



## EED NEWSLETTER

ENVIRONMENTAL ENGINEERING features the Application of ENVIRONMENTAL Technologies to ENGINEERING Systems to attain OPTIMAL Performance according to ESTABLISHED Standards.

The Newsletter of the Environmental Engineering Division (EED) will attempt to highlight a Variety of Environmental Technology Applications aimed at Enhancing Engineering Systems Performances in accordance with the Latest Standards by presenting Excerpts of and Links to Selected Articles from a Variety of Websites. EED Members are encouraged to forward materials on Environmental Engineering topics for review by the Newsletter Editorial Staff. EED Newsletter Readers are urged to forward comments on materials that appear in its content.

The EED Newsletter will feature presentations in **NINE** Sections:

1. ENVIRONMENTAL TECHNOLOGIES
2. ENVIRONMENTAL REGULATIONS
3. EDITORIAL BOARD SELECTIONS
4. CHAIRMAN/DIVISION NEWS
5. NEWSLETTER READER COMMENTS
6. NEWSLETTER EDITORIAL BOARD
7. NEWSLETTER REFERENCES - TECH
8. NEWSLETTER REFERENCES – REGS
9. EDITORIAL BOARD SELECTION REFERENCES

It is envisioned that the EED Newsletter will be Monthly enterprise involving ALL members of the EED in its production. Your participation in providing and reviewing EED Newsletter materials is encouraged and will be greatly appreciated by the EED Newsletter Editors.

## 1. ENVIRONMENTAL TECHNOLOGIES

### \$2B HYDROELECTRIC STORAGE PROJECT IN VA

Dominion Energy is set to build a \$2-billion pumped hydroelectric storage unit in Virginia to accommodate 240 MW of solar generation it plans to add every year through 2032. The utility has filed a preliminary permit with the Federal Energy Regulatory Commission for a traditional unit in Tazewell County, Va., and it has tapped Virginia Tech to study the feasibility of using an abandoned mine cavity as the lower reservoir of a pumped storage unit at a separate site. The unit could range from 300 MW over 10 hours up to 1,000 MW. Dominion will decide which to build by mid-2018. It would be on line in 2027. (Ref 1)

## 1. ENVIRONMENTAL TECHNOLOGIES

### USDA, DOE ANNOUNCE AWARDS FOR BIOREFINING

The USDA and DOE announced \$15 million in joint funding for projects that will further efforts to develop integrated bio-refineries that utilize new feedstocks, such as wood waste, purpose-grown crops and grasses. Much like a petroleum refinery, a bio-refinery produces multiple products, in addition to fuels. At a petroleum refinery, chemicals make up the higher value products, with fuels acting as loss-leaders. As the biofuels industry has struggled to compete in a low oil price environment, biofuels companies have begun investing in diversifying product streams from fuels to chemicals. Selected projects include:

**Thermochemical Recovery International Inc. (Baltimore, MD)** – improve feedstock and residuals handling at both pyrolysis and gasification reactors.

**Texas A&M Research (College Station, TX)** – use lignin to create diversified and valuable products – e.g., carbon fiber and biodiesel. Carbon fiber is a high strength, low weight product that has many applications, but is expensive and energy intensive to produce. **White Dog Labs (New Castle, DE)** – use residual cellulose to create a higher-value aquaculture feed. Residuals are used for biogas production and the use as a higher-value co-product could significantly improve bio-refinery economics. (Ref 2)

### INTERNATIONAL CONSORTIUM IMPROVES BIOFUEL PRODUCTION

An international research team of researchers from Spain, Poland and Ireland engineered cellulosomes that serve as catalysts in the degradation process. The researchers focused on the clostridium thermocellum bacterium. Capable of converting cellulose into ethanol - especially at elevated temperatures - the bacterium has garnered much interest as an optimal biofuel catalyst. The proposed method is universal and can be applied to multiple mutations. (Ref 3)



## 1. ENVIRONMENTAL TECHNOLOGIES

### **NUSCALE HIGHLIGHTS NON-POWER USE OF SMR**

NuScale undertook a study with Aquatech International on the use of its Small Modular Reactor (SMR) for water desalination. The study looked at using an eight-module plant to produce 50M gallons per day of clean water plus 340 MW to the grid - enough to support a city of 300,000 people. The study considered coupling a NuScale plant to three desalination technologies - reverse osmosis (RO), multi-stage flash (MSF) desalination and multi-effect desalination (MED).

