

What's Happening
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Amped Up!

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U.S. DEPARTMENT OF
ENERGY | Energy Efficiency &
Renewable Energy

EERE's Clean
Energy Manufacturing
Initiative Launches

Energy Materials Network

Sparking a
Revolution in
Clean Energy
Materials

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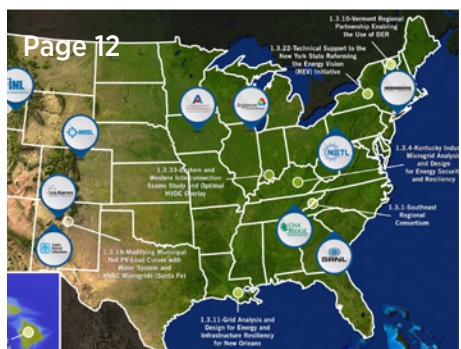
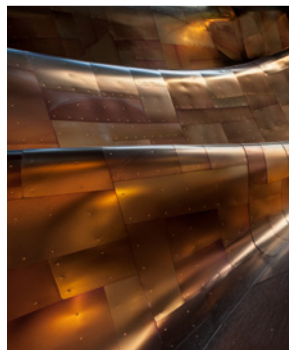
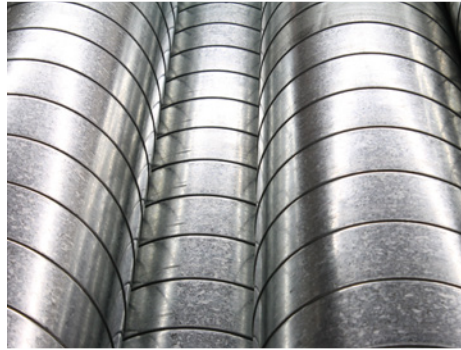
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A Message from Dave



Dear EERE Family,

Welcome to the first *Amped Up!* issue of 2016, which holds great promise to be EERE's most exciting year yet. Together, we will cap off an unprecedented eight years of progress in clean energy for the nation.

In his final State of the Union address, President Obama highlighted the central role that clean energy is already playing in driving the world's economic growth. He posed this question: "Why would we want to pass up the chance for American businesses to produce and sell the energy of the future?"

Indeed, the invention and manufacturing of clean and renewable energy technologies represents the greatest economic opportunity of the 21st century. We have made tremendous progress in reestablishing American leadership in manufacturing, with more than 900,000 new manufacturing jobs created since the president took office in 2009.

In this issue, you'll learn more about our Clean Energy Manufacturing Initiative (CEMI). One of my top priorities as assistant secretary, this effort is focused on dramatically increasing U.S. competitiveness in the manufacturing of clean energy technologies, in addition to improving American manufacturing competitiveness for all companies by significantly increasing industrial energy productivity.

Through CEMI, we have launched an unprecedented network of clean manufacturing research and development (R&D) consortia that are laying the foundation for an era of American dominance in the industry, including the establishment of three new innovation institutes in President Obama's National Network for Manufacturing in the areas of power electronics, advanced composites, and smart manufacturing. We've also set up two new high-impact manufacturing demonstration facilities with our national labs, focused on additive manufacturing (such as 3-D printing) and high performance computing power.

The development of advanced materials is at the heart of enabling continued rapid cost reduction and growing U.S. manufacturing leadership in the next generation of clean energy technologies. With this opportunity in mind, we recently launched our third major R&D effort under CEMI, the Energy Department's Energy Materials Network (EMN). This national lab-led network of new materials acceleration R&D consortia will focus on dramatically reducing the time it takes to invent, develop, and manufacture game-changing new materials for clean energy through the use of key new tools like advanced computation, modeling, and simulation and other emerging high throughput materials discovery approaches. By building an enduring, accessible network, EMN will address market deployment challenges and help create competitive, made-in-America products.

You'll find more coverage in this issue on the work we are doing to strengthen clean energy manufacturing. This includes an exciting partnership to manufacture 3-D printed wind turbines; a profile of Etosha Cave, a talented engineer who we are supporting through the groundbreaking Cyclotron Road program; and much more.

I'm confident that you'll come away from this issue with a renewed understanding of how investing in clean energy ensures that the clean energy jobs of tomorrow are created right here in America. Let's make 2016 EERE's most groundbreaking year yet!

Dave

Amped Up is a bimonthly newsletter on the latest developments within EERE and is brought to you by EERE's Communications Office; do not cite or release without prior approval. If you have any suggestions or comments about what you would like to see in this newsletter, please contact eeAmpedUp@ee.doe.gov.

ENERGY MATERIALS NETWORK



With a commitment to double the speed and reduce costs of developing and deploying new advanced materials, President Barack Obama launched the Materials Genome Initiative in 2011. Here, he tours the Orion Energy Systems, Inc. in Manitowoc, Wisconsin in 2011 as an operator demonstrates the final stage of light fixture assembly. Source: White House/Samantha Appleton

Accelerating Materials Innovation & Advanced Manufacturing

From the development of cell phones to the creation of artificial organs – none of these advancements would be possible without innovative research on advanced materials. Yet bringing a new material to market can take decades and significant investment.

In 2011, President Barack Obama launched the [Materials Genome Initiative](#) (MGI), a multi-agency approach aimed at doubling the speed and cutting the cost of discovering, developing and deploying new advanced materials to address challenges in diverse domains—such as clean energy, health and human welfare, national security, and workforce development. Since the launch of MGI, federal agen-

cies, including the Energy Department, have invested more than \$250 million in new research and development to ensure U.S. leadership in materials.

In addition to MGI, the Obama Administration's [Advanced Manufacturing Partnership](#) (AMP) convenes industry, academia, and the federal government to identify and report on how public-private partnerships could invest in emerging technologies to strengthen the U.S. advanced manufacturing sector. In 2014, the re-chartered partnership, AMP 2.0, recognized materials innovation in industrial applications as a key part of U.S. manufacturing competitiveness and recommended that private and public sectors work collaboratively to

share and leverage expertise, capabilities, and data.

By implementing both White House imperatives, the Energy Department's Office of Energy Efficiency and Renewable Energy (EERE) is fulfilling its mission to create and sustain American leadership in the transition to a global clean energy economy while strengthening U.S. manufacturing competitiveness.

Since the launch of MGI, federal agencies, including the Energy Department, have invested more than \$250 million in new materials R&D

Sparking a Revolution in Clean Energy Materials

High performance materials hold the key to innovation in many critical clean energy technologies. But with ambitious national targets to reduce America’s carbon footprint, advanced materials’ traditional 15-20 year time frame to get to market isn’t keeping pace with America’s goals to achieve a clean energy economy.

“At the core of virtually every problem we tackle at the Energy Department, there is a materials challenge,” said Deputy Assistant Secretary for Transportation Reuben Sarkar. “Whether it’s a better battery, a lighter material, or a new fuel cell technology – materials underlie almost everything that we do, so shifting the paradigm from traditional materials research to an acceleration-focused strategy is crucial.”

The Energy Department is taking a different approach to materials research and development (R&D) by aiming to better integrate all phases of R&D, from discovery through deployment, and by facilitat-

ing industry access to its national laboratories’ resources. In support of the Obama Administration’s Materials Genome Initiative and the Advanced Manufacturing Partnership 2.0, multiple technology offices within EERE are enabling the launch of the Energy Materials Network (EMN). EMN is a targeted, growing network of consortia led by the national labs that is aiming to solve industry’s toughest clean energy materials challenges.

