ORNL to jointly appoint faculty with common scientific interests, support collaborative research, train graduate students, and provide regional support for ORNL in the state of Tennessee. Dr. Padma Raghavan, vice provost for research, serves as Vanderbilt's representative on the UT–Battelle Board of Governors, which oversees management of ORNL and works closely with ORNL leadership to promote collaborations.

Jason Valentine, associate professor of mechanical and electrical engineering, serves as the core university liaison with ORNL. Vanderbilt and ORNL are strongly committed to their ongoing research partnership. Current activities by Vanderbilt researchers at ORNL include use of the Spallation Neutron Source, the nanotechnology laboratories, and the TITAN and SUMMIT supercomputers for engineering, chemistry, physics, biochemistry, and cell biology research. These growing collaborations leverage our complementary strengths and have the potential to drive innovation and address challenges of national importance.

Nuclear power plants contain miles of pipes of different sizes which make it difficult to spot a failing pipe before further damage occurs. (Tennessee Valley Authority)

In tandem with ORNL, an engineering professor, whose research involves building statistical models of whole brain data sets, has received a competitive research grant from Oak Ridge Associated Universities—a consortium of American universities that provide innovative scientific and technical solutions to advance national priorities in science, education, security, and health.

Alert system for failing nuclear plant pipes uses thin films and sound vibrations

A failing pipe can be tough to spot. It may cause a puddle, produce another sign of damage, or simply burst before detection. A flooded kitchen or laundry room is messy and inconvenient, but the stakes are much, much higher in nuclear power plants—which, on average, contain many miles of pipeline. As concern about aging plants escalates, Vanderbilt engineers are working on an early warning system with support from DOE's Nuclear Energy Enabling Technologies program. They are using polymer coatings on the inside of the pipes and 3D-printed polymer devices infused with nanoparticles on the outside of the pipes as sensors to signal changes in the polymer film occurring inside the pipes. To detect these changes, the team developed a proactive technique using sound, or vibrometry.

Consortium for Risk Evaluation with Stakeholder Participation

CRESP is one of the nation's leading independent, interdisciplinary research groups focused on the waste management and environmental legacy from production of defense nuclear materials and nuclear energy. Vanderbilt is leading this multi-university consortium of engineers, scientists, and legal and policy experts who have contributed over the past 25 years to the progress being made in addressing the nation's largest environmental liability. With the support of DOE, these nuclear waste experts leverage their knowledge to help the U.S. find safe ways to effectively manage nuclear waste from both defense nuclear materials production and civilian nuclear power sources. They see this as a critical component of environmental responsibility, including as a needed foundation for future nuclear power generating capabilities. The work at CRESP requires engineers, scientists, and policy experts to understand the complete life cycle of nuclear power generation, weapons production, and environmental impacts from nuclear weapons tests. Academic research through CRESP educates undergraduate, graduate, and post-doctoral students while carrying out foundational research needed to improve the efficiency and effectiveness of the cleanup program.

Life in evolution's fast lane

Most living things have a suite of genes dedicated to repairing their DNA, limiting the rate at which their genomes change through time. A Vanderbilt team, supported by the DOE Office of Science Biological and Environmental Research Program, has discovered an ancient lineage of yeast that appears to have accumulated a remarkably high load of mutations. This yeast—which is closely related to baker's yeast—has lost large numbers of genes involved in repairing errors in DNA and cell division that were previously thought to be essential. These losses are particularly surprising because mutations in the human versions of many of these genes dramatically increase the rates of different types of mutations and lead to cancer. This ancient lineage has diversified and thrived, despite having lost many of the genes previously thought to be essential; it may represent a novel system for studying cellular life without them.

Nanoscale origami: Smallest-ever, atomically precise structures set stage for quantum breakthroughs

If you think learning traditional paper origami is a difficult practice, try wrapping your head around origami on the atomic scale. An international team of researchers, including Vanderbilt physicists, with support from the DOE Office of Science Basic Energy Sciences Program and DOE's National Energy Research Scientific Computing Center, have accomplished just that, using sophisticated and precise control of atoms to experiment with new structures and set the stage for future generations of breakthroughs in quantum technology. Researchers have long sought to apply origami techniques to small atomic structures, including graphene—a two-dimensional semimetal and "supermaterial" capturing the attention of researchers around the world for its properties of tensile strength, flexibility, and impermeability.

Vanderbilt partners with major players in advanced nuclear reactor research

Experts in nuclear environment engineering from Vanderbilt University and ORNL are part of a public-private partnership that has been awarded up to $40 million from DOE to explore, develop, and demonstrate advanced nuclear reactor technologies to help America meet its goals for carbon emission reduction. The research is aimed at developing molten chloride fast reactors, an advanced concept for nuclear power generation that researchers believe will provide enhanced operational performance, safety, security, and economic value when compared with other advanced reactor concepts. The project is intended to mitigate key technical risks through integral effects and materials tests; to develop a conceptual design and license application for a test reactor; and to conduct preliminary safety analyses, manufacturing readiness evaluations and supply chain and infrastructure assessments to support deployment.

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