For RO, a single dedicated NuScale module was found to produce up to 340,000 cubic meters of potable water. One module was also found able to produce 30,000 cubic meters of clean water using steam extraction, plus 30 MW of power, when coupled with MSF technology. For MED technology, one module produces some 50,000 cubic meters of water through steam extraction - plus 30 MW of electricity. (Ref 4)

### **SMART WINDOWS WILL LOWER HEATING COSTS**

Smart reflective windows that allow sunlight through during the cold winter months and act like blinds in the hot summer months could reduce the energy consumption for heating and cooling structures by 12 percent. The windows, developed at Eindhoven University are able to reflect invisible infrared light while also allowing visible light through.

Users will either have the option to automate the process based on temperature sensors or to control the process remotely by turning the windows on and off at will. In addition to being used in structures, the smart windows are also suitable for reducing energy consumption in cars and greenhouses. (Ref 5)



## 1. ENVIRONMENTAL TECHNOLOGIES

### COMPANY GIVES OLD WIND TURBINE BLADES A SECOND LIFE

Some wind farms across the U.S. are growing older. While their wind turbine towers show little sign of aging, their blades performance is coming up short. Replacing existing blades with more advanced tech and designs can increase an entire wind farm's performance by up to 25% and extend its life by up to 20 years. But what do you do with the obsolete technology? Crushing a blade yields about 15K pounds of fiberglass waste and creates hazardous dust. Given that the blades are half the length of a football field, sending them to a landfill is not easy.

That's why Ron Albrecht and Don Lilly of Global Fiberglass Solutions Inc. (GFSI) have come up with a better second act. Their Seattle-area-based company, which has been recycling fiberglass since 2008, invented a way to transform the old blades into products like manhole covers, building panels and pallets.

GFSI loads the dismantled blades onto enormous flatbed trucks and hauls them to nearby yards where the blades are shredded into raw fiberglass material known as feedback. A single blade yields about 15-20 bags of feedback weighing between 700 and 1,000 pounds each. GFSI will reuse 100 percent of each blade. GFSI's secret sauce is inside a formula that turns the crushed-up fiberglass into products like manhole covers, which are made of fiberglass mixed with rock and filler.

General Electric (GE) has been working with GFSI to buy back its old wind blades as new products. A single blade makes about 1,000 pallets that can be used for building walkways or vehicle flooring. GFSI has recycled a total 564 blades for GE in less than a year. Based on current plans, GE envisions reuse of 50M pounds of waste in the next few years. (Ref 6)



## 1. ENVIRONMENTAL TECHNOLOGIES

### **LANDFILL GAS FOR DINNER?**

Imagine a world where gas emitted from landfills can be turned into edible protein that ends up on your plate as a burger or a steak. CALYSTA in California and STRING BIO in the Indian city of Bengaluru are among the biotechnology firms that have separately discovered ways to turn methane into protein. Bacteria found in soil are fed a liquid containing the gas, sparking a fermentation process similar to making beer. Instead of alcohol, protein is released into a water mix which is then dried into a brown powder. The product is already being used in animal feed - the first step toward readying it for human consumption.

The companies are betting their products will help alleviate the strain of a growing global population on agricultural land and oceans while natural gas prices trade near the lowest level in almost two decades. STRING BIO - a start-up that won \$200,000 in Indian government grants and CALYSTA - backed by investors including Japan's Mitsui & Co. and Cargill Inc. - hope methane-made protein will become a sustainable food of the future. (Ref 7)

### **CRAYFISH HELP CZECH BREWERY KEEP ITS WATER PURE**

To keep their water supply pure, a Czech brewery utilizes crayfish equipped with high-tech sensors. The PROTIVIN brewery in South Bohemia has placed the creatures - which react quickly to changes in their aquatic environment - in fish tanks through which is pumped water from the same natural source that the brewery uses. The animals are fitted with infrared biosensors that monitor their heartbeat and movement. A computer analyzes the crayfish data and any changes in the animals' body or behavior flags a change in the purity levels of the water in its tank. The water system was developed and patented by scientists at the Faculty of Fisheries and Protection of Water at South Bohemia University in Vodnany. (Ref 8)



## 1. ENVIRONMENTAL TECHNOLOGIES

### **TEEN-AGE ENTREPRENEUR HAS IDEA THAT COULD CHANGE THE WORLD**

Sharon Lin – an 18 year-old first-year student at MIT – recently won the annual Built-by-Girls startup challenge. She was recognized for an app she developed to help impoverished communities around the world cheaply and easily determine whether their water supplies are contaminated with harmful bacteria. The app uses machine learning to analyze photos of water samples and can recognize different bacterial strains.