Through the [Clean Energy Manufacturing Initiative](#) (CEMI), an effort to increase U.S. competitiveness in the manufacturing of clean energy technologies, EERE is launching four EMN pilot consortia in 2016, centered on specific classes of clean energy materials. These initial research efforts will focus on:

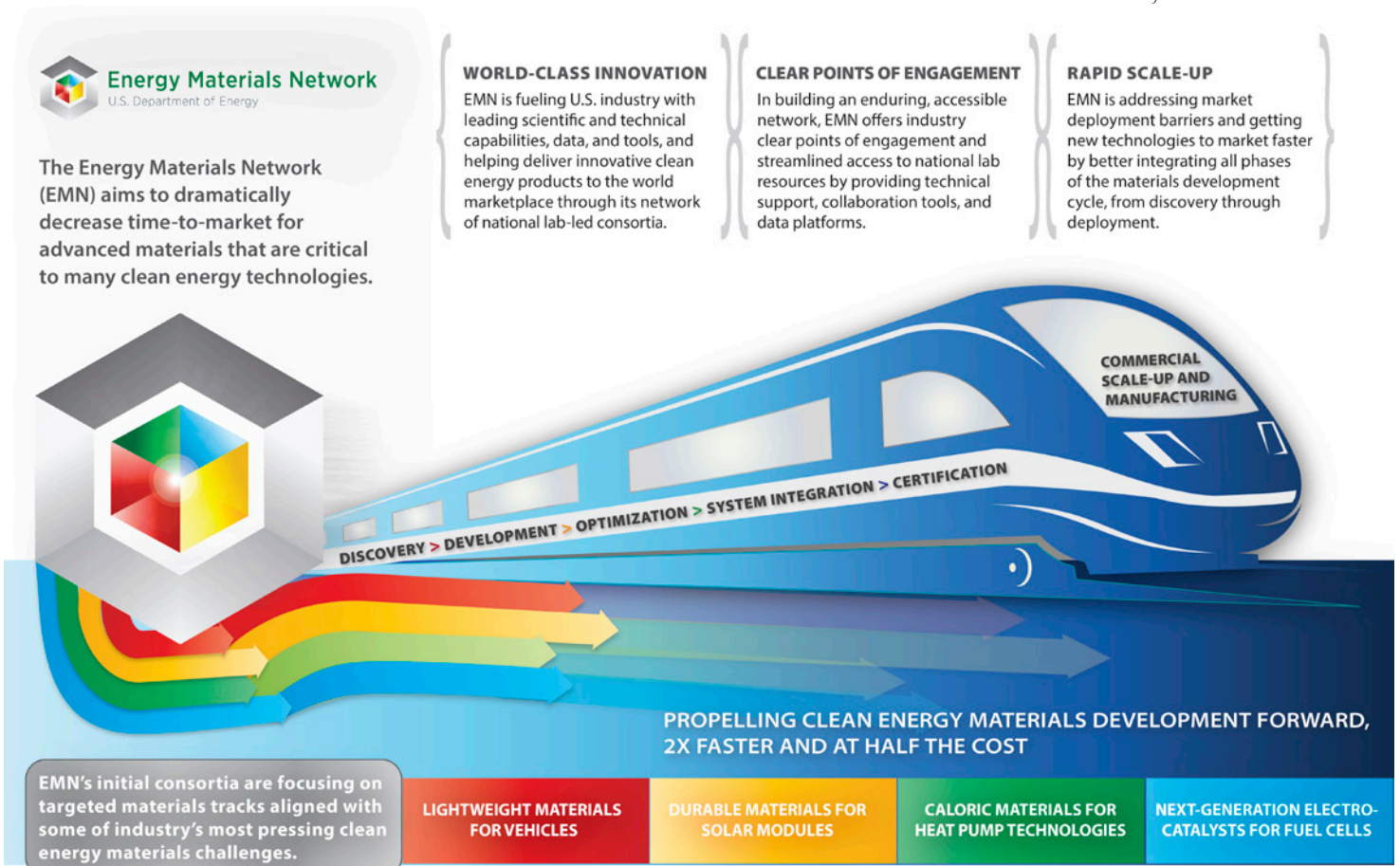
- Low-cost magnesium sheet alloys and processes compatible with automotive manufacturing
- Next-generation catalysts for fuel cells that are free of platinum group metals

- Caloric materials for use in energy-efficient and environmentally-friendly heat pump technologies
- New coatings, encapsulants and flexible packaging that enable innovative, durable, and bankable photovoltaic module form factors.

(See more on the descriptions of each consortia on pages 6-7)

Through well-known partnership mechanisms, such as competitively selected projects funded by the Energy Department, these EMN consortia will match stakeholders from industry and academia with specific capabilities found only at the national labs. These capabilities include materials design, synthesis, characterization, manufacturing, and digital data management and informatics—all EMN priorities needed to accelerate materials development at a fraction of the cost.

“Our goal is to catalyze a movement that changes the United States’ approach to materials research,” said Sarkar.



EERE is launching four EMN pilot consortia in 2016, centered on specific classes of clean energy materials.

LIGHTWEIGHT MATERIALS FOR VEHICLES

“Magnesium alloys have been used for structural systems since World War II. Despite excellent weight reduction potential, magnesium alloys make up less than 1% of the weight of an average vehicle today. Access to these advanced resources at the labs can help push application of magnesium to much greater heights.”

William Joost, Program Manager



IMPACT

Every 10% reduction in weight improves vehicle fuel efficiency by about 7%. While many materials can reduce weight, magnesium (Mg) alloys offer the potential for a 50% reduction when compared to conventional steels. However, many technical challenges prevent the application of Mg such as high cost, difficulty in manufacturing components, and poor corrosion performance.

LABS AND RESOURCES

In order to accelerate the use of Mg alloys in vehicles, the national labs offer resources such as fine-scale and atomic resolution characterization, assessment of chemical reactivity and performance, and detailed exploration of mechanical properties. The consortium will spend its first year focusing on Mg alloys and then develop other lightweight technologies in the future.

VEHICLE TECHNOLOGIES OFFICE

DURABLE MATERIALS FOR SOLAR MODULES

“This is an excellent opportunity to bring together researchers and develop the infrastructure to make more durable PV modules.”

Lenny Tinker, Program Co-Manager

“Being able to predict and rapidly advance durable coatings and module materials will ultimately lead to significant cost reductions of PV energy.”

Dana Olson, Program Co-Manager



IMPACT

With materials already accounting for 40% or more of the total cost of photovoltaic (PV) modules, substantial opportunities exist to engineer materials with improved performance and lifetime at reduced costs, enabling significant reductions in the cost of PV energy. Targeted materials would include advanced anti-reflective coatings, encapsulants, flexible packaging, and low-cost alternatives to glass substrates that can maintain performance across decades of harsh operating conditions.

LABS AND RESOURCES

The consortium will drive innovation across computational material property predictions and design, data informatics, as well as high throughput synthesis and characterization through integration of lab, university, and PV industry facilities and capabilities in order to rapidly develop new durable module materials.

SOLAR ENERGY TECHNOLOGIES OFFICE

CALORIC MATERIALS FOR HEAT PUMP TECHNOLOGIES

“It facilitates a move from today’s environmentally burdensome refrigerants toward a better environmental and energy efficient solution.”

Tony Bouza, Program Co-Manager

“Materials discovery underpins the transformative technology development and deployment strategy of this consortium.”

Nick Litombe, Program Co-Manager



IMPACT

Caloric materials underlie the potential for environmentally friendly and energy-efficient cooling technologies. These materials are solid-based, compared to traditional gas compression refrigeration. Applying magnetic fields, mechanical strains or electric fields cause caloric materials to experience a change in temperature. Accelerating the discovery of such materials for cooling could lead to 20%-30% reduction in U.S. energy demand for cooling end use.

LABS AND RESOURCES

The Advanced Manufacturing and Building Technologies offices will leverage the capabilities of Ames National Laboratory and other national labs in the field of caloric materials. These labs have world-class scientists using high throughput testing capabilities to innovate around novel solid-based energy conversion materials.

ADVANCED MANUFACTURING OFFICE /BUILDING TECHNOLOGIES OFFICE

NEXT-GENERATION ELECTROCATALYSTS FOR FUEL CELLS

“Expediting the development of PGM-free catalysts and electrodes will accelerate the deployment of fuel cells and other electrochemical energy conversion devices, making them a cost-effective strategy for reducing emissions from both the U.S. transportation and power sectors.”

Dimitrios Papageorgopoulos, Program Manager



IMPACT

Developing effective platinum group metal (PGM)-free catalysts by using cheaper, more abundant metals at an accelerated pace is the most pressing materials challenge related to fuel cell development. PGMs represent the current standard in fuel cell systems. They are expensive and restrict the ability to develop fuel cells that are cost-competitive with traditional hydrocarbon-based power sources.

LABS AND RESOURCES

Accelerating deployment of PGM-free catalysts will benefit from efficient collaboration of national labs that already have core competencies in developing PGM-free catalysts for fuel cells and in high throughput combinatorial methods. Automated tools guided by computational studies and researcher expertise will allow researchers to make and test promising catalysts at an unprecedented pace.

FUEL CELL TECHNOLOGIES OFFICE

3-D Printed Molds Hold Promise for Enhanced Wind Energy Manufacturing

EERE's Wind & Water Power Technologies Office (WWPTO) is teaming up with the [Advanced Manufacturing Office](#) (AMO), Oak Ridge and Sandia National Laboratories to explore additive manufacturing—also known as 3-D printing—in the production of next-generation molds for wind turbine blade manufacturing. The collaboration is part of the [Clean Energy Manufacturing Initiative's](#) (CEMI's) effort to increase U.S. competitiveness.

“Additive manufacturing represents a whole new realm of design for blade manufacturing,” said Megan McCluer, co-manager of the project. “You can design in features that were physically

impossible before, exploring complex shapes that are uniquely tailored to address the needs of blade fabrication. Even better, new designs can be produced quickly and cheaply compared to typical mold-making techniques.”

With more than 66 gigawatts of electricity—enough to power 15 million homes—that is generated across 39 states nationwide, the United States leads the world in wind energy. In fact, wind power represents a third of all new domestic electricity capacity since 2007, and it remains the fastest growing form of renewable energy. Wind currently provides 5% of U.S. electricity.

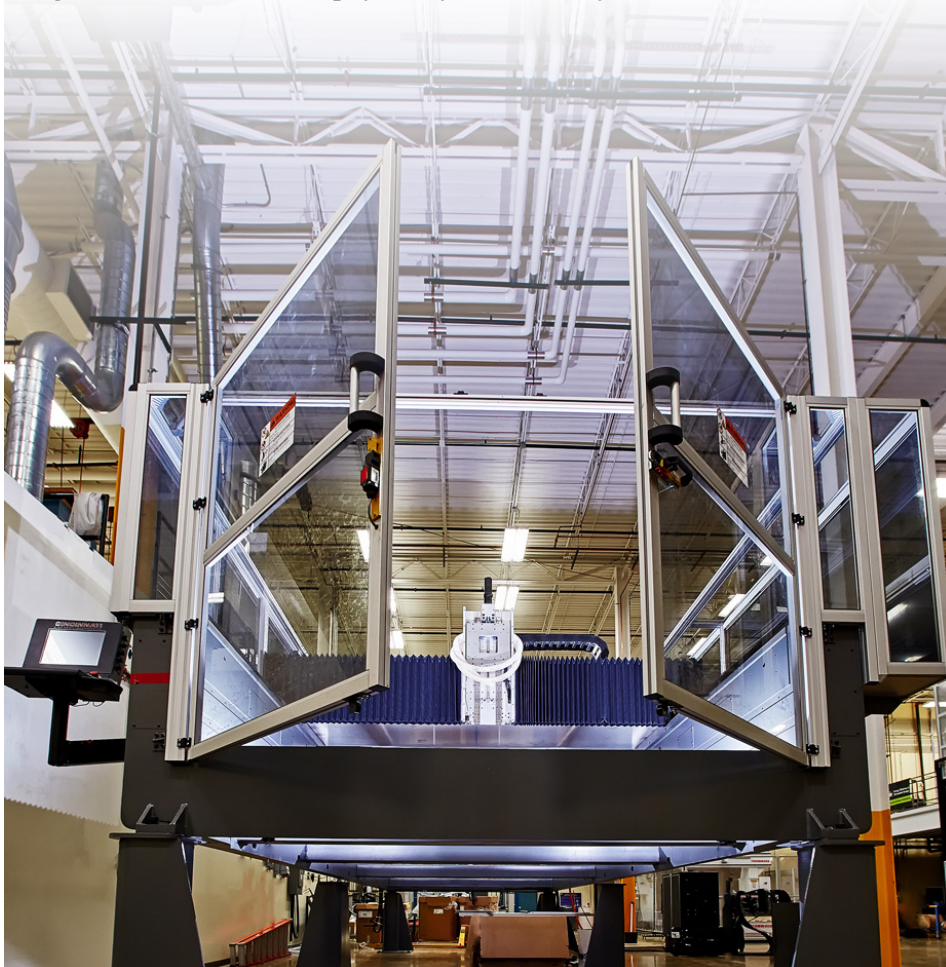
A trend toward [larger blades](#), up to 300 feet for offshore applications, is helping developers harvest a greater percentage of available wind that converts to more electricity per turbine. Yet the time and cost to produce these first-of-their-kind blades has sent the industry back to the drawing board, searching for a better system.

Currently, EERE's [wind program](#) is focusing on simplifying the manufacture of molds for turbine blades. Right now, a “plug” must be manufactured and then used to form a mold, from which fiberglass blades can then be made. Additive manufacturing can eliminate the need for a plug by applying 3-D printing technology directly to the mold process, which leads to a reduction in the time and cost required for blade manufacture.

The 3-D printing process deposits successive layers of composite material directly from a digital design file. This process reduces waste as material is deposited only where needed and not machined or drilled away unnecessarily. 3-D printing also allows much more freedom in the design phase by printing parts directly from computer-aided design files, enabling rapid design innovation.

BAAM Machine

AMO and WWPTO are working with the [Oak Ridge National Laboratory](#) (ORNL) to apply this 3-D printing technology to turbine blade molds by using its Big Area Additive Manufacturing (BAAM) machine at Oak Ridge's Manufacturing Demonstration Facility. The BAAM system, used to 3-D print the replica [Shelby Cobra](#),



was jointly developed by ORNL and Cincinnati Incorporated and is used to rapidly fabricate large structures up to nearly 1,000 cubic feet in size.

Mold components are a perfect fit for this process. While traditional methods can take six months to a year—requiring low-volume, labor-intensive construction—BAAM technology can produce larger molds within about two weeks at a reasonable cost.

“The BAAM system is unique compared to conventional machining and even other similar 3-D printers on the market,” said Blake Marshall, AMO’s co-manager of the project.

According to Marshall, BAAM is capable of printing polymer components up to 20 feet in length—over 10 times larger than other industrial additive machines. It’s also faster than similar industrial printers, depositing up to 1,000 cubic inches – or 100 pounds – of material per hour. Further, the printed composite costs only five dollars per pound, which is 50 times less than the cost of material for other printers. “The combination of size, speed, and cost are a great fit for the needs of blade manufacturers,” added Marshall.

Research and Development

The 3-D printed mold will be used to make scaled-down turbine blades designed to simulate the aerodynamic characteristics of a full-size turbine. The blades will measure 13 meters (approximately 43 feet) in length, but are designed to create a rotor wake that emulates a much larger rotor.

The research blades will undergo static and fatigue testing at the [National Renewable Energy Laboratory](#), and operate on wind turbines at the



Energy Department’s [Scaled Wind Farm Technology](#) facility in Texas. Researchers at the national laboratories will use the results to model wake aerodynamics and how performance can be affected by turbines in close proximity to each other.

Learn more on [energy.gov](#) about the Energy Department’s role in advancing wind energy through the [Atmosphere to Electrons Initiative](#)—a multi-year, integrated research effort designed to coordinate and integrate advances in wind plant performance, financial risk assessment, atmospheric science, and next-generation technologies.

Megan McCluer, with EERE’s Wind Program (left) and Blake Marshall, in Advanced Manufacturing, co-manage a project that is pushing the envelope on 3-D printing.

Cyclotron Road Catapults Young Energy Innovators' Ideas to Next Level



Cyclotron Road's first cohort of innovators includes co-founder Etosha Cave of Opus 12. Her team is on a mission to show how carbon dioxide could transform the future. Source: Fortune Brainstorm E

A program that creates a new pathway for energy innovators to take early stage technologies from lab to market has gained significant recognition from its first crop of researchers. Their six projects are producing exciting first year results including vital partnerships, capital, and scientific progress.

One innovator buoyed by the benefits of joining the [Cyclotron Road](#) program is Etosha Cave, whose startup Opus 12 has forged an important commercial alliance in Connecticut with the help of the pilot program supported by EERE's [Advanced Manufacturing Office](#) and the [Lawrence Berkeley National Laboratory](#) (Berkeley Lab). Cave and the other co-founders of Opus 12, Kendra Kuhl and Nicholas Flanders, are part of the program's first cohort.

This innovative program provides young energy researchers with a stipend and mentorship for two years and

access to the national lab for a total of five years, significantly reducing the time and cost required to get technology moving from lab to market. The first cohort drew the interest of 150 applicants in a three-week window, from which eight individuals were selected as Cyclotron Road innovators.

The Road to Innovation

Cave earned her master's and Ph.D. degrees in mechanical engineering at Stanford University. Her doctoral work focused on the conversion of carbon dioxide (CO₂), water, and electricity into high-value chemicals and fuels using metal catalysts. A National Science Foundation Graduate Research Fellow and a Ford Fellow, Cave teamed up with Kuhl and Flanders to found Opus 12 in 2014.

After some very hard work to develop their initial concept, the Opus 12 team submitted an application in August 2014 to participate in the Cyclotron Road program, and the rest is his-

tory. Opus 12 is one of six projects at Cyclotron Road, which provides mentorship and technical support to young energy entrepreneurs like Cave to take their breakthrough ideas to the next level.

In just over one year with Cyclotron Road, Cave's team has made exciting progress toward its goal to convert carbon dioxide to fuel. Her startup surpassed many of its initial technical milestones one to two years ahead of schedule, and it has developed a working prototype. The project swelled to five full-time team members and they hope to get additional funding in the near future.

"Everyone we spoke to said our project was too early and that we needed a working prototype," said Cave. "At the time, we were grad students working as a team on nights and weekends... we would not have been able to build our prototype without Cyclotron Road."

The Path Forward

Today, Opus 12 is focused on a product that has many potential applications. For one, it can be made into diesel fuel and is currently used by an eyeglass manufacturer to make lenses and the semiconductor industry. Key challenges for Cave and her team include optimizing conditions to make particular compounds, narrowing the scope to a specific product, and building a demonstration unit.

Her group has spoken with a lot of investors but the finance community wants to see a product that actually works, Cave says. Her team is now focused on “showing the world a unit that works,” and that “this team can execute.”

That’s where Cyclotron Road has been a real game-changer. She and her colleagues have the time and ability to focus on scaling and manufacturing challenges that they otherwise could not pursue. Another boon has been the critical mentorship and network support it affords the young researchers. Mentors help young

researchers define their projects and align them with an appropriate commercialization strategy, and Cave traces her team’s commercial ties to connections made by Cyclotron Road staff and mentors.

Thanks to those connections, Opus 12 has established vital ties with commercial partners in Connecticut and plans to begin integrating its technology with them starting in June. The team’s initial prototype is a hand-held unit that converts 100 grams of CO₂ per day. The demonstration unit that the team will produce with its partners will convert about 50 kilograms per day. The goal, Cave said, is to have a fully functioning demo in the field within two years.

Cave and her team imagine the day when carbon dioxide and water can be used to make plastic and liquid fuel. “We would effectively be creating an industrial carbon cycle where we take waste, CO₂, and make higher value products,” she said.

SELECTION OF SECOND COHORT NEARS

The second cohort of energy innovators vying for a spot in the pioneering Cyclotron Road program at the Lawrence Berkeley National Laboratory (Berkeley Lab) will be announced shortly. Plans call for an announcement of the finalists by early March.

The competition for the second cohort drew applicants from 16 different states with clean energy ideas on a broad spectrum of breakthrough technology areas. The pilot program was created to nurture technologies until they can succeed beyond the lab. Part of the Energy Department’s new energy innovation model, Cyclotron Road is supported by EERE’s Advanced Manufacturing Office and Berkeley Lab.

Cyclotron Road’s first cohort has made big strides during the first year of the pilot program. Just last month, Cyclotron Road project lead Marcus Lehmann and Opus 12 co-founder Nicholas Flanders were recognized on the 2016 Forbes 30 under 30 list. This list recognizes the brightest young entrepreneurs, breakout talents, and change agents in 20 different sectors.

Fun Fact

Nobel Prize-winning nuclear physicist Ernest O. Lawrence built the first cyclotron particle accelerator in the Berkeley Hills in the 1930s, ushering in a new era of scientific collaboration and invention. Cyclotron Road is building on that legacy, “creating a new home for best-in-class innovators to work on badly needed energy technology breakthroughs,” according to Ilan Gur, the director of Cyclotron Road.



Entrepreneurial researchers (left to right) and Opus 12 co-founders Kendra Kuhl, Etosha Cave and Nicholas Flanders are part of the Cyclotron Road program. Source: Cyclotron Road

Regional Demos to Support Grid Modernization Initiative

From behind-the-meter photovoltaic systems to nationwide transmission planning, the challenges facing America’s electric grid are diverse and specific to different parts of the country. To address the most pressing state and regional grid challenges, EERE and the [Office of Electricity Delivery and Energy Reliability](#) (OE) are investing in 10 Pioneer Regional Partnerships to help inform future research and development efforts outlined in the recently released [Grid Modernization Multi-Year Program Plan](#) (MYPP)—the Energy Department’s blueprint for modernizing the U.S. electric grid.

As part of the [\\$220 million Grid Modernization Initiative](#) (GMI) Lab Call, funded through the Grid Modernization Laboratory Consortium (GMLC)—a network of 14 national laboratories and partners—Pioneer Regional Partnerships cover the main objectives and priorities highlighted in the MYPP. These early-stage public-private collaborative projects address specific near-term grid modernization issues that are important to different U.S. regions and its stakeholders.

“These Pioneer Regional Partnerships are helping the Energy Department and the national laboratories kick-start our activities with state and regional stakeholders to ensure our efforts in grid modernization are relevant and impactful across the country,” said Kevin Lynn, director of Grid Modernization for EERE.

The partnerships, stretching from Vermont to Hawaii, will:

- Address a key state/regional grid modernization challenge that is currently visible and important to local industry and government stakeholders
- Facilitate collaboration from local stakeholders, utilities, and vendors to pursue a grid modernization outcome with links to GMI objectives
- Generally address multiple technologies and policy options important for grid modernization
- Offer the potential to provide data and lessons learned that support and inform subsequent regional grid modernization activities and ongoing GMLC cross-cutting projects.

Collectively, the portfolio for Pioneer Regional Partnerships has strong potential to accelerate statewide visibility and stakeholder networks to support the national grid modernization effort. Its geographic diversity also links Energy Department efforts with the full range of regional differences in terms of grid design, regulatory environments, and stakeholder priorities.

Energy Secretary Ernest Moniz announced in January the release of the MYPP and \$220 million in research and development (R&D) funding under the GMLC. These funds will fuel more than 80 projects to establish a comprehensive grid-related R&D effort to address a range of emerging challenges and opportunities in the nation’s power grid.



Selected Projects Underway

DISTRIBUTED ENERGY RESOURCE SITING TOOL IN CALIFORNIA

The Lawrence Berkeley National Laboratory will lead a multi-lab team delivering an integrated distributed energy resource (DER) planning and optimization platform to the California Public Utilities Commission, investor-owned utilities, and stakeholders. The online tool will identify meaningful behind-the-meter DER adoption patterns, potential microgrid sites and demand-side resources, and it will evaluate the impacts of high renewable penetration feeders on the distribution and transmission grid.



GRID ANALYSIS AND DESIGN FOR RESILIENCY IN NEW ORLEANS

With support from Sandia and Los Alamos National Laboratories, a team made up of local stakeholders including Entergy, a local utility, and the City of New Orleans will conduct technical evaluations to assess energy and critical infrastructure vulnerabilities. The project will also identify cost-effective options to improve the resiliency of both the electrical grid infrastructure and the community.



ENABLING THE USE OF DER IN VERMONT

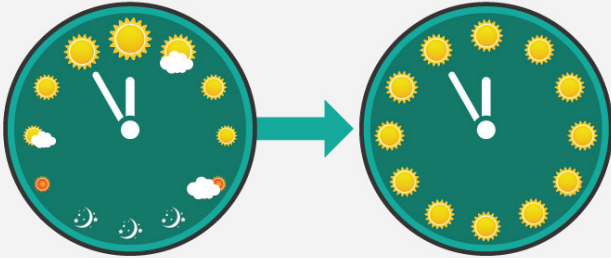
Sandia and the National Renewable Energy Laboratories are leading an effort to partner with Vermont utilities to meet their goals of obtaining 90% of its energy from renewable sources by 2050 through DER integration, DER control, validation of wind and solar forecasting and techno-economic analysis of energy storage.



New SunShot Program Makes 24-hour Solar a Reality

24-HOUR
SOLAR
ENERGY,


COMING TO
A ROOFTOP
NEAR YOU.



