Small-Scale Energy Storage
Researchers in the Department of Electrical Engineering at the University of Maryland are working on new technologies that will allow for the efficient storage of energy on small scales. This is crucial for applications such as portable devices, vehicles, and homes. The research focuses on developing new materials and methods for storing energy in a compact and efficient manner.

Researchers are exploring the use of advanced materials such as metal-organic frameworks (MOFs), which can store and release energy in a controlled manner. These materials have the potential to store more energy per unit volume than traditional batteries. Additionally, researchers are developing new methods for charging and discharging energy storage devices, such as fast-charging technologies that can recharge batteries in a matter of minutes instead of hours.

The goal of this research is to develop highly efficient and durable storage devices that can be integrated into a wide range of applications, from portable electronics to electric vehicles. The Maryland team is working closely with industrial partners to bring these technologies to market and make them accessible to consumers.
WIND TURBINE AERODYNAMICS

Professor Greg Bryan Eichhorn, at the University of Maryland, is working on improving wind turbines’ aerodynamics.

CONSTRUCTION AND MACHINING

Professor Mohammad Modarres, an expert in rotating-wing aerodynamics, is investigating approaches to make rotors and blades more efficient.

PLASMA PHYSICS

The Center for Plasma Physics, sponsored by the DoE, examines the plasma dynamics of high-temperature, magnetically confined plasmas. It is led by Dr. William Dorland, a physicist at the University of Maryland, and the center’s principal investigator is Dr. Reinhard Radermacher, a physicist at the University of Maryland, College Park.

NUCLEAR SAFETY

The Center for Nuclear Reactor Safety Science, co-directed by Mohammad Modarres and Dr. Steve Fetter, focuses on developing the software needed to make nuclear power plants safer.

MATERIALS SCIENCE

To view all of the latest research on energy at the University of Maryland, go to http://energymaryland.umd.edu.
Wachsman has expanded UMERC’s capabilities, reaching out to faculty from chemical and physical sciences, public policy, computer science, social science, and agriculture to join a core group of researchers in the Center for Technological Change. “Energy research and development are vital to America’s economic competitiveness, and public and private partnerships will be key to sustainability,” he adds.

“Energy research and development are vital to America’s economic competitiveness, and public and private partnerships will be key to sustainability,” he adds. Key resources and programs that enhance energy research and energy innovation at the University of Maryland include:

**resources, capabilities & innovation**

**Building an “Energy Economy”**

In the United States, energy may be as crucial as— or even more than— clean air in determining the future of the nation. It is the public policy imperative, and the social issues that have the public’s attention.

A variety of energy research projects and public policy initiatives at the University of Maryland are designed to foster new energy innovations and policies that will meet the country’s growing need for energy security and sustainability.

**Key resources and programs that enhance energy research and energy innovation at the University of Maryland**

**Overview**

Wachsman is using experimental approaches to improve the performance of fuel cells, which operate on hydrogen, which will allow them to integrate better with existing fuel infrastructures. The University of Maryland is using experimental approaches to develop fuel cells that operate on hydrogen, which will allow them to integrate better with existing fuel infrastructures.

**Wind Turbine Aerodynamics**

An expert in rotating-wing mechanics, J. Gordon Leishman is leading several experimental wind turbine projects at the university, which are focused on aerodynamic design. His work at the university has focused on developing more efficient rotors and wind turbines.

**Nuclear Safety**

The Center for Nuclear Research, established in 1976, provides a unique environment for researchers to study nuclear energy and policy. It offers the opportunity to work with other researchers and to develop new partnerships.

**Policy Physics**

The Center for Policy Physics, led by William Dorland, examines the policy implications of the DoE’s efforts to advance fuel cell research and development. The Center for Policy Physics offers an interdisciplinary approach to policy analysis and is a key resource for policy makers and researchers.

**Shining a Light on Energy Research**

To view all of the latest research on energy at the University of Maryland, go to www.energymaryland.edu.
WIND TURBINE AERODYNAMICS

An expert in rotating-wing aerodynamics, J. Stephen Leishman’s laboratory develops computer simulations that enhance the efficiency of wind turbines. The Center for Environmental Research Computing, housed in the Greenough Hall, supports these efforts. A former dean of public policy at the University of Maryland, Steve Leishman has expanded the University of Maryland Energy Research Center’s (UMERC) capabilities, including its focus on clean-energy research and development.

MAKING THE LIGHT BULB BRIGHTER

The Center for Environmental Research Computing, or CEREC, is the University of Maryland’s gateway for energy research. Since arriving at Maryland last year, Steve Leishman has turned the center into a powerhouse of clean-energy research and development.

NUCLEAR SAFETY

The Center for Nuclear Research (CNRC), led by Mohammad Modarres, focuses on the development of advances for improving the safety of nuclear reactors. The center’s work is supported by the Department of Energy’s (DOE) Office of Nuclear Energy (NE).

ALTERNATIVE BIPOLAR TECHNOLOGIES

Since arriving at Maryland last year, Steve Leishman has turned the center into a powerhouse of clean-energy research and development.

WASTE TREATMENT BIOREACTORS

Bryan Eichhorn is a top expert in biological wastewater treatment. His team has developed advanced water-treatment technologies, including devices for collecting, storing, treating, and reusing water.

PLASMA PHYSICS

The Center for Plasma Physics and Fusion Energy (CPPFE), led by William Dorland, is a Top 10 facility in fusion and plasma research. Dorland is using experimental and theoretical approaches to tackle some of the most challenging problems in plasma physics.

> THE UNIVERSITY OF MARYLAND AND ENERGY RESEARCH CENTER, OR UMERC, COORDINATES CAMPUSSIDE ENERGY RESEARCH UNDER THE DIRECTION OF ERC WACHSMAN.