To show how it works, Lin - who created a company called White Water to develop the app - tested it on photos sent from a family in China. Lin still needs to build out a database of water samples. Her program could have a lot of promise – it was designed so that even people without a background in science could use it to test their water. (Ref 9)

### **TURBOCHARGING ENGINE DESIGN**

For the first time, Argonne's scientists and engineers pinpointed engine designs for a given fuel using the MIRA supercomputer at the heart of the Argonne Leadership Computing Facility (ALCF) - a DOE Office of Science User Facility. With MIRA supercomputing prowess, the Argonne Virtual Engine Research Institute and Fuels Initiative (VERIFI) team simulated over 2,000 engine design combinations and reduced design time from months to weeks.

Engine simulations were conducted with design scenarios from the Aramco Research Center in Detroit, MI - one of three U.S.-based research centers operated by the Saudi Aramco North American subsidiary - Aramco Services Company (ASC). One area of the research seeks to match engine combustion modes with improved fuel properties to create higher efficiency and lower emission transportation technologies. (Ref 10)



## 1. ENVIRONMENTAL TECHNOLOGIES

### **TESLA POWERPACK FOR SOUTH AUSTRALIA**

In September 2016, a 50-year storm damaged critical infrastructure in the state of South Australia, causing a blackout and leaving 1.7 million residents without electricity. Further blackouts occurred in the heat of the Australian summer in early 2017. In response, the South Australian Government - as a leader in renewable energy - looked for a sustainable solution to ensure energy security for all residents - now and into the future. In a competitive bidding process, TESLA was selected to provide a 100 MW/129 MWh Powerpack system. The TESLA Powerpack will charge using renewable energy from the Hornsdale Wind Farm near Jamestown, South Australia (Ref 11)

### **WOODEN SKYSCRAPERS**

For centuries, wood was the building material of choice for buildings. During the Industrial Revolution, steel and concrete took its place. Now we are seeing a resurgence of interest in wood as a construction material. In 2012, the Forte building in Melbourne, Australia set the record for the world's tallest wood structure at 10 stories. Two years later, The Treet - a 14-story building in Bergen, Norway - outdid it. The Treet has now been surpassed by the 18-story Brock Commons. Building at the University of British Columbia in Vancouver, Canada.

Cross-Laminated-Timber (CLT) is the material that allows these structures to be built without safety concerns. It's made from sheets of two-by-fours that are layered together and bound by fire-resistant glue. The grain of each layer is rotated 90 degrees, and as such, the material's structural strength is comparable to that of steel. The US Green Building Council (USGBC) states that 39% of carbon emissions in the USA are the result of the construction of buildings. Wood is far lighter than steel, which makes it easier to transport to a construction site. Furthermore, the foundations for wood buildings do not have to be as deep. Both of these factors serve to cut down construction emission profiles. (Ref 12)

## 1. ENVIRONMENTAL TECHNOLOGIES

### A NEW NAVY PAINT

A new coating developed at the US Naval Research Laboratory (NRL) for the exterior topsides of Navy surface ships was recently tested on an entire ship, the USS Essex (LHD-2), an amphibious assault ship. Before that, the new single-component 1K-polysiloxane coating had only been tested on 400 to 800 ft<sup>2</sup> areas of ships due to limited production quantities and the typical size of topside paint jobs conducted by crews. The application consumed about 320 gallons of the 1K polysiloxane, and took 4 weeks to complete. The performance of the polysiloxane on the USS Essex will be monitored for several years and is expected to save the Navy several million dollars annually once fully in use. (Ref 13)

### ENERGY FROM EVAPORAYION

In the first evaluation of evaporation as a renewable energy source, researchers at Columbia University found that US lakes and reservoirs could generate 325 GW of power - nearly 70 percent of what the United States currently produces. One machine developed in his lab - the Evaporation Engine - controls humidity with a shutter that opens and closes, prompting bacterial spores to expand and contract. The spores' contractions are transferred to a generator that makes electricity. One benefit of evaporation is that it can be generated only when needed. Solar and wind power require batteries to supply power when the sun isn't shining and wind isn't blowing. Batteries are also expensive and use toxic materials. (Ref 14)

### LENS-FREE MICROSCOPY SYSTEM FOR MONITORING AIR QUