



Florida Energy Systems Consortium

April 2016 Issue

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WORLD NEWS

smartflower comes to the U.S.



After what the company said is a tremendous start in Europe, smartflower energy technology is now bringing its revolutionary all-in-one solar system, smartflower POP, to the U.S.

With its headquarters in Los Angeles, the official market kick-off will be in May 2016. And at the Intersolar show in San Francisco in July, smartflower POP will be presented to the American solar industry for the very first time.

smartflower POP says it offers effortless power generation, in peoples' own gardens. With the world's first all-in-one solar system, everyone can complete their own personal energy revolution, says the company. smartflower POP automatically tracks the course of the sun, which boosts its yield by up to 40 percent vs. a static solar system. This revolution on the solar energy market combines technology with elegant design and simple assembly. All you have to do is plug and play: set it up, plug it in and clean energy will be flowing in less than an hour, says smartflower POP.

smartflower POP is inspired by the shape of a sunflower: it automatically unfolds its 18 m2 of solar petals to form a perfect circle. With various "smart features" such as smart tracking, smart cleaning and smart cooling, the solar energy yield as well as self-utilization is maximized. Depending on the region, it is said to deliver between 3,400 and

6,200 kWh a year.

smartflower POP is "Made in Austria" and stands for reliability and the highest quality, says the company.

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## A Renewable Energy Boom

Some world leaders, especially in developing countries like India, have long said it's hard to reduce the emissions that are warming the planet because they need to use relatively inexpensive — but highly carbon-intensive — [fuels like coal](#) to keep energy affordable. That argument is losing its salience as the cost of renewable energy sources like wind and solar continues to fall.



Last year, for the first time, renewables accounted for a majority of new electricity-generating capacity added around the world, according to a [recent United Nations report](#). More than half the \$286 billion invested in wind, solar and other renewables occurred in emerging markets like China, India and Brazil — also for the first time. Excluding large hydroelectric plants, 10.3 percent of all electricity generated globally in 2015 came from renewables, roughly double the amount in 2007, according to the [report](#).

The average global cost of generating electricity from solar panels fell 61 percent between 2009 and 2015 and 14 percent for land-based wind turbines. In sunny parts of the world like India and Dubai, developers of solar farms have recently offered to sell electricity for less than half the global average price. In November, the accounting firm [KPMG](#) predicted that by 2020 solar energy in India could be 10 percent cheaper than electricity generated by burning coal.

These are all hopeful signs. They suggest that reductions in carbon emissions can be achieved more quickly and more cheaply than widely believed. And they provide hope that nations will be able to achieve the ambitious goals they set for themselves at last December's climate summit meeting in Paris — to keep warming below the threshold beyond which the world will be locked into a future of devastating consequences, including rising sea levels, severe droughts and flooding, widespread food and water shortages and more destructive storms.

Replacing coal-fired plants or avoiding new ones will have major health benefits as well, especially in heavily polluted cities in [China](#) and [India](#) where ground-level pollutants like soot and smog make the simple act of breathing a major undertaking. Those benefits will be even greater as gasoline-powered cars are replaced with electric vehicles that draw power from wind and solar farms.

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## Funding the Risks of New Solar PV Technology and Recycling

The transition from fossil fuels to renewable, sustainable energy is proving to be slow but gradual, and this is in large part due to the stumbling blocks that face the green energy sector. While scientists attempt to produce [solar](#) PV modules that are more efficient and can harvest a greater amount of energy, they are also under pressure to produce cheaper, more widely available solar modules to encourage the switchover. Herein lies a problem: with solar modules being in such high demand for mass production, can we be sure that they are being disposed of and recycled in a way that remains true to their purpose — helping the environment and reducing pollution? With the UK government recently making cuts to the [solar PV Feed in Tariff](#) (as [reported here](#) by the BBC), property and commercial building owners are less likely to make the switch to solar, the knock on effect is reducing the amount of money that solar companies have to invest in new technology.

### Recycling Solar Modules

The good news is that solar PV modules can be recycled relatively efficiently — the bad news is that this is not necessarily easy. Recycling solar modules isn't as simple as recycling regular glass or plastic, as the range of materials and chemicals that are used to make PV modules are subject to stringent restrictions set out in the [Waste Electrical and Electronic Equipment recycling \(WEEE\) regulations](#). The greatest issue when recycling these modules is the presence of silicon, as solar panels using silicon must be recycled in an entirely different way to those without.

### The Recycling Process

As reported by Lisa Krueger [in her research paper](#) on recycling programs, up to 97 percent of the materials used in producing solar modules can be extracted and repurposed using thermal recycling. Only modules that do not contain silicon can be recycled in this way, as this material cannot be broken down by use of a chemical bath. For solar modules that do contain silicon, recycling is a slightly untidier process, as they can only be broken down manually or mechanically. Mechanical recycling involves removing each component of the solar panel and either salvaging, repurposing, or grinding the materials down before reselling. It's a less chemically-efficient process than thermal recycling, but still boasts results above the 95% mark.

In application, the recyclable materials in solar modules usually equate to nearly all of the weight, and it is estimated that from a 20kg panel, around 19.5kg of materials will be recycled. Again, this yield would be increased further if a method was developed to recycle silicon more efficiently, as even with mechanical recycling, this material will often go to waste due to it being inseparable from glass.

### Solar Funding

The reduction in government incentives means that the return on solar modules has reduced, and so with property owners now facing a less favourable returns for solar power, the energy sector must find a way to incentivize consumers into making the switch to green energy before they are compelled to. Although energy prices continue to rise, the cost of living isn't getting any lower, so it is understandable that building owners may be intimidated by a large investment into solar when it could take years before they start to see their return on investment.

Installation companies may have to delve into the world of financing to encourage property managers to invest in their products. Finance and funding options are available

that will allow customers to invest in solar energy sooner rather than later. Being offered a realistic financing scheme allows the end user to tailor a specific plan that will work for them.

Offering this lending option to public sector and commercial organisations not only satisfies the property owner in the short term, but provides a revenue stream that allows the industry to take bigger risks when investing in new solar technology and recycling processes. With the government not looking set to change their stance on solar support, this option seems to be the most affordable and realistic for property owners.

### **An Incentive to Save the World**

While solar power has been repeatedly proven to be a sustainable, clean source of energy, we are unfortunately not at the stage where integration of this technology in buildings is mandatory. Nevertheless, the industry will face high demand going forward and will thrive if an effort is made to incentivize building owners to make the renewable energy switchover sooner rather than later.

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## **Surge in Renewable Energy Stalls World Greenhouse Gas Emissions**



Falling coal use in [China](#) and the US and a worldwide shift towards renewable energy have kept greenhouse gas emissions level for a second year running, one of the world's leading energy analysts has said.

Preliminary data for 2015 from the International [Energy Agency](#) (IEA) showed that carbon dioxide emissions from the energy sector have levelled off at 32.1bn tonnes even as the

global economy grew over 3% .

Electricity generated by renewable sources played a critical role, having accounted for around 90% of new electricity generation in 2015. Wind power produced more than half of all new electricity generation, [said the IEA](#).

The figures are significant because they prove to traditionally sceptical treasuries that it is possible to grow economies without increasing climate emissions.

"The new figures confirm last year's surprising but welcome news: we now have seen two straight years of greenhouse gas emissions decoupling from economic growth. Coming just a few months after [the landmark COP21 agreement in Paris](#), this is yet another boost to the global fight against climate change" said IEA director, Fatih Birol. The two largest emitters, China and the US, both reduced energy-related emissions in 2015. In China, they declined 1.5%, as [coal use dropped for the second year running](#) and in the US they declined 2%, as a large switch from coal to natural gas use in electricity generation took place.

However, these declines were offset by increasing emissions in most other Asian developing economies and the Middle East, said the IEA.

In the 40 years in which the IEA has reported on CO2 emissions, there have been only four short periods in which emissions stood still or fell compared to the previous year. Three of those — the early 1980s, 1992 and 2009 — came in periods of economic crisis. But the new stall in emissions comes amid economic expansion. According to the International Monetary Fund, global GDP grew by 3.4% in 2014 and 3.1% in 2015.

“When the IEA said last year that global emissions had stalled whilst economic growth had continued, they understandably sounded a note of caution; was this a one-off, or the start of something major?” said Richard Black, director of the Energy and Climate Intelligence Unit (ECIU).

“The sense of excitement as they report similar findings this year therefore is palpable, because in essence they’re showing that combating climate change is perfectly compatible with continuing economic growth, and that’s hugely significant,” said Black.

A [separate report by the European Environment agency \(EEA\)](#) shows that the EU-wide share of renewable energy has increased from 14.3% in 2012 to 15% in 2013. This allowed the EU to cut its demand for fossil fuels by 110m tonnes of oil equivalent in 2013. This, said the EEA, is the equivalent of a gross reduction of CO2 emissions of 362m tonnes in 2013.

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## **This Massive Magnet Will Generate Power At America's First Offshore Windfarm**

Offshore wind farms can tap into a bounty of wind that allows them to work twice as productively. But that efficiency comes at a cost. Like any sea-based technology, wind farms are difficult to build and expensive to maintain, with workers fighting against the same weather that makes the farms work so well. As a result, terrestrial turbines have been steadily gaining ground compared to turbines built at sea. But that may soon change.



Engineers at GE’s Power Conversion business in Nancy, France, designed an innovative 6-megawatt direct-drive generator — one of the largest ever built — equipped with a permanent magnet rotor. The design allows them to eliminate the gearbox and reduce the number of moving parts that could potentially break down, and leads to easier maintenance. The team also split the electrical drive train into three independent electrical channels. Even if two go offline, the turbine can still operate on one channel and produce electricity.

Low maintenance and redundancy are hugely important, especially for offshore installations where treacherous waters and high winds can delay a repair trip for days or weeks.

Support vessels cost upwards of \$10,000 a day, sourcing spare parts can take time and trained engineers have to be found in a hurry, says Frederic Maenhaut, a renewables executive at GE Power Conversion. "Our direct-drive technology mitigates the main risk to the reliability of a wind turbine — the gearbox," Maenhaut says. "When it comes to maintenance costs, that makes a big difference. We developed it to be ideal for an offshore setting."

The generator weighs 150 tons, measures 7.6 meters in diameter and sits hundreds of feet above the waves. It draws rotational energy from a giant GE wind turbine called the Haliade and converts it into electricity. The turbine must be large to move the big magnet. In fact, its 150-meter-diameter rotor covers an area that would fit two double-decker Airbus A380 planes.

The combo's very first commercial application will be at [America's first offshore wind farm](#) that's currently being built near Block Island, Rhode Island. Each Haliade can produce enough electricity to power 5,000 homes.

GE makes the generators in St. Nazaire in France, at the same factory that also produces the Haliades. (GE Reports is visiting the place on Tuesday so make sure to tune in for our Periscopes.) The first GE nacelle with the permanent magnet generator left the plant last week. The plant can make 100 of them per year.

The manufacturing process is in several ways as innovative as the generators themselves. The machines float down the manufacturing line on an air-cushion system that reduces the need for cranes inside the factory. The site also has its own test bench. Workers test every generator before it leaves the factory, rather than shipping it elsewhere for testing.

Maenhaut says the offshore wind market is expected to grow at a rate of 20 percent globally each year through 2020 and he wants to be ready. "Offshore wind is gaining increasing competitiveness in the power mix, and GE is well-positioned to serve this industry," he says.

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## **A Look at Liquid Air Energy Storage Technology**

With traditional coal-fired power stations coming to the end of their working lives, the challenge to engineers to develop clean, reliable energy technologies has never been so pressing.

Renewable energy technologies such as wind and solar power both offer potential solutions but the unresolved issue has always been consistency of supply and how to store energy generated for use at a later date.

One energy storage solution that has come to the forefront in recent months is Liquid Air Energy Storage (LAES), which uses liquid air to create an energy reserve that can deliver large-scale, long duration energy storage.

Unlike other large-scale energy storage solutions, LAES does not have geographical



restrictions such as the need to be located in mountainous areas or where there are reservoirs, which could render it more viable for a range of operations. However, many great ideas in the energy industry abound so how does new technology such as LAES make the leap from the drawing board into reality and is it effective when it does?

Highview Power Storage with project partners, Viridor, recently received more than £8m [US \$11.4m] in funding

from the UK Department of Energy and Climate Change for the design, build and testing of a 5-MW LAES technology plant that would be suitable for long duration energy storage. The site will soon be operational in the north west of England.

"Our liquid air energy storage technology stores liquid air in insulated tanks at low pressure before discharging it as electricity when required," explained Matthew Barnett, Head of Business Development, at Highview Power. "Like all energy storage systems, the LAES system comprises three primary processes: a charging system; an energy store; and power recovery. However, unlike many other storage systems, these can be scaled independently to optimize the system for different applications."

Barnett said that the technology turns air liquid through refrigeration (down to  $-196^{\circ}\text{C}$ ) and storing the very cold liquid in insulated vessels. When power is required, liquid air is drawn from the tanks and pumped to high pressure, he said. "Stored heat from the air liquefier is applied to the liquid air via heat exchangers and an intermediate heat transfer fluid. This produces a high-pressure gas that is then used to drive the turbine and create electricity. With 700 liters of ambient air being reduced to just one liter of liquid air, the storage capacity this offers is significant, representing GWh of energy potential."

The technology is also able to use waste heat and cold from its own and other processes to enhance its efficiency. Matthew continued: "During the discharge stage, very cold air is exhausted and captured by a high-grade cold store that can be used at a later date to enhance the efficiency of the liquefaction process. In a similar way, we can integrate waste cold from industrial processes such as LNG terminals.

"Similarly, the low boiling point of liquefied air means the efficiency of the system can be improved with the introduction of ambient heat. The standard LAES system is designed to capture and store the heat produced during the liquefaction process (stage 1), integrating it into the power recovery process (stage 3). This makes it a great option for applications that have their own waste heat source, such as thermal power generation or steel mills."

Highview tested and demonstrated a fully operational 350-kW/2.5-MWh LAES pilot plant at SSE's 80-MW biomass plant at Slough Heat and Power in Greater London from 2011 to 2014 - successfully connecting to the UK grid and complying with the necessary regulations and inspections.

Now showcasing the 5-MW pre-commercial demonstration plant at Viridor's landfill gas

generation site at Pilsworth Landfill facility in Greater Manchester, the project will operate for at least one year, providing energy storage as well as converting low-grade waste heat from the landfill gas engines from heat to power.

### **Building the Supply Chain**

While the 5-MW/15-MWh pre-commercial demonstration plant is appropriately sized to demonstrate grid scale storage, the supply chain is equipped to provide components that are scalable to hundreds of MWs in power for multiple hours.

Avintrans' Stainless Metalcraft business supplied the most important part of the system: the energy storage vessels.

According to Kelvin Boyce, Technical Manager at Metalcraft, the company has a track record of "working with companies to bring new concepts to life."

Boyce said the vessels in the demonstration project are nearly 12 and a half meters high, three meters in diameter and 13mm thick.

"With an empty weight of 16,230 kg, working on vessels this size and bigger throws up a range of manufacturing challenges, not least of which is finding production facilities large enough to house the vessels and their protective scaffolding as they're produced," he said.

A special welding skill set was required to build the vessels correctly since they were manufactured from carbon steel which offers impact energy absorption greater than 27J at -20°C, according to Boyce.

"The high integral welds were non-destructive tested using radiograph techniques at our own, on-site facility, and the completed vessel was also hydrostatic tested to 12.6 bar g, including allowance for static head as the vessel is around 12 meters tall. The actual test weight of the vessel was 94,000 kg."

Boyce added that his company will be able to provide in-house training to scale up production "as the technology is proven and orders come in."

### **Proof of Concept**

After co-ordinating the delivery and installation of components from a number of suppliers — including GE, Heatric, Siemens and Nikkiso — the pre-commercial demonstrator is now going through the commissioning phase and is due to be operational in the first half of 2016.

As well as generating power, the project hopes to demonstrate how LAES can be used to help balance supply and demand on the grid during its time in operation, including Short Term Operating Reserve (STOR), Triad avoidance (supporting the grid during the winter peaks), and testing for the PJM regulation market in the U.S.

Should all go according to plan, Highview Power hopes to build an even larger 200-MW / 1.2-GWh that it is calling "The Gigaplant." Barnett said that Highview is selecting components for this larger system. "There's nothing in the world today available at this scale without geographical constraints and at such a competitive cost. We believe that Highview's LAES systems will be the cheapest, cleanest and lowest environmental impact GWh scale, locatable storage systems available," he said.

## UCF Unveils New Smart Grid Lab

A new engineering laboratory that enhances the University of Central Florida's leading role in modernizing and sustaining the nation's power grid is opening week, in concert with the national DistribuTECH conference in Orlando of 12,000 grid engineers energy leaders.

The 660-square-foot Smart Grid located in the Harris Engineering Center on UCF's main campus, provide a real-world environment hands-on experience using advanced technology – real-time digital simulation, hardware-in-the-loop testing, power system protection and more – for research faculty and about 220 students per year.



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"The lab will enable us to perform advanced smart grid research, develop curriculum and course offerings, partner with utility companies on their research and development projects, and collaborate with other universities," said Zhihua Qu, chair, UCF Department of Electrical and Computer Engineering.

The new Smart Grid lab will be connected to power sources on campus, such as solar arrays and an on-campus power plant. The Smart Grid lab at UCF is the latest development in a national, multi-partner consortium that Qu leads, known as "FEEDER," or the [Foundations for Engineering Education for Distributed Energy Resources](#). FEEDER launched in 2013 with an initial grant of \$3.2 million from the U.S. Department of Energy that brought together eight universities, eight utilities, 11 industry partners and two national labs. It has grown to more than 50 partners – located nationwide from the east coast to California and as far as Hawaii.

The partners are upgrading and sustaining the power grid through research, and by educating the current grid workforce, and recruiting and educating the future workforce.

"Our nation relies on a vital, robust power grid that integrates renewable energy sources to maintain basic societal and economic needs. But the current infrastructure needs to be upgraded with advanced 'smart' technology, and the current grid workforce needs to learn the technology," Qu said. "What's more, it's critical that our nation's engineering schools recruit students to the field to ensure an adequate supply of smart grid engineers in the years to come."

UCF is one of the nation's largest producers of engineers, and its expertise in electrical and computer engineering makes UCF an ideal leader for the project.

Researchers in FEEDER are analyzing the infrastructure inside the current grid to find ways to enhance its capacity and make it more efficient. They are also exploring ways to safely and efficiently process the amount of fluctuating energy currently fed into the grid from an increasing number of small, decentralized power producers, many of which generate power from renewable sources such as wind and solar farms. They are also envisioning and designing potentially new and better ways of integrating renewables. On the education front, the intent is for FEEDER universities to educate the nation's

current and future smart grid workforce by working together to develop and deploy updated, shared curricula, guest lectures and workforce training activities.

FEEDER aims to attract and educate more students to become future power engineers, to address real-world research and development challenges, to train existing workforce and speed up technology transfers, and to realize smart grid implementation.

### **Research and Education in Renewable Energy Systems at UCF**

UCF's many power and energy resources provide hundreds of electrical and computer engineering students hands-on, real-world smart-grid experience that will help them in their careers.

UCF's Florida Solar Energy Center, also part of the FEEDER effort, has numerous research projects underway, including a study of the impact that the nation's increasing number of electric vehicles on the road will have on the power grid.

And last fall, the university announced a faculty research cluster to bring together and recruit multi-disciplinary experts to advance power systems science. The Resilient, Intelligent and Sustainable Energy Systems (RISES) cluster, also led by Qu, will facilitate collaborative research in the deployment and integration of renewable energy resources, and provide innovative solutions that make electricity grids self-organizing, efficient and resilient.

UCF is committed to green initiatives and supports the Climate Action Plan, an ambitious guide that the university is taking to become climate neutral by 2050.

Qu is a nationally renowned expert in distributed control and optimization of smart grids. In 2009, he was elected as a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for his scientific contributions in electrical and computer engineering. He joined UCF's faculty in 1990, and was named chair of the Department of Electrical and Computer Engineering in 2011. He holds a Ph.D. in electrical engineering from the Georgia Institute of Technology.

The [DistribuTECH conference](#), Feb. 9-11, at Orange County Convention Center, will also feature some work produced by UCF engineering students. Five research posters created by 10 UCF electrical and computer engineering students will be presented at the conference, and more than 40 students will attend along with Qu.

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## **UF/IFAS Scientists Closer to Finding Key to Converting Algae to Biofuel**

University of Florida Institute of Food and Agricultural Sciences researchers may have found a key to converting algae to fuel.

The scientists have found what researchers call a "transcription factor," called ROC40. Bala Rathinasabapathi, a UF/IFAS professor of horticultural sciences, likened a transcription factor's role in controlling the expression of many genes inside the algae cells to a policeman controlling a large crowd. To draw lipids out of algae, scientists must starve the algae of nitrogen. Among the hundreds of proteins modulated by nitrogen starvation, the synthesis of ROC40 was the most induced when the cells made the most oil. The high induction of that protein suggested to scientists that it could be playing an important biological role, said Elton Gonçalves, a former UF/IFAS doctoral student in the plant molecular and cellular biology program. In fact, the team's research showed that ROC40 helps control lipid production when the algal cells were starved of nitrogen.

“Our discovery about the ROC40 protein suggests that it may be increasing the expression of genes involved in the synthesis of oil in microalgae,” Rathinasabapathi said. “Such information is of great importance for the development of superior strains of algae for biofuel production,” Gonçalves said. “We conducted this research due to the great socioeconomic importance of developing renewable sources of fuels as alternatives for petroleum-based fuels for future generations. In order to advance the production of algal biofuels into a large-scale, competitive scenario, it is fundamental that the biological processes in these organisms are well understood.”



Rathinasabapathi said this information is valuable for the future for engineering algae so it overproduces oil without starving the algae of nitrogen.

Lipids from microalgae provide an excellent renewable source for biofuels. The algae grow quickly, tolerate extreme weather conditions and do not pose the same issues as biofuel crops that are grown both for fuel and food.

The rub was if algae are deprived of nitrogen, the cells become stressed and begin to produce lipids, but their growth rate slows. And if alga is going to become a commercially viable fuel source, scientists must ensure that not only can it produce as much oil as possible, but also that it can grow as fast as possible.

Rathinasabapathi and Gonçalves co-authored the study, which has been accepted for publication in *The Plant Journal*. Other collaborators were Sixue Chen, an associate professor of biology and faculty director of the UF proteomics and mass spectrometry, part of the Interdisciplinary Center for Biotechnology Research; Jodie Johnson, an assistant scientist at the mass spectrometry facility at UF and Takuya Matsuo, an assistant professor at Nagoya University in Japan.

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## Florida Approves \$15 Million for Research Consortium

A \$15 million Florida appropriation for the International Consortium for Advanced Manufacturing Research will enable the partnership to increase its momentum in capturing a part of the next-generation sensor industry for Florida, leaders said Thursday.

ICAMR will use the one-time \$10 million appropriation to purchase tools and equipment for manufacturing. The \$5 million in continuing funds puts the consortium in a strong strategic position to pursue federal contracts, attract industry, and proceed with plans for a design center that will strengthen consortium’s ability to capitalize on the burgeoning sensor economy for years to come.

ICAMR leaders and partners thanked supporters including the Central Florida legislative delegation, led by Senate President Andy Gardiner and House Speaker Steve Crisafulli, Gov. Rick Scott, and the many industry and community leaders who wrote letters and advocated for the project during the past several years.

"We are thankful for all who have so diligently carried the flag for ICAMR and we are looking forward to the returns this investment will bring to the state of Florida," Chester Kennedy, ICAMR CEO said.

Osceola County, the University of Central Florida, the Florida High Tech Corridor Council, Enterprise Florida and others have dedicated more than \$162 million to develop the center that will be housed in a 109,000-square-foot advanced-manufacturing facility under construction in Osceola County.



Industry will use the facility to develop the tools and processes to manufacture sensors that connect people and their devices to the Internet of Things and enable devices of all kinds to communicate.

"We've assembled a great team that not only understands this project but is very capable of sharing that vision and getting decision-makers excited about the significance of what we are going to accomplish," said Osceola County Manager Don Fisher. "This funding shows that the state is vested in the success of the project. Its commitment will play a key role in our efforts to continue to build our partnerships by bringing in top-flight companies and research organizations from around the world."

UCF President John C. Hitt also thanked supporters and said ICAMR is "a game changer" poised to give Florida a global competitive advantage in advanced manufacturing.

"Here, in our nation's fast-growing, third-largest state, our alliance stands to reinvent the future of nano-electronics research and development in this country and beyond," Hitt said. "We will position Central Florida to be a high-tech magnet for 21st century international industry."

Randy Berridge, president of the Florida High Tech Corridor Council, said: "The corridor connects 23 counties and their tech clusters to our three great universities (UCF, USF and UF) and ICAMR promises to exponentially expand this technology economy."

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## **FAU to Develop Robotic Boats with a 'Mind of Their Own'**

The notion of robotic boats that can move, think and make decisions on their own to help human supervisors may be closer than you think. A researcher in the College of Engineering and Computer Science at Florida Atlantic University has received a \$469,822 grant from the National Science Foundation to advance technology on risk-informed decision making that will enable unmanned surface vehicles (USVs) to team up with humans to work on a wide variety of civilian marine missions.

In recent years, USVs also known as unmanned robotic boats, have been increasingly



used in many marine applications including ocean sampling, maritime search and rescue, hydrologic surveys, harbor surveillance, defense, and industrial offshore supply and support, which involves the extraction of both fossil fuels and renewable energies. USVs also are used to assist autonomous underwater vehicles (AUVs) for studying various types of marine species, coral reefs, and searching for natural

resources.

“There are a number of civilian applications where deploying a team of small unmanned surface vehicles operating under the guidance of human supervisors can significantly reduce costs, improve safety, and increase operational efficiencies for marine missions,” said Karl von Ellenrieder, Ph.D., principal investigator of the grant and professor in the Department of Ocean and Mechanical Engineering and associate director of the SeaTech Institute for Ocean Systems Engineering at FAU. “Significant advances have been made in the area of distributed robotics, where a team of robots carries out a complex task. Our project will build on this progress.”

FAU researchers on the three-year joint project will work with their collaborator S.K. Gupta, Ph.D., professor of mechanical engineering at the University of Maryland, to develop technologies and scientific approaches that will permit between three and 10 USVs to work together. The USVs, which will range in size from about 5 to 10 feet, will be programmed to make decisions on their own until it’s determined that they need human intervention. They will be designed to operate in complex marine environments such as congested harbors and ports, which are complex and can be chaotic.

“We believe that both the safety and efficiency of these marine operations can be significantly improved by including a cooperative team of USVs,” said von Ellenrieder. “For example, ships entering and exiting a port are guided by specially trained pilots. The USV team will support the safe transfer of the pilot from the pilot vessel to the ship by using onboard sensors to measure wave and wind conditions. As the ship navigates through the port, the USV team will provide situational awareness of boat traffic, obstacles, and environmental conditions.”

In a busy port where thousands of containers and other cargo are unloaded daily, it is not uncommon for items to fall into the water. The USV team will be able to see, sense and track these types of mishaps and inform their human operators. The human-guided USV team also will be useful during the docking process itself. They will be able to gather visual information about the shape of mooring lines, line tension and the position of the ship with respect to the dock, which can be obtained from multiple vantage points on the water that are not normally available to human operators.

“Dr. von Ellenrieder’s technology is expected to have a very positive impact on our coastal habitats, which are estimated to support about 70 percent of the U.S. commercial and recreational fisheries,” said Javad Hashemi, Ph.D., professor and chair of the Department of Ocean and Mechanical Engineering at FAU. “As the cost of cleanup and remediation from a single oil spill resulting from a marine accident can cost tens of

millions of dollars, preventing these types of accidents is one of the most cost-effective measures that can be taken to protect fragile coastal ecosystems.”

## Award-Winning Manufacturer of Super-Efficient Ceiling Fans Licenses UCF-Developed Fan Blade Design

Versa Drives, an India-based manufacturer of electric motors, drives and appliances, has licensed an innovative fan blade design developed at the [Florida Solar Energy Center \(FSEC\)](#) a research institute of UCF. Under the direction of Danny Parker, principal research scientist at FSEC who developed the design concept, the fan blade is based on aviation propeller innovations. It is an aerodynamic design that produces maximum performance and energy efficiency.

Versa Drives, which recently received global recognition by DuPont for its exemplary performance and dedication to energy sustainability, will incorporate the UCF-developed fan blade design into its award-winning Superfan series of ceiling fans. Marketed as India’s first super-efficient ceiling fan, Superfan uses less than half the power required by a conventional fan to deliver the same or greater air flow.

“We are excited about the opportunity to combine this energy efficient fan blade design with our super-efficient fan motors and drives—it’s a winning combination,” said Sundar Muruganandhan, managing director, Versa Drives. “As a company, we are committed to energy saving and green products—right down to the recyclable materials we use for our packaging. Adding this UCF-developed aerodynamic blade technology to our Superfan series will significantly enhance energy savings and open the door to new, international markets.”

FSEC is well-recognized within the industry for its research and development of energy-efficient building technologies, hydrogen research, renewable energy technologies and its innovative ceiling fan blade technology. The FSEC-developed Gossamer Wind® series of ceiling fans—which offer 40 percent higher airflow with no additional energy use—feature the prestigious Environmental Protection Agency’s Energy Star designation for energy efficiency. Through several licensing agreements, more than 1.9 million Gossamer Wind® ceiling fans have been purchased, saving consumers more than \$20 million annually.

The average ceiling fan using 25 – 100 watts is in operation 6-12 hours or more each day. Thanks to advances in motor, drives and blade technologies, energy efficient ceiling fans can run on lower power consumption using only 4 – 40 watts and enhance overall air circulation. With improved air flow, these fans also allow consumers to adjust their cooling thermostats to more efficient settings.

“UCF’s Florida Solar Energy Center is on the forefront of energy research developing some of the most advanced technologies,” said Thomas O’Neal, Ph.D., associate vice



president of UCF's [Office of Research and Commercialization](#). "Companies such as Versa Drives recognize the groundbreaking work being conducted right here in Central Florida and are looking to the Florida Solar Energy Center for continued innovation and energy savings."

The license agreement with Versa Drives was executed through the UCF [Office of Technology Transfer](#).

## FLORIDA ENERGY NEWS

### Jacksonville Launches LED Streetlight Replacement Project



Energy-efficient LED streetlights JEA is installing in Jacksonville are more expensive than the current high-pressure sodium ones used now but are brighter, designed to last longer and promise an ultimate saving of at least \$1 million annually in electricity costs to the city once all are installed, utility company officials say.

The LED lights also are intended to help prevent crime in neighborhoods, as well as provide more consistent and concentrated illumination to make it safer for motorists, bicyclists and pedestrians at night, said Tom Ventresca, manager of electric transmission and distribution standards for the city-owned utility.

Launched about a month and a half ago, the LED streetlight replacement project will span six years. It is an initiative that evolved with input from city leaders and the Jacksonville Sheriff's Office.

Ventresca said a LED streetlight typically costs about three times more than a regular high-pressure sodium one.

"We're projecting about \$5 million a year for the next six years for a total \$30 million," Ventresca said of the project's projected cost.

However, LED streetlights use about 40 percent to 50 percent less electricity for an eventual \$1 million or more annual savings after all are installed, Ventrusca said. The average JEA customer won't see any change in their electric bill because of the switch to LED, he said. The savings from using the LED lights would be used at the discretion of city leaders.

#### **LET THERE BE LIGHT**

Streetlight improvement is an issue explored periodically over the years.

In a 2004 city-sponsored survey, two-thirds of the people responded that Jacksonville should crank up the illumination in residential neighborhoods when asked about streetlights but funding wasn't available.

JEA's goal is to install about 20,000 of the LED lights a year, Ventresca said.

Barring getting struck by lightning or someone shooting them out, the LED streetlights last a lot longer than the sodium lights, said Bill Delk, a JEA construction and maintenance working foreman. Delk along with four other JEA linemen installed the flat LED Cobra Head streetlights

recently in neighborhoods near 103rd Street and Ricker Road on the Westside.

A LED light uses roughly half the power of a sodium one, Delk estimated.

The sodium ones — distinguishable by a yellow or reddish core glow — have a reflector inside at the center. So, the light diminishes as it extends outward from the center. LED streetlights provide a very uniform white light with a bluish core. The LED lights don't need a reflector and shine the light down more directly without shadows for crisper illumination.

Sometimes, they'll also have to replace wiring that's worn out or has been chewed up by squirrels or birds, Delk said.

JEA already has installed the lights in the neighborhoods near Moncrief Road, Golfair Boulevard and portions of Fairfax, 11th and Eighth streets and Boulevard. Linemen were working near 103rd Street, Ricker Road and McManus Drive on the Westside last week.

"I think it's a good idea," said Alecia Mills as Delk and the other linemen worked a few blocks from her family's home Wednesday. "I think they need better, brighter streetlights in all the neighborhoods because then people won't have as many places to hide."

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## **Orlando Passes PACE Legislation and Selects Florida's Largest PACE Program, YgreneWorks, to Finance Millions in Energy Efficiency and Climate Resiliency Upgrades**

On the heels of this year's National Hurricane Conference and Florida's continuing efforts on climate preparedness, Ygrene Energy Fund announced today that Orlando has joined the ranks of 60+ cities and counties across Florida in the adoption of property assessed clean energy (PACE). By voting to join the Green Corridor PACE district, Orlando has selected the state's largest PACE program, YgreneWorks, to finance millions in energy efficiency and climate resiliency upgrades for home and business owners.

Through the award-winning YgreneWorks program, Ygrene has financed over 90% of the PACE projects in the state of Florida to date, providing residential, commercial and multi-family property owners the financing they need to immediately install efficiency, renewable energy and climate resiliency upgrades in the face of rising sea levels and hurricane activity--with no up-front costs.

Ygrene is the only PACE provider in Florida to reach scale with over \$55M in project contracts and more than 2,000 projects financed and approved. Nationwide, YgreneWorks has approved more than \$1 billion in applications for over 21,000 buildings and has completed \$300 million in contracts nationally, producing more than \$750 million in economic stimulus, 4,500 jobs and 19MW of energy. Together these projects have saved 1.3 billion gallons of water and enough energy to power 300,000 homes for a full year, while also keeping 360K metric tons of CO2 from entering the atmosphere.

"Today Florida and Green Works Orlando took yet another step in protecting Floridians as they face rising sea levels, more extreme weather scenarios and increased risk to property values," said Stacey Lawson, CEO of Ygrene. "We applaud Orlando and its Green Works initiative as they work to become one of the most sustainable cities in America."

### **About Ygrene Energy Fund**

Ygrene Energy Fund is a leading residential and commercial provider of clean energy financing throughout the United States. The award winning, privately funded YgreneWorks™ program provides immediately accessible financing with no upfront costs for energy efficiency, renewable energy, water conservation and, in certain areas, hurricane protection, electric vehicle charging stations and seismic upgrades. Ygrene is committed to making it easy for families to invest in their future and a healthier environment. Over the next five years, YgreneWorks is projected to create tens of thousands of local jobs and invest hundreds of millions into local economies. Learn more at [ygreneworks.com](http://ygreneworks.com).



## U.S. ENERGY NEWS

### Energy Department Announces Participation in Clean Line's Large-Scale Energy Transmission Project

Building on the Department of Energy's (DOE) ongoing efforts to modernize the grid and accelerate the deployment of renewable energy, today U.S. Secretary of Energy Ernest Moniz announced that DOE will participate in the development of the Plains & Eastern Clean Line Project (Clean Line), a major clean energy infrastructure project.

The Clean Line project will tap abundant, low-cost wind generation resources in the Oklahoma and Texas panhandle regions to deliver up to 4,000 megawatts of wind power via a 705-mile direct current transmission line — enough energy to power more than 1.5 million homes in the mid-South and Southeast United States.

This marks the first use of Congressional authority conferred to DOE as part of Section 1222 of the Energy Policy Act of 2005 with the objective of promoting transmission development. Congress passed this provision when it was becoming clear that our nation's transmission infrastructure was beginning to show its age and needed modernization. Congress recognized the need for a modern and resilient grid that could accommodate increasing demands for power with newly available resources. Based on our thorough review of the Clean Line project, it satisfies the goals for which Congress established DOE's authority.

"Moving remote and plentiful power to areas where electricity is in high demand is essential for building the grid of the future," Secretary Moniz said. "Building modern transmission that delivers renewable energy to more homes and businesses will create jobs, cut carbon emissions, and enhance the reliability of our grid."

The project will, if built, address infrastructure challenges outlined in the **2015 Quadrennial Energy Review (QER)**, which focused on Energy Transmission, Storage and Distribution Infrastructure. The QER acknowledged the importance of establishing transmission lines to facilitate remote generation development of renewable energy. The QER found that new long-distance transmission capacity like Clean Line has the potential to enable lower-carbon electricity, enhance system reliability and operate at a reasonable cost to consumers.

The project is expected to create supply chain jobs in Arkansas and Oklahoma to build the new infrastructure that will be constructed, operated and maintained in both states. Clean Line has announced a \$300 million agreement with Pelco, an Oklahoma company, to build the project's tubular steel transmission structures. Clean Line has also identified three Arkansas companies to build infrastructure that supports the project, such as transmission conductors and glass insulators.

Through its rigorous review and lengthy negotiations to build in protections for landowners and the local communities, the processes insisted upon by the Department go well beyond the provisions established by Congress in Section 1222. Before obtaining land for the project from landowners, commercial viability will need to be demonstrated. This means Clean Line will need to execute significant firm transmission service agreements and complete key technical studies required by the Southwest Power Pool, Midcontinent Independent System Operator and Tennessee Valley Authority.

This announcement marks the conclusion of a review process that began in 2010 that included 15 public meetings and provided multiple opportunities for the public to submit written comments as part of the review process. As a result, protections for taxpayers, ratepayers and land owners have been put in place:

- The federal government will only exercise eminent domain as a last resort — after the project has met significant milestones to prove its viability — and the process will provide every opportunity for the land owner to maximize the value of their land in a transparent and fair manner;
  - DOE will enter an agreement with Clean Line that ensures that all of DOE's costs will be paid by Clean Line in advance and that Clean Line will contribute two percent of project revenues to offset the cost of federal hydropower infrastructure improvements;
  - In response to public input, the Clean Line project will include a 500 megawatt converter station in Arkansas to ensure that consumers in the state can benefit from the renewable energy delivered by the project;
- Protections have been built into the participation agreement to ensure that no liability falls on the ratepayers if the project were ever to fail;
- And, Clean Line will also make payments to counties in Arkansas and Oklahoma for land and assets owned by the federal government that would otherwise be taxable.

For more information about the Clean Line project, including the Summary of Findings, which explains DOE's decision at length, the Participation Agreement, the National Environmental Policy Act Record of Decision and more, [visit Energy.gov](http://www.energy.gov).

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## The US DOE: To Be or Not to Be in Renewable Energy

Without exception, the [U.S. Department of Energy \(DOE\)](http://www.energy.gov) is all about Atomic Energy Defense (AED). Energy Efficiency and Renewable Energy (EERE), on the other hand, are far from mission-critical. To the extent that the DOE's 2016 budget request allocates 63 percent to AED activities and only 9 percent to EERE, energy efficiency and renewable energy programs seem to make good publicity and little else (See Figure 1).

The argument is not whether AED is more important than EERE; rather it is a question of the horsepower behind EERE, and DOE's performance in ensuring America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions.

The DOE states, "the FY 2016 Budget Request includes robust funding levels for clean energy technologies that advance American leadership in nuclear power, fossil energy, renewables, efficiency, and grid security for the 21st century. To sustain the nation's primacy in scientific discovery, the request also increases funding for basic research."

Figure 1 shows a breakdown by apportionments for DOE's 2015 Enacted Budget and the 2016 Congressional Budget Request; \$27.4 billion and \$29.9 billion, respectively. The top section is a high-level overview; segmented into five major areas of investments. This is followed by EERE appropriations, which consist of four primary areas: Sustainable Transportation, Renewable Energy, Energy Efficiency, and Corporate Support.

DOE BUDGETS				
APPROPRIATION	FY 2015 Enacted		FY 2016 Request	
	Allocation (\$000)	% Total Budget	Allocation (\$000)	% Total Budget
Total Atomic Energy Defense Activities	17,605,500	64.2%	18,867,172	63.1%
Energy Programs (not including EERE Projects)	8,293,821	30.3%	8,814,977	29.5%
Total Energy Efficiency and Renewable Energy (EERE)	1,914,195	7.0%	2,722,987	9.1%
Power Marketing Administrations	80,368	0.3%	82,000	0.3%
Adjustments	-491,485	-1.8%	-563,384	-1.9%
<b>TOTAL DOE FY BUDGET</b>	<b>\$27,402,399</b>	<b>100.0%</b>	<b>\$29,923,752</b>	<b>100.0%</b>
<b>ENERGY EFFICIENCY and RENEWABLE ENERGY (EERE)</b>				
<b>SUSTAINABLE TRANSPORTATION</b>				
Vehicle Technologies	280,000	1.0%	444,000	1.5%
Bioenergy Technologies	225,000	0.8%	246,000	0.8%
Hydrogen & Fuel Cell Technology	92,000	0.4%	103,000	0.3%
<b>TOTAL SUSTAINABLE TRANSPORTATION</b>	<b>\$602,000</b>	<b>2.2%</b>	<b>\$793,000</b>	<b>2.7%</b>
<b>RENEWABLE ENERGY</b>				
Solar	233,000	0.9%	336,700	1.1%
Wind	107,000	0.4%	145,500	0.5%
Water Power	61,000	0.2%	67,000	0.2%
Geothermal	55,000	0.2%	96,000	0.3%
<b>TOTAL RENEWABLE ENERGY</b>	<b>\$456,000</b>	<b>1.7%</b>	<b>\$645,200</b>	<b>2.2%</b>
<b>ENERGY EFFICIENCY</b>				
Advanced Manufacturing	200,000	0.7%	404,000	1.4%
Federal Energy Management Programs	27,000	0.1%	43,088	0.1%
Building Technologies	172,000	0.6%	264,000	0.9%
Weatherization and Intergovernmental Program	243,000	0.9%	318,499	1.1%
<b>TOTAL ENERGY EFFICIENCY</b>	<b>\$642,000</b>	<b>2.3%</b>	<b>\$1,029,587</b>	<b>3.4%</b>
<b>CORPORATE SUPPORT</b>				
Facilities and Infrastructure	56,000	0.2%	62,000	0.2%
Program Direction	160,000	0.6%	165,330	0.6%
Strategic Programs	21,000	0.1%	22,870	0.1%
<b>TOTAL CORPORATE SUPPORT</b>	<b>\$237,000</b>	<b>0.9%</b>	<b>\$255,200</b>	<b>0.9%</b>
<b>RESCISSION OF PRIOR YEAR BALANCES</b>	<b>-22,805</b>	<b>-0.1%</b>	<b>0</b>	<b>0.0%</b>
<b>TOTAL ENERGY EFFICIENCY AND RENEWABLE ENERGY</b>	<b>\$1,914,195</b>	<b>7.0%</b>	<b>\$2,722,987</b>	<b>9.1%</b>
<b>OTHER ENERGY PROGRAMS AND EXPENDITURES</b>				
Electricity Delivery & Energy Reliability	146,975	0.5%	270,100	0.9%
Nuclear Energy	833,379	3.0%	907,574	3.0%
Fossil Energy Programs	791,117	2.9%	842,100	2.8%
Uranium Enrichment D&D Fund	625,000	2.3%	542,289	1.8%
Energy Information Administration	117,000	0.4%	131,000	0.4%
Non-Defense Environmental Cleanup	246,000	0.9%	220,185	0.7%
Science (Basic Energy, High Energy Physics, Nuclear, etc.)	5,067,738	18.5%	5,339,794	17.8%
Advanced Research Projects Agency	279,982	1.0%	325,000	1.1%
Departmental Administration	125,130	0.5%	153,511	0.5%
Indian Energy Programs	0	0.0%	20,000	0.1%
Office of the Inspector General	-40,500	-0.1%	46,424	0.2%
Innovative Technology Loan Guarantee Program	17,000	0.1%	0	0.0%
Advanced Technology Vehicles Manufacturing Loan	4,000	0.0%	6,000	0.0%
Tribal Indian Energy Loan Guarantee Program	0	0.0%	11,000	0.0%
<b>TOTAL OTHER ENERGY PROGRAMS AND EXPENDITURES</b>	<b>\$8,293,821</b>	<b>30.3%</b>	<b>\$8,814,977</b>	<b>29.5%</b>
<b>TOTAL ENERGY PROGRAMS</b>	<b>\$10,208,016</b>	<b>37.3%</b>	<b>\$11,537,964</b>	<b>38.6%</b>

Figure 1 Source: Department of Energy

Note that differences between requested and enacted items are anticipated. For example, the 2015 enacted budget was 1.9 percent lower than the request. The largest reduction was EERE programs at 17.4 percent, from \$2.3 billion to \$1.9 billion. AED request of \$17.7 billion was reduced by \$133 million, a mere 0.7 percent decline. Key points are (percent of total budget):

EERE allocations of \$1.9 billion (7 percent) and \$2.7 billion (9.1 percent) for 2015 and 2016, respectively

AED funding approximately 820 percent and 600 percent of EERE program for 2015 and 2016, respectively

RE investments of \$456 million (1.7 percent) and \$645 million (2.2 percent) for 2015 and 2016, respectively

EE investments of \$642 million (2.3 percent) and \$1 billion (3.4 percent) for 2015 and 2016, respectively

Figure 2 illustrates the relationship between the total DOE (red bars) and EERE (blue bars) budget requests from 2000 through 2016. EERE allocations ranged from a low of 1.4 percent in 2003 to a high of 9.8 percent in 2014. EERE allocations averaged about 5.8 percent during the 17-year period, with a slight upward trend in the latter years, though never exceeding 10 percent.

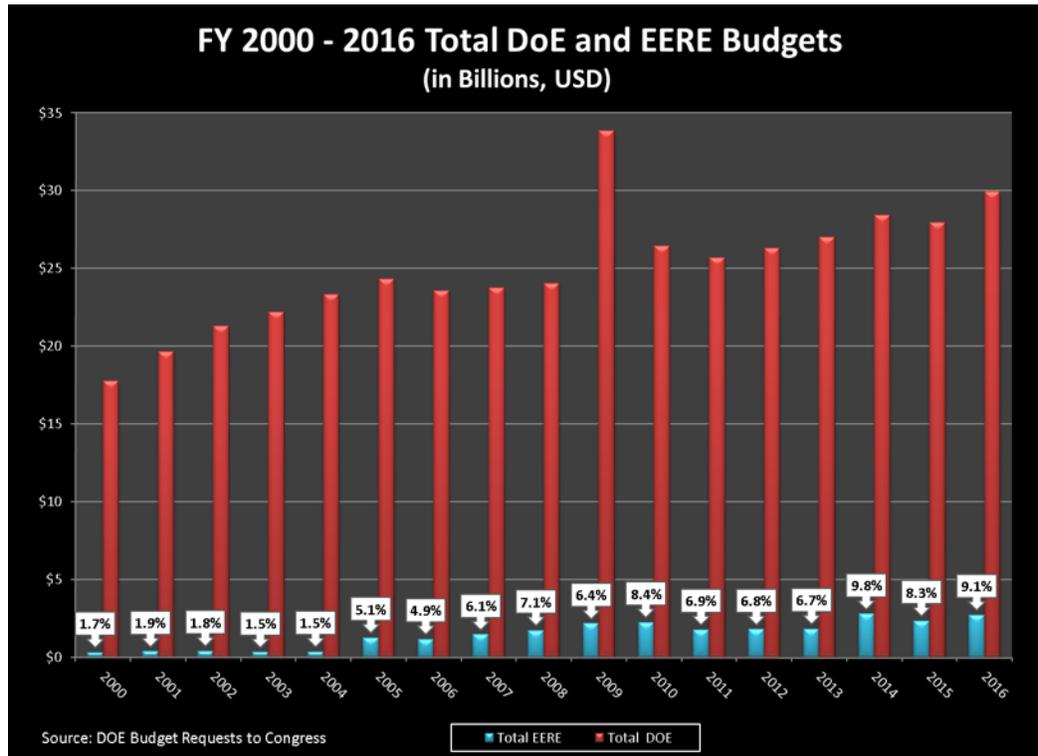


Figure 2 Source: Department of Energy FY 2000 through 2016 Congressional Budget Requests  
 Figure 3 shows 2012 to 2016 EERE budget allocations for 14 programs. Vehicle technologies received the most funds and strategic programs the least. Within RE programs, the lion’s share of investments went to solar projects. Collectively, the three corporate support activities — facilities and infrastructure, program direction and strategic programs — absorbed about 12 percent of all EERE dollars.

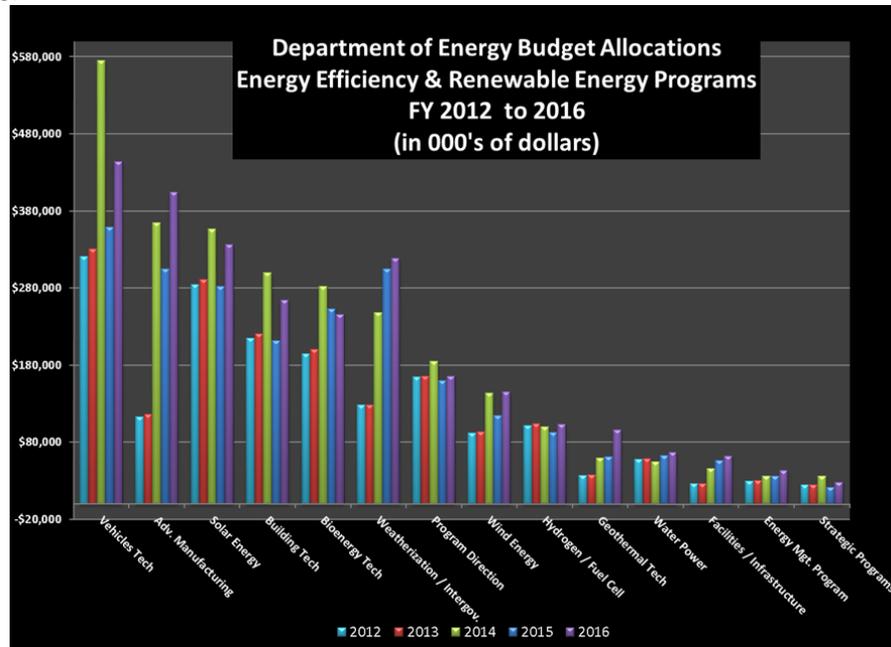


Figure 3 Source: Department of Energy FY 2012 through 2016 Congressional Budget Requests

**Renewable Energy**

Using total RE capacity as a measure of DOE’s effectiveness in transitioning the U.S. to a low-carbon energy future, America’s prowess is unquestioned. According to the Renewable Energy Policy Network, by the end of 2014, the seven countries with the highest capacity of renewable energy (not including hydro power) were China, the U.S., and Germany followed by Italy, Spain, Japan, and India (See Figure 4).

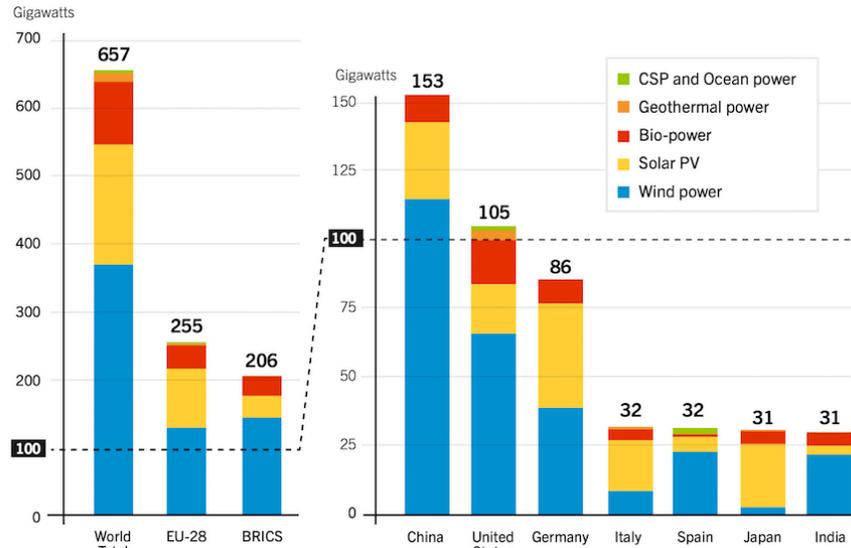


Figure 4: Renewable Power Capacities\* in World, EU-28, BRICS, and Top Seven Countries, 2014 \* not including hydropower Source: REN21. Renewables 2015 – Global Status Report Considering investments made in new renewable power and fuels relative to annual GDP, top countries included Burundi, Kenya, Honduras, Jordan, and Uruguay. The leading countries for investment per inhabitant were the Netherlands, Japan, Uruguay, the UK, Ireland and Canada.

Another meaningful measure to determine DOE’s effectiveness in transitioning America to a low carbon-energy future is the percentage of renewable energy (hydro, wind, geothermal and solar) in total electric generation.

This measure gives an entirely different picture from capacity statistics. Figure 5, compiled from data supplied by Enerdata, shows the 2014 share of renewables (including hydropower) by countries. The red bar shows the U.S. share at 13.7 percent (about 8 percent without hydro). Norway, with a 98 percent share of renewable energy, is the world leader and benchmark towards 100 percent renewable energy.

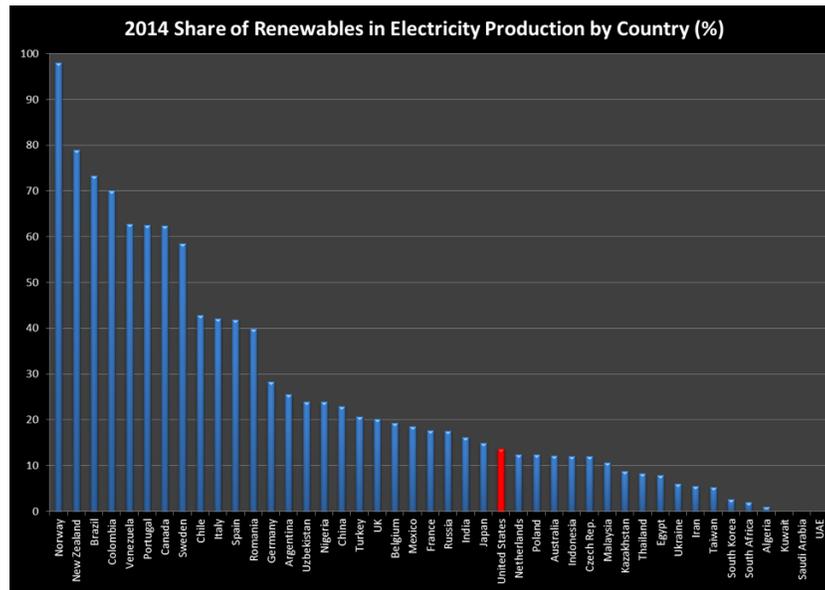


Figure 5 Source: Enerdata

Of the 44 countries in the study, 26 had a higher percentage of renewables than the U.S. That list included Canada, Romania, Nigeria, China, India, Russia and Mexico. The U.S. share of renewables was also below the average share for the World — OECD, G7, BRICS, Europe, European Union, CIS, America and North America.

Most developed countries showed higher rates of renewables in their energy mix than U.S. Developed countries with lower RE inventories than the U.S. include the Netherland, Poland, Australia, the Czech Republic, and South Korea.

### Energy Efficiency

The other major program under EERE is Energy Efficiency. Figure 6 shows useful EE statistics from *The 2014 International Energy Efficiency Scorecard*, published by the American Council for an Energy-Efficient Economy. The scorecard evaluates the energy efficiency of the world's 16 largest economies.

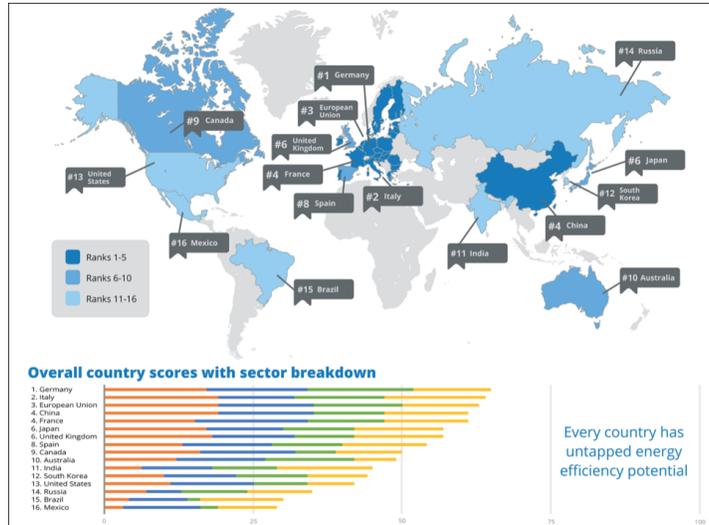


Figure 6: 2014 International Energy Efficiency Scorecard Source: American Council for an Energy-Efficient Economy

The analysis found that “the U.S., long considered an innovative and competitive world leader, has allowed 12 of the 16 countries studied to surge ahead. Germany has the highest overall score. The top-scoring countries in each sector include:

- China in buildings
- Germany in industry
- Italy in transportation
- France, Italy, and the European Union in national efforts

The report suggests the U.S. can improve by:

- National Effort — The U.S. Congress should pass a national energy saving target
- Buildings — The U.S. federal government should strengthen national model building codes
- Industry — The federal government should support education and training in the manufacturing and industrial sectors
- Transportation — The U.S. Congress should prioritize energy efficiency in transportation spending

The U.S. “made some progress toward greater energy efficiency in recent years, particularly in areas such as building codes, appliance standards, voluntary partnerships between government and industry, and, recently, fuel economy standards for passenger vehicles and heavy-duty trucks,” the report said.

### Disappointing Results

In closing, DOE’s performance in transitioning America to an energy efficient and renewable energy economy is rather disappointing when compared to other developed and developing economies of the world. The million-dollar question is, “Why?” The short answer is renewable energy costs more and is less reliable than traditional energy and significant gains in energy efficiency can be capital intensive.

The long and more plausible answer is fourfold — insufficient funds, politics at play, mismanagement, and lack of accountability. Fixing the problem is simple but politically impossible. DOE should be

taken out of the EERE business. In addition, the cost of the programs should be transitioned to bottom line incentives granted by the IRS, such as Section 1603 Treasury Cash Grant Program. And tax deductions should be provided for energy efficiency improvements made to new and existing residential, commercial and industrial facilities. If incentives become a point of contention, then incentives for the fossil fuel industry should be discontinued. With these measures in place, America could return to a leadership role in renewable energy and energy efficiency and help save our planet.

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## **Ivanpah Solar Facility on Track To Meet Production Target, NRG Says**

The operator of a massive U.S. government-backed solar project in California that fell short of production targets says the facility more than doubled its output last month, putting it on pace to meet its obligations to Pacific Gas and Electric Co.

The [Ivanpah Solar Electric Generating System](#), the world's biggest [solar-thermal](#) power plant, generated 67,300 megawatt-hours electricity in February, up from about 30,300 a year earlier, according to NRG Energy Inc., which operates the facility and co-owns it with BrightSource Energy Inc. and Alphabet Inc.'s Google.

Mitchell Samuelian, NRG's vice president of operation for utility-scale renewable generation, said the improved performance shows the plant's technology is viable and that the facility is on track to fulfill its contractual obligations. The release of the February output data comes 12 days after California regulators gave NRG and its partners more time to avoid defaulting on a contract with PG&E for failing to supply power they had guaranteed.

"The February numbers were well in excess of what we were targeting," Samuelian said in an interview.

### **175,000 Mirrors**

The 377-MW facility, about 50 miles (80 kilometers) southwest of Las Vegas in the Mojave Desert, received a \$1.6 billion loan guarantee from the U.S. Energy Department and began operating in February 2014. Instead of converting sunlight directly into electricity with photovoltaic cells, the system uses almost 175,000 mirrors to focus sunlight onto boilers atop three 450-foot (137-meter) towers, generating steam that drives a turbine.

The plant experienced mechanical problems in 2014 that caused it to fall short of production targets for the first 24 months in operation. The deal approved by California regulators gives NRG and its partners until Aug. 1 to avoid defaulting on its agreement with PG&E if it pays the utility for past shortfalls in generation and continues to meet future targets. The facility is on pace to generate 102 percent of its target capacity for March, Samuelian said.

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## **NREL Updates Survey of Advanced Biofuel Producers in the United States**

The National Renewable Energy Laboratory (NREL) updated its annual survey of U.S. non-starch ethanol and renewable hydrocarbon biofuels producers. The survey report, titled [2015 Survey of Non-Starch Ethanol and Renewable Hydrocarbon Biofuels Producers](#), documents important changes (e.g., biorefinery development, production capacity, feedstock use, and technology pathways) that have occurred since the publication of the original [2013 survey](#). Released in January 2016, the report provides an inventory of the domestic advanced biofuels production industry as of the end of calendar year 2015.

During 2015, NREL surveyed 114 companies that were reported to be pursuing commercial-scale biofuel production capacity. Companies were classified as either non-starch (cellulosic or algae-derived) ethanol producers or renewable hydrocarbon producers. The questionnaire included topics such as facility stage of development, facility scale, feedstock, and biofuel products. Industry experts from NREL and the U.S. Department of Energy (DOE) validated the results and then compared them with publicly available data.

This update provides continued insight as to the current status of the non-starch ethanol and renewable hydrocarbon biofuels industry in the United States, including industry choices and direction. This will ultimately help inform research and development efforts aimed at producing cost-competitive advanced biofuels from non-food biomass resources.

NREL's **biomass research program** is funded by DOE's **Bioenergy Technologies Office** (BETO) and is the largest national laboratory bioenergy program across the Energy Department's **eleven national laboratories that conduct bioenergy research**. BETO is focused on forming cost-share partnerships to develop and demonstrate technologies for advanced biofuels production.

## Solar And Wind Energy May Be Nice, But How Can We Store It?



Renewable energy like solar and wind is booming across the country as the costs of production have come down. But the sun doesn't always shine, and the wind doesn't blow when we need it to.

This challenge has sparked a technology race to store energy — one that goes beyond your typical battery.

### Heat Storage: Molten Salt And A Giant Solar Farm

Batteries are often used to store solar power, but it can be a **costly endeavor**.

A company called SolarReserve may have found a solution: It built a **large solar plant** in the Nevada desert that can store heat from the sun and generate electricity for up to 10 hours even after sundown.

You can see the Crescent Dunes Solar Energy Plant from miles away. There's a 640-foot-tall tower surrounded by 10,347 mirrors. The heliostats, as they're technically called, are arranged in a circle that is 1.75 miles across. They direct heat from the sun to the top of the tower, which glows white-hot.

"This is really the first utility-size project of this type in the world," says SolarReserve CEO Kevin Smith.

He says the key to the plant's ability to store energy is molten salt. You can't see this special kind of salt because it's contained in a system of pipes and insulated storage tanks.

"It actually looks like water. It's clear — it flows like water," Smith says.

He says the molten salt has to remain above 450 degrees Fahrenheit to stay liquid. It's sent up the tower to the glowing tip, where it's heated further. When the salt comes back down, it is 1,050 degrees.

The molten salt is used to make steam to power a generator. The facility can continue to produce electricity for up to 10 hours after the sun goes down. Smith says that flexibility is very important to the local utility.

"That's the whole concept here is that this facility would operate just like a natural gas, or a coal or nuclear facility — turn us on and off when they want," he says. "We have energy in storage so that we can generate at night."

At full capacity, he says, the \$997 million plant generates enough electricity to power 75,000

Nevada homes.

There was a problem with the plant briefly last year. During a test, observers [recorded a video](#) of birds flying into heat from the mirrors and being incinerated.

The plant is on federal Bureau of Land Management property, and the agency says the company fixed the problem by adjusting where mirrors are pointed at certain times. The BLM says biologists have documented fewer than five bird deaths a month since then.

The group Basin and Range Watch is [suing the agency](#) to get more detailed data that biologists have collected.

Executive Director Laura Cunningham says she supports solar. "So we're in a little bit of an unpopular position of trying to defend solar but then criticizing some solar," she says. Cunningham says in addition to the bird issue, she believes facilities like this should be built closer to where people live and away from wild areas.

Another issue with this plant is cost. The utility NV Energy is buying all the electricity from Crescent Dunes for the next 25 years at 13.5 cents per kilowatt-hour. That's much more than the same power would cost from a natural gas plant.

Smith says his company learned a lot from building this first project, and he says subsequent plants will be cheaper. That'll reduce the cost of electricity, because once the plant is built, the fuel is free. The ability to store solar power will also add value to the plants.

"We really think we've cracked the code here with energy storage and we can take this technology and bring it worldwide," Smith says.

SolarReserve expects to begin work soon on the company's [second solar plant](#) with heat storage that will be built in South Africa.

### **Compressed Air: A Cheaper And Longer-Lasting Alternative To Batteries**

The challenges of renewable energy are becoming apparent in California, where the state's ambitious goals are driving a boom in solar power. Earlier this spring, there was so much electricity on the grid that solar companies were told to turn off their production.

To cope with the higher demand for power in the evening, electric utilities are being required to add energy storage to the grid, which would store the extra electricity that solar farms generate during the daytime.

One startup — LightSail Energy — experimented with compressed air.

"What you're looking at really is best described as a giant scuba tank," says Steve Crane, pointing to a 25-foot tank in the warehouse of his company, LightSail Energy in Berkeley, Calif.

A scuba tank is the inspiration for his technology, which compresses air.

"The electrical energy is hard to hold onto," Crane says. "Compressed air is relatively easy to store for hours or even days."

Here's [how it works](#): When there's extra electricity, Crane turns on a giant air pump. It fills the tank, compressing the air by 200 times.

Then, when electricity is needed, the air is released to drive an electric generator. The hard part has been dealing with all the heat this makes.

"Any air compressor that you use, even a bicycle pump, creates heat," Crane says. "A bicycle pump will feel warm after you've used it for a while."

Crane's technology uses water to capture some of the heat, so the energy isn't lost. The technology is still in the early stages, but he says it could have an edge over batteries because it's likely cheaper and lasts longer.

"If you have a laptop or cellphone, you know that after two to three years, you start to see significant deterioration," he says.

### **Ice Energy: A Thermal Battery That Brings Down Electricity Demand**

Traditionally, batteries store energy in chemical form, but a thermal "battery" uses temperature.

A California-based company is using the concept to build Ice Bear, a [thermal energy storage unit](#) that can both reduce energy demand and store energy during the night.

An Ice Bear can save up energy in a 450-gallon tank of water, for example, by turning it into ice. That energy is used later on, to cool the building next door during the hottest time of the day and into early evening.

"Essentially what we're doing is we're shutting air conditioners off during the day, consuming energy at night and displacing that peak load for the utility company," says Greg Miller, executive vice president of the company, Ice Energy.

Peak load refers to the time of day or year when we're using the most electricity. In Fort Collins, Colo., [that's in the summer](#), between 2 and 7 p.m. The Ice Bear brings down the total amount of electricity needed during those busy peaks.

In 2014, the company got its first [big order](#) from Southern California Edison for 25.6 megawatts of storage, which is around 1,800 Ice Bear units. The California utility won't disclose how Ice Energy's thermal storage stacked up to the other companies that also won storage contracts. Ice Energy also has a deal in process on the island of Nantucket, Mass.

In Colorado, there is an important limitation to Ice Bear's technology. During winter, the demand for air conditioning is low, so there is no need for the Ice Bear's services. Miller says that during cold months, the unit just sits idle.

The Ice Bear, unlike compressed air or molten salt storage, saves up energy for temperature control but can't feed electricity back onto the grid.

But when temperatures soar in the summer, the Ice Bear goes to work.

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## **EIA Report: Renewables to Increase by 9.5% in 2016**

EIA expects total renewables used in the electric power sector to increase by 10.0% in 2016 and by 5.1% in 2017. Forecast hydropower generation in the electric power sector increases by 8.8% in 2016 and then falls by 0.4% in 2017. Renewables other than hydropower are forecast to grow by 11.0% in 2016 and by 9.9% in 2017.

EIA expects [utility-scale solar photovoltaic \(PV\) power capacity to grow by more than 9 gigawatts \(GW\)](#) in 2016, after growing by 3 GW in 2015. PV capacity is forecast to increase by an additional 1 GW in 2017. States leading in utility-scale solar capacity additions are California, Nevada, North Carolina, Texas, and Georgia. Forecast utility-scale solar power generation averages 1.1% of total U.S. electricity generation in 2017.

Wind capacity, which starts from a significantly larger installed capacity base than solar, grew by 13% in 2015, and it is forecast to increase by 8% in 2016 and by 9% in 2017. In 2017, wind generation accounts for 5.6% of total generation.

### **Liquid Biofuels**

On November 30, EPA finalized a rule setting Renewable Fuel Standard (RFS) volumes for 2014 through 2016. EIA used these final volumes to develop the current STEO forecast and assumes the 2016 targets for 2017, except the biomass-based diesel 2017 target of 2.0 billion gallons that was included in the November 30 rule. Ethanol production averaged 966,000 b/d in 2015, and it is forecast to average between 970,000 b/d and 980,000 b/d in 2016 and 2017. Ethanol consumption averaged about 910,000 b/d in 2015, and it is forecast to average about 930,000 b/d in both 2016 and 2017. This level of consumption results in the ethanol share of the total gasoline pool averaging 10.0% in both 2016 and 2017. EIA does not expect significant increases in E15 or E85 consumption over the forecast period.

EIA expects the largest effect of the proposed RFS targets will be on biodiesel consumption, which helps to meet the RFS targets for use of biomass-based diesel, advanced biofuel, and total renewable fuel. Biodiesel production averaged 82,000 b/d in 2015 and is forecast to average 100,000 b/d in 2016 and 106,000 b/d in 2017. Net imports of biomass-based diesel are expected to rise from 29,000 b/d in 2015 to 45,000 b/d in 2016 and to 47,000 b/d in 2017.

#### Energy-Related Carbon Dioxide Emissions

EIA estimates that energy-related emissions of carbon dioxide decreased by about 2.5% in 2015. Emissions are forecast to decrease by 0.9% in 2016, and then increase by 0.9% in 2017. These forecasts are sensitive to assumptions about weather and economic growth.

## FUNDING OPPORTUNITIES

FESC office tracks the energy related funding opportunities, shares them with faculty and industry partners, facilitates the submission of multi-faculty, multi-SUS university competitive proposals in response to solicitations for major research programs. The most recent funding opportunities are listed below. For a complete list please visit the [funding opportunities page](#) on the FESC website.

### DEPARTMENT OF ENERGY

**DE-FOA-0001531 - Regional and Global Climate Modeling and Integrated Assessment Research: An Integration Framework for Multi-Model, U.S. Regional Climate Evaluation that Incorporates Local Human Influences for Research at the Energy-Water-Land Nexus**  
Application Due Date: April 18, 2016

**DE-FOA-0001514 - Energy Frontier Research Centers**  
Letter of Intent Due Date: March 09, 2016 (required)  
Application Due Date: April 19, 2016

**DE-FOA-0001430 - Atmospheric System Research Program**  
Full Application Due Date: April 20, 2016

**DE-FOA-0001493 - Addressing Risk and Uncertainty in the Future Power System**  
Application Due Date: April 21, 2016

**DOE Office of Science Graduate Student Research (SCGSR) Program**  
Application Due Date: May 11, 2016

**DE-FOA-0001542- U.S. China Clean Energy Research Center - Medium and Heavy Duty Trucks**  
Application Due Date: May 15, 2016

**DE-FOA-0001457 - Supercritical Carbon Dioxide Pilot Plant Test Facility**  
Application Due Date: May 17, 2016

**DE-FOA-0001467 - Next Generation Electric Machines: Enabling Technologies**  
Concept Paper Submission Deadline: April 12, 2016  
Full Application Submission Deadline: June 7, 2016

**DE-FOA-0001403: Cities Leading through Energy Analysis and Planning (Cities-LEAP)**

Concept Paper Submission Deadline: May 17, 2016  
Full Application Submission Deadline: June 17, 2016

**DE-FOA-0001414 - FY 2016 Continuation of Solicitation for the Office of Science  
Financial Assistance Program**

Application Due Date: September 30, 2016

**H2 Refuel H-Prize Competition**

Deadline: October 31, 2016

[Read more at our website>>](#)

## UPCOMING EVENTS

**[2016 Florida's Women in Energy Leadership Forum](#)**

April 14th, 2016 - April 15th, 2016  
Orlando Marriott World Center

The 2016 Energy Solutions Conference is a sequel to our highly successful Virtual Conferences held in 2013 and event available from wherever you are (via computer or mobile device) PLUS an on-site event, at 2 locations (Tall person AND an Energy Expo.

The Conference will take place as an innovative "modular forum" across a 4 month span, March - June. Part I, the

Click [here](#) for more information.

**[Palm Beach International Agricultural Summit](#)**

May 4, 2016  
Palm Beach County Convention Center  
West Palm Beach, FL

A forum by diverse stakeholders from Palm Beach County whose purpose is to educate the public a its role in advancing quality of life and the economy.

Click [here](#) for more information.

**[Better Buildings Tomorrow 2016](#)**

May 9 - May 11, 2016  
Washington Hilton Hotel  
Washington, DC

The Better Buildings Summit is a national meeting where leading organizations across key sectors s buildings portfolio-wide by 20% over the next ten years. This Summit is designed for partners and demonstrated market solutions with an equal emphasis on discussing future opportunities for great

Click [here](#) for more information.

**[Advanced Bioeconomy Feedstocks Conference](#)**

June 7-8, 2016  
Four Seasons Hotel Miami

Miami, FL

ABFC is the largest gathering of advanced bioeconomy feedstock and supply chain leadership - focusing on advanced technology, logistics and more.

What happens at ABFC? Companies coming out of stealth, product and project milestone announcements, key policy networking re: finance, public-private partnerships, policy, award ceremonies, and a real array of new products and technologies. Watch the event on BioChannel TV.

Click [here](#) for more information.

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**ESCC 2015: 3rd International Conference on Energy, Sustainability and Climate Change**

July 10th - 16th, 2016

Marathon, Athens, Greece

ESCC series aims on bringing together leading experts in the fields of optimization and computational optimization and other trending topics.

Click [here](#) for more information.

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Note from the Editor

Thank you for reading Florida Energy Systems Consortium Newsletter and sharing this newsletter with your colleagues. We try to highlight developments in renewable energy technology and research all across Florida and the world. If you have any news you would like to see featured in the Newsletter, or events you would like to announce, feel free to e-mail [floridaenergysystems@gmail.com](mailto:floridaenergysystems@gmail.com) for posting in the next newsletter and on the **FESC website**: [www.floridaenergy.ufl.edu](http://www.floridaenergy.ufl.edu)