INTERMITTENT

DISPATCHABLE

[Click here to watch video on the SHINES program.](#)
▶



As part of the [Grid Modernization Initiative](#), EERE recently announced \$18 million in funding for [six new projects](#) that could make 24-hour solar energy available across the country. These projects are part of SunShot’s Sustainable and Holistic Integration of Energy Storage and Solar PV (SHINES) program, which aims to dramatically increase solar-generated electricity that can be dispatched day or night to meet consumer needs.

Today’s 100-year-old electricity system relies on central generation and distribution. Instead of solar feeding energy from one central location to thousands of customers, thousands of customers with photovoltaic (PV) rooftop panels are feeding energy to the grid. This reverse flow creates the need to reconfigure or upgrade grid infrastructure to handle larger amounts of distributed energy production.

SHINES addresses energy storage challenges. Because solar energy is only generated during the day, there is

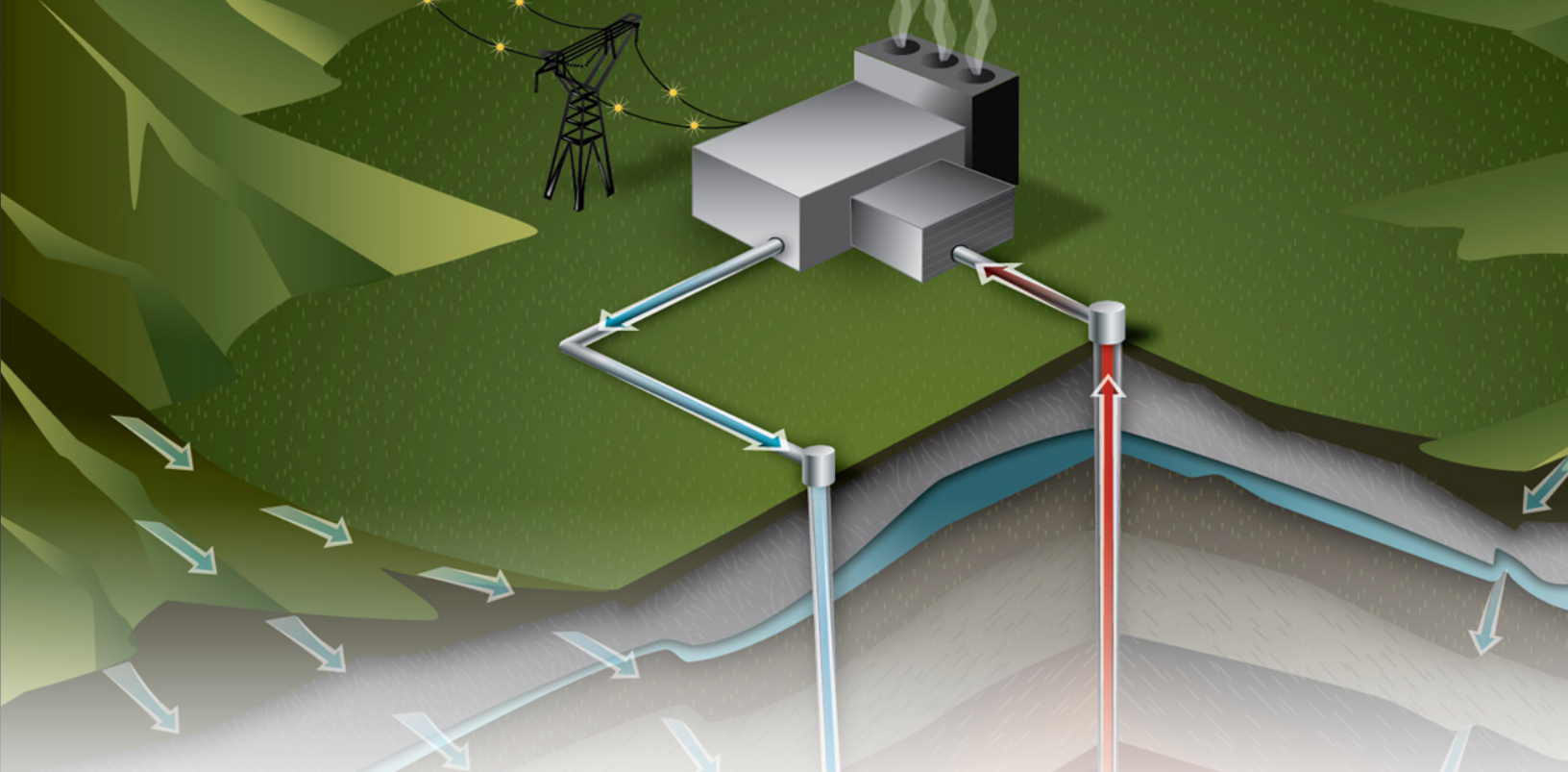
an influx of mid-morning energy that goes onto the grid and a drop when the sun goes down. These large swings in energy flow are currently difficult and expensive to accommodate. SHINES projects are investigating new integrated solutions that utilize batteries and smart inverters to enable more reliable solar energy generation.

Plans call for at least one year of field demonstrations of the SHINES solutions by utilities or their partners. Widespread adoption of these advanced solutions could eventually lead to hundreds of gigawatts of solar energy on to the grid.

“Energy storage, solar PV and smart grid technologies experienced incredible growth in 2015,” said EERE Assistant Secretary Dave Danielson. “We expect they will play an increasingly important role in reaching the nation’s climate and clean energy goals in the coming years.”

The [SunShot Initiative](#) is a national collaborative effort to make solar energy cost-competitive with other forms of electricity by the end of the decade.





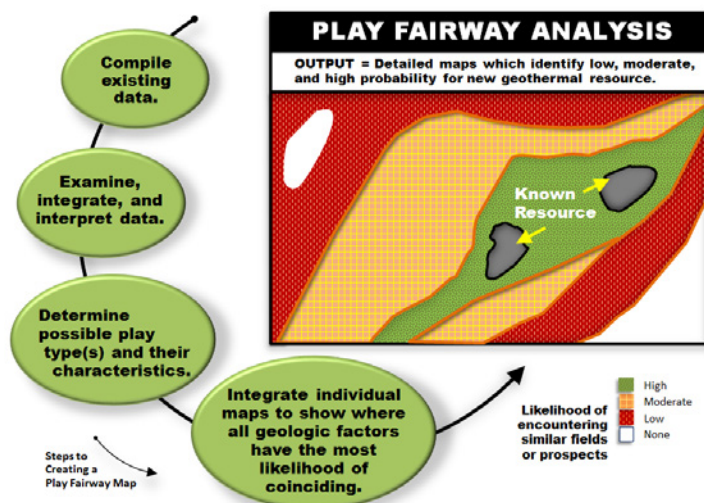
Play Fairway Analysis Identifies Hidden Geothermal Resource

To generate more geothermal electricity at lower cost and risk, EERE is exploring a method called play fairway analysis, a tool borrowed from the petroleum industry to map the known geologic factors most favorable to find a geothermal resource. The use of play fairway analysis could reduce costly drilling and improve the probability of successfully tapping the vital mix of high temperatures and water flow necessary to generate electricity from geothermal steam. By improving success rates for exploration drilling, this data-mapping tool will help attract investment in geothermal projects and significantly lower the cost of geothermal energy.

The [Geothermal Technologies Office](#) supports six projects currently underway that are focusing on quantifying and reducing uncertainties for better targeted geothermal drilling. Once identified, hydrothermal resources can be brought online quickly with current technologies, supporting the near-term expansion of renewable energy in America.

WHAT IS A GEOTHERMAL RESOURCE?

Geothermal resources are reservoirs of hot water that exist at varying temperatures and depths below the earth's surface. Mile or more deep wells can be drilled into underground reservoirs to tap steam and very hot water that can be brought to the surface for use in a variety of applications, including electricity generation, direct use, and heating and cooling. In the United States, most known and/or developed geothermal reservoirs are located in the western states. The lack of ability to accurately predict temperature and permeability at depth from the surface is a major cause of exploration risk. Subsurface imaging and characterization are critical to effectively capture all types of geothermal resources, including low temperature and coproduced, hydrothermal, and enhanced geothermal systems. EERE focuses on reducing these risks to make geothermal power a more competitive contender in the global race for clean energy.



EERE Innovation on Display at Washington Auto Show



Chevrolet displayed the Spark electric vehicle (left) at this year's Auto Show. Batteries developed at the Energy Department's Argonne National Laboratory are now commercially manufactured by a company that licensed the technology and supplies the Chevy Bolt (all-electric vehicle) and Volt, (plug-in hybrid electric vehicle) on opposite page, as well as the Ford Focus EV. New battery technologies allow plug-in electric vehicles to go further and are more affordable than previous ones.



In January, Energy Secretary Ernest Moniz visited the Washington Auto Show.

He celebrated achievements in clean energy enabled through Energy Department funding and announced new inroads that will continue to revitalize the American auto industry.

Last year alone, vehicle production in America doubled, creating 35,000 new jobs.



The Honda Clarity fuel cell electric vehicle (above) at the Washington Auto Show. Honda announced the Clarity as its first commercial fuel cell vehicle that will be leased and then sold, starting in California. Honda and other automakers are partners with the Energy Department in H2USA, a public-private partnership to enable hydrogen infrastructure.

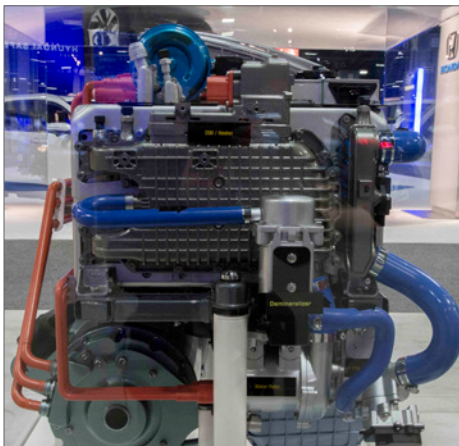


[Click here to watch Secretary Moniz at the 2016 Washington Auto Show](#) 

Energy Secretary Ernest Moniz (left) inspects the Ford Fusion. On the Multi-Material Lightweight Vehicle project, the Energy Department teamed with Ford and Magna to develop a concept vehicle that weighs nearly 25% less than the 2013 Ford Fusion. Reducing vehicle weight by 10% can improve fuel economy up to 7%.



Chevy Volt



The Hyundai Tucson fuel cell electric vehicle engine (left) is powered by hydrogen and emits only water. The Energy Department worked closely with national laboratories, research universities, and industry partners to advance reliable, low-cost fuel cell components for this high-performance vehicle. The Tucson (right) is commercially available to lease in California.



As part of the Energy Department's EcoCAR3 collegiate competition, 16 North American university teams are redesigning the Chevy Camaro to reduce its environmental impact while maintaining the muscle and performance of this American icon.

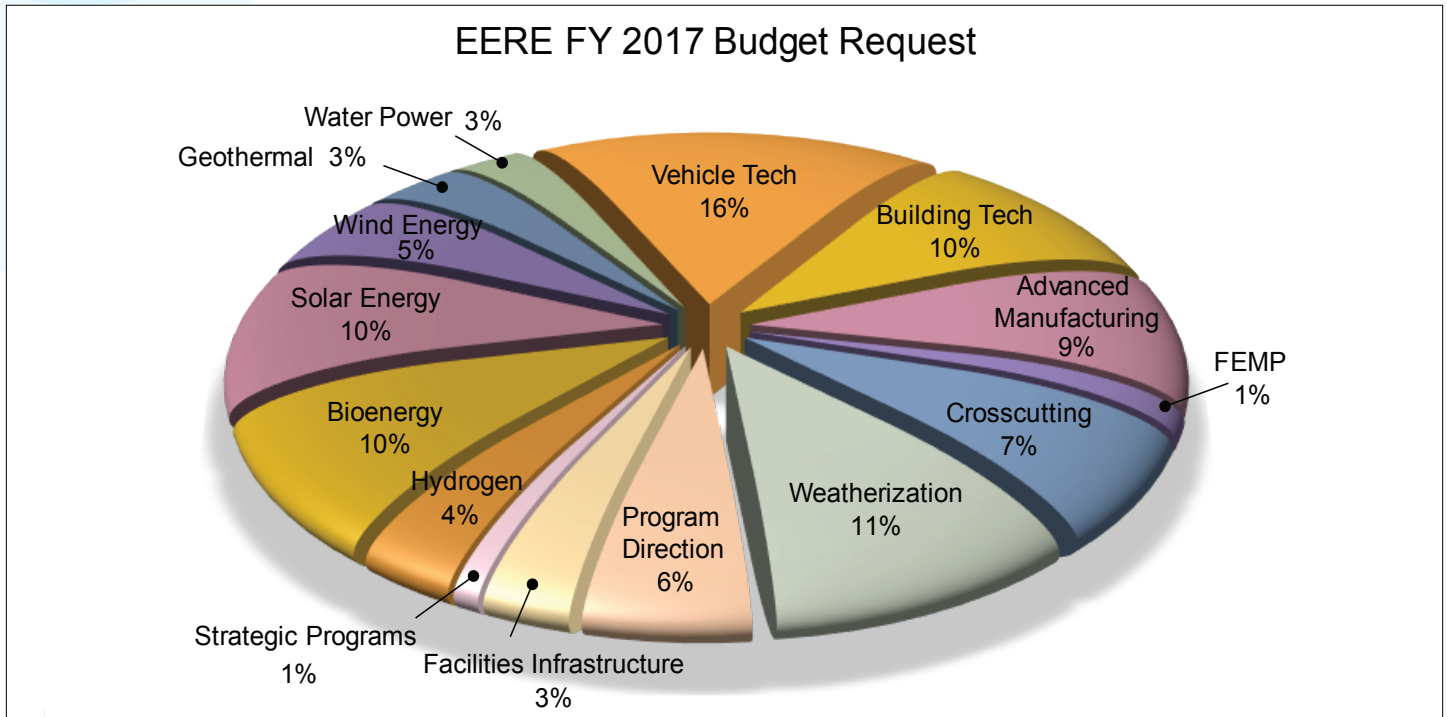
Hydrogen Fueling Gets a Boost

The Energy Department announced Jan. 29 SimpleFuel as the finalist for the \$1 million H₂ Refuel H-Prize Competition to deploy small scale, hydrogen generation and fueling systems and prepare them for testing.

SimpleFuel plans to develop a home scale refueler that can provide a 1-kilogram fill to vehicles in 15 minutes at 700 bar using hydrogen produced using water via electrolysis, with a design that minimizes setback distances and reduces the physical footprint of the system. SimpleFuel is a collaboration of three companies: Ivys Energy Solutions (Massachusetts), McPhy Energy N.A. (Massachusetts), and PDC Machines (Pennsylvania).

The H₂ Refuel H-Prize Competition challenges American innovators to deploy on-site hydrogen generation systems that use electricity or natural gas in homes, community centers, retail sites, or similar locations to fuel hydrogen vehicles. Visit www.hydrogenprize.org for more information.

Fiscal Year 2017 Budget Proposal Bolsters Clean Energy Innovation

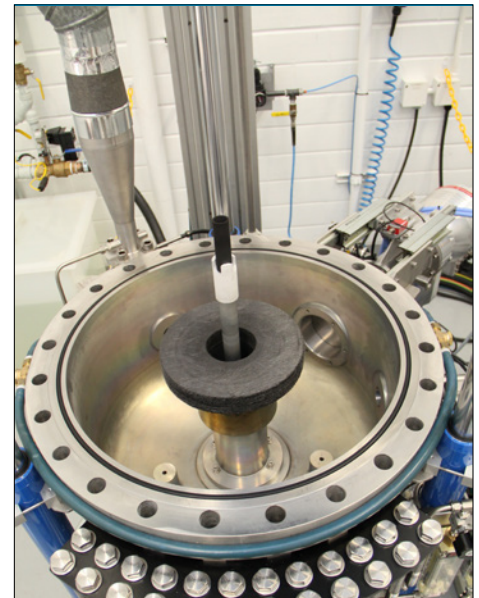


Proposed Energy Department investments will facilitate national goals to speed clean energy adoption and address global climate change.

EERE’s Fiscal Year 2017 budget request seeks a total of \$2.89 billion to sustain U.S. leadership in the transition to a clean energy economy, including \$215 million for crosscutting activities that would bolster the Mission Innovation initiative. [Mission Innovation](#), unveiled recently by President Obama and world leaders, is designed to speed clean energy innovation and address global climate change goals. Through the initiative, 20 countries are committing to double their respective clean energy research and development investment over five years.

EERE program funding keyed to Mission Innovation includes \$110 million to support partnerships targeting clean energy technologies for specific regions, and \$105 million for initiatives to accelerate technology development and innovation, partly through partnerships with the national laboratories.

The proposed Fiscal Year 2017 budget includes more than \$853 million for sustainable transportation technologies, \$621 million for renewable power, and \$919 million for energy efficiency technologies. The budget request also includes \$189 million for grid modernization activities, \$261 million for clean energy manufacturing research and development projects, and \$43 million for the Federal Energy Management Program to improve federal sustainability.



Science and engineering advances through the national laboratories are enabling more efficient clean energy manufacturing. Source: Ames National Laboratory

EFFICIENCY

New Report: Cost-Effective Benefits of Renewable Portfolio Standards

A [recent report](#) published jointly by Lawrence Berkeley National Laboratory and the National Renewable Energy Laboratory finds that renewable portfolio standards (RPS) have enormous environmental and economic benefits and impacts – saving the United States billions of dollars.

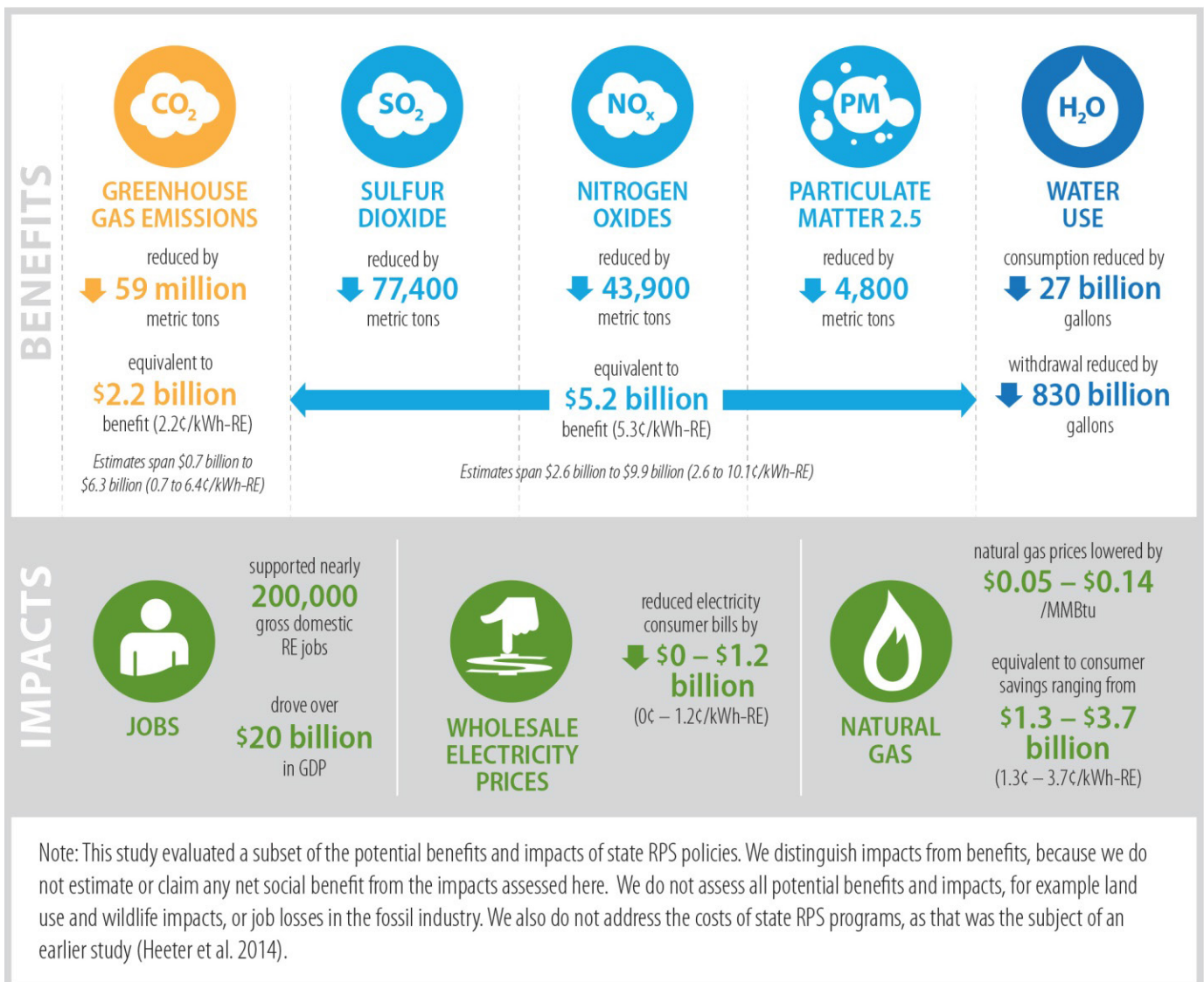
This study is the first national level assessment of the potential benefits and impacts of state RPS policies using uniform methodologies and data. In 2013, RPS policies led to a reduction in greenhouse gas emissions estimated

to be worth \$2.2 billion, a reduction in air pollution approximately worth \$5.2 billion, roughly 27 billion gallons saved in water consumption, and an influx of nearly 200,000 additional gross domestic renewable energy jobs.

RPS policies are in place in 29 states and Washington, D.C., but for many states these policies will expire within the decade. Now, stakeholders around the country are beginning to debate whether to expand, revise, or eliminate their RPS policies.

To better inform these decisions, EERE partnered with researchers at the national labs to issue a series of reports examining the costs, benefits, and future impacts of RPS policies that mandate the requirements of increased production of renewable energy sources.

Although not directly comparable, the [first report](#) by the same lab team found average annual costs of RPS policies of roughly \$1 billion per year – meaning the benefits of these policies vastly outweigh their costs.



Better Buildings Helps Unlock Energy Data Access for More Building Owners

Thanks to the success of EERE's Better Buildings Energy Data Accelerator (EDA), more owners will be able to improve the efficiency of their buildings by gaining access to whole-building energy data. In a joint statement, the White House and Energy Department [announced EDA results](#) and new partnerships supporting President Obama's Better Buildings program that include:

- 18 utilities, serving more than 2.6 million customers, providing building owners access to energy data by 2017
- 30 U.S. cities and states and 21 organizations, committed to identifying new ways to cut energy waste by making energy data available to building owners
- 24 cities, states, and businesses committed to improve the energy efficiency of their buildings by 20% by 2020
- Seven cities and states committed to install more efficient outdoor lighting.

These actions build on program commitments made by 285 organizations representing nearly four billion square feet of building space. These organizations pledged to improve energy efficiency by 20% by 2020 and share successful strategies that maximize efficiency deployment over the next decade.

Federal Facilities Set Clean Energy Example

The [Federal Energy Management Program](#) (FEMP) is leading efforts to bring clean energy projects to four federal facilities that will reduce carbon emissions and help strengthen America's economic, energy, and environmental security. The Assisting Federal Facilities with Energy Conservation Technologies (AFFECT) [selections](#) will invest \$2.85 million in photovoltaic (PV) installations and biomass generation to advance President Obama's Climate Action Plan. Cost-shared with industry, the total investment is nearly \$75 million.

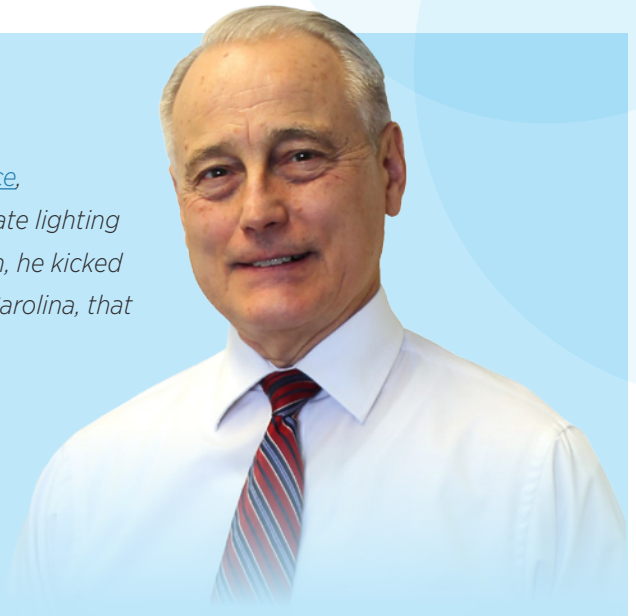
AFFECT projects funded under FEMP include a total of 22 PV

installations deploying more than 13 megawatts of solar power to facilities within Departments of State, Agriculture and Justice. The Department of Defense will use a 10-megawatt biomass steam turbine generator at its U.S. Marine Corps Installations Command in Georgia, to reduce annual electricity consumption by approximately 4,600 megawatt-hours annually.