GREG LEISHMAN

Dr. Greg Leishman is the director of the University of Maryland Energy Research Center (UMERC), a multidisciplinary and cross-disciplinary team of researchers from the University of Maryland A. James Clark School of Engineering, which administers the center.

JON GUTMAN VERITY

The Key resources for the UMERC are the Maryland Technology Enterprise Institute, or Mtech, and the Maryland Technology Enterprise Institute, or Mtech, which provides funding for getting energy innovations to the marketplace. Mtech helps research faculty, students, and entrepreneurs to form new companies that can commercialize the research and development.

MTECH

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Small-Scale Energy Storage

Researchers in the department for Electrical Energy Storage from UM are developing nationwide leadership for the field, using nanostructured materials and advanced technologies to address the storage capacity of today’s devices. The key, says director David Rubloff (above left), is to carefully design and build materials that can capture and deliver energy much faster than anything currently in use, says Rubloff.

“With the demand for next-generation electrical energy storage expected to grow, existing energy storage devices and infrastructure will need to be rapidly expanded to accommodate the load,” he added.

The center, which includes UM faculty from engineering, chemical and materials science, is part of a national effort by the U.S. Department of Energy to develop next-generation technologies and systems that can convert electrical energy into heat, heat into flow, and flow into mechanical work. “We want to develop next-generation electrical energy storage devices that are not only compact but also make minimum demands on the grid,” Rubloff said. “If a new device will need to be added to the grid, it must be compatible with the existing system.”

The researchers expect to answer these questions and design energy storage devices that could be used in transportation, including all-electric vehicles, and in the development of more efficient grid systems. “The key is to train a new generation of scientists in the United States,” Rubloff said. “The center is designed to build a new generation of researchers who will lead the next generation of technologies.”

Sustainable Biofuels

Maryland students are busy preparing for the 2011 Solar Decathlon, a DoE-sponsored competition that invites 20 student teams from around the world to design, build and operate an energy-efficient solar-powered house.

The Maryland team is using experience gained from a 2007 UM entry, which took first place nationally and second place worldwide, as it finalize its plans for the 2011 competition. The University of Maryland’s 2011 entry will be guided by a set of shared scientific principles, including a conception of the house and its surrounding site as a living system, particularly exciting, Tilley says, is that the students’ work will be showcased to the public at the Maryland Solar Decathlon competition in October in Washington, D.C. “It’s a great opportunity for students to learn about the design process and how to make a product work in the real world,” Tilley said.

The center, which includes UM faculty from engineering, chemical and life sciences and computer, mathematical and physical sciences as well as experts from architecture, is part of a new program that brings together groups of leading scientists to address fundamental research issues.

RESEARCH & EDUCATION spotlight

Maryland researchers shape the new energy economy

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UM Team Readies for 2011 Solar Decathlon

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Sustainable Biofuels

Researchers at the University of Maryland are busy preparing for the 2011 Solar Decathlon, a biennial competition that invites 20 student teams from around the world to design, build and operate an energy-efficient solar-powered house.

The Maryland team is using experience gained from the 2007 UM entry, which took first place nationally and second place worldwide, as it finalizes its plans for the October 2010 competition on the National Mall in Washington, D.C.

“It’s a great opportunity for students to learn about a field they might not have known anything about before,” says Amy Gardner, associate director for research development at the university’s Office of the Vice President for Research and a faculty adviser from architecture who is principal investigator on the project. “It provides an experience that can’t be duplicated in the classroom.”

Maryland’s 2011 entry will be guided by a set of shared principles that include a commitment to the house and its surrounding site as a living system, making sure nature is prominent in the how the house is designed, operated and inhabited; and embracing technologies that lack an established power grid. “It’s a great opportunity for students to learn about a field they might not have known anything about before,” says Amy Gardner, associate director for research development at the university’s Office of the Vice President for Research and a faculty adviser from architecture who is principal investigator on the project.

“Testing the new energy economy” is one of the mid-Atlantic research community’s priorities, says Jeanette J. Nelson, the university’s vice president for research and a faculty adviser from architecture who is principal investigator on the project. “Testing the new energy economy” is one of the mid-Atlantic research community’s priorities, says Jeanette J. Nelson, the university’s vice president for research.}

**Small-Scale Energy Storage**

Researchers in the Materials for Electrical Energy Storage (MFEES) are part of an Energy Frontier Research Center, funded by the national laboratory’s Office of Science, that aims to design and develop advanced materials and technologies to store and transport energy. The center brings together groups of leading scientists to address energy issues. The MFEES program that brings together groups of leading scientists to address energy issues is as part of a new federal initiative. The center’s mission is to develop new materials and technologies to store and transport energy, particularly from renewable sources like the sun and wind.

“Researchers in the Nanostructures for Electrical Energy Storage center, one of 46 Energy Frontier Research Centers nationwide funded by the DoE, seek more efficient ways to store energy, particularly in small-scale devices that could be used in transportation, including all-electric vehicles of the future that demand battery materials with 10 times the storage capacity of today’s devices.”

The center—which includes laboratory facilities in engineering, chemistry and the sciences and computer, mathematics and physics sciences—will conduct research in four areas: materials; design, fabrication and processing; measurement and characterization; and real-world applications. For more information, visit www.umd.edu/energy.

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“The researchers expect to answer these questions and design energy storage devices that could be used in transportation, including all-electric vehicles of the future that demand battery materials with 10 times the storage capacity of today’s devices.”

“This is an opportunity to work on a project that will have a real-world impact,” says Gary Rubloff, associate director for research and a faculty adviser from architecture who is principal investigator on the project. “The researchers expect to answer these questions and design energy storage devices that could be used in transportation, including all-electric vehicles of the future that demand battery materials with 10 times the storage capacity of today’s devices.”

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