As the nation's largest single user of energy, the federal government is leading by example and working to achieve a rate of 30% electricity from renewable sources by 2025.

Solid State Lighting Pace Quickens

As Lighting Program Manager for EERE's [Building Technologies Office](#), Jim Brodrick leads Energy Department activities to advance solid-state lighting (SSL) technologies that will reshape the lighting industry. This month, he kicked off a research and development (R&D) workshop in Raleigh, North Carolina, that brought together experts and stakeholders from across the country to discuss SSL trends that will inform future efforts. Working with researchers, manufacturers and stakeholders nationwide, Brodrick is helping to pave the way for light emitting diode (LED) technologies that will reap huge U.S. energy and carbon savings and transform the way people live and work. He shares what's ahead in an interview with Amped Up!



SSL lighting can be found in homes and businesses across the nation yet the technology is still in its infancy. Where are things today?

You will find LED-based products in many places but as far as all the sockets in the United States, or luminaires in the ceiling or out in the streetlights—it's only 3% penetration. So that's extremely small and there's a lot more to happen. What's going to drive progress is that the LED-based products will become more efficient and they will cost less.

The Energy Department is working to solve difficult riddles in LED chips and this will open the door to a new level of performance. Today, the best commercial LED package is about 160 lumens per watt and the program seeks 250 lm/W. That's quite a jump and will allow the technology to reap bigger energy savings in our homes and buildings.

Also, SSL is at a point in time where the delivery of lighting services may change greatly. Future connected SSL systems will use lighting as a platform for sensors and data collection. Each streetlight could have a camera so you will know if there's a traffic jam downtown. This is all coming and how it plays out is not certain. This is a large business opportunity and an opportunity for even bigger energy savings.

What energy savings have been realized through SSL technologies, and what is untapped?

Some 230 cost-shared projects funded by the Energy Department to date have resulted in millions of SSL products that are currently on the market. Those products yielded about \$2.8 billion in U.S. energy savings over the past 15 years. By 2030, SSL could potentially reduce national lighting electricity use by nearly half—the annual equivalent to saving 3,000 trillion British thermal units worth \$26 billion in today's dollars.

What does 2016 hold for Energy Department SSL investments?

By June, we'll announce the project selections from our annual funding opportunity for advanced R&D on LED and organic light-emitting diode technologies. The projects selected—worth about \$10 million—aim to maximize the energy efficiency of SSL products in the market; remove market barriers through lifetime, color quality, and lighting system performance improvements; reduce costs of SSL sources and luminaires; improve product consistency; and boost domestic U.S. manufacturing within the SSL industry.

Office Round Ups

STRATEGIC PROGRAMS

Technology to Market

Sixteen collegiate teams were selected to participate in the U.S. Department of Energy Solar Decathlon 2017 competition. Teams from across the United States and around the world will have nearly two years to build solar-powered homes that are affordable, innovative and highly energy efficient. For the first time, teams will compete for \$2 million in prize money. A 2017 competition site will be announced soon.



Solar Decathlon 2015: The NexusHaus from students at the University of Texas at Austin and Technische Universität München.

EERE International

EERE International supported a successful measurement and verification (M&V) workshop to advance a U.S. initiative that expands deep energy-saving retrofits in China with energy performance contracting (EPC). More than 60 attendees from more than 35 organizations including representatives from nine U.S. companies attended the January workshop in Beijing. As an outcome, both sides will begin drafting a bilateral M&V standards list and work plan, which could lead to more pilot projects and scaled-up use of EPCs in China, providing market opportunities for U.S. technology and service providers.

TRANSPORTATION

Vehicle Technologies Office

The Vehicle Technologies Office supported a project that led to Cooper Tire's recent development of concept tires that improve fuel efficiency by 5.5%. The new tires are more than 23% lighter than current tires—roughly a five to six pound difference. They also reduce rolling resistance by more than 30% while still meeting performance and durability goals.



Bioenergy Technologies Office

The Geniefuel Corporation recently released a report on its completion and testing of a pilot-scale system to convert algae into fuels. The report is an addendum to the 2014 National Alliance for Advanced Bioproducts Report, which details accomplishments and insights from the consortia's exploration of algae's potential to contribute substantially to the supply of U.S. transportation fuels.

Fuel Cells Technologies Office

Fuel cell expert Dr. Sanjiv Malhotra is the first director of the recently formed Clean Energy Investment Center. Malhotra joins the center after most recently serving as a consultant for tech-to-market activities with the Fuel Cells Technologies Office. The Clean Energy Investment Center was established in 2015 as part of the Obama Administration's Clean Energy Investment Initiative to advance private, mission-oriented investments in clean energy technologies that address the present gap in U.S. clean tech investment.

RENEWABLE POWER

Solar Energy Technologies Office

Hill Air Force Base in Utah and Fort Drum in New York recently launched their first cohorts in SunShot's expanding Solar Ready Vets program. Solar Ready Vets trained more than 150 military veterans and transitioning service members in 2015 to enter the solar workforce. Participating military bases hope to train another 600 veterans in 2016. To date, all participants have received at least one job offer to work in the solar industry.

Geothermal Technologies Office

The 2016 Geothermal Design Challenge is looking for smart and creative student teams to design an infographic that illustrates how geothermal energy is clean, safe, reliable and sustainable. Winners will share \$7,500 and present their infographic at a February 2017 geothermal energy conference in California. All drafts are due by March 1, 2016.



Water Power

Seventeen Wave Energy Prize qualified teams completed small-scale tank testing in January. Up to 10 finalists and two alternates will be selected in March to build larger 1/20 scale wave energy conversion (WEC) models in preparation for the final round this summer. The Wave Energy Prize is a design-build-test competition to develop WEC devices that would double the energy captured from ocean waves.

Wind Power

A small-scale wind turbine from Pika Energy is now on display at Energy Department headquarters in Washington, D.C. EERE supported technology used to develop and test the blades using a novel injection-molding process, reducing blade costs by approximately 90% compared to conventional hand-laid composite techniques.



The Pika wind turbine, on display at the Energy Department in February.

EFFICIENCY

Building Technologies Office

The Energy Department's Building America research team, Advanced Residential Integrated Energy Solutions, recently developed and evaluated methods to reduce energy use in factory-built housing, compared to best practices of U.S. Housing and Urban Development code construction. Results prove it is technically feasible to construct factory-built homes to be up to 50% more energy efficient for nominal increased cost. On average, one in every six new homes built each year within the United States is factory built.

Federal Energy Management

The Federal Energy Management Program funded national lab support for the Federal Aggregated Solar Procurement Pilot led by the U.S. General Services Administration in partnership with the Energy Department, U.S. Environmental Protection Agency, and the U.S. Forest Service. The pilot program is a strategic sourcing project that combines several small to mid-size photovoltaic installation opportunities within northern California and northern Nevada into a single procurement. It is the federal government's first joint solar power procurement in the two states.

Advanced Manufacturing Office

The EERE Robotics Internship Program is looking for current students and recent graduates to intern with public agencies and private industries. The program is a public-private partnership that seeks to continue development of the future robotics technical, engineering, and advanced manufacturing workforce. The deadline to apply is March 4.



The Robotics Internship Program seeks recent high school and college graduates who have experience in robotics competitions.

Weatherization and Intergovernmental Programs Office

The Weatherization and Intergovernmental Programs Office released the State Energy Program (SEP) Fiscal Year 2016 Competitive Funding Opportunity Announcement. This funding opportunity will allow states to compete for funding focused on state energy planning, opportunities for innovative energy efficiency and renewable energy practices, and technical assistance to advance SEP formula grant clean energy activities. The third focus is new this year and is designed to enhance the effectiveness of state and territory SEP formula-funded work by funding impactful technical assistance activities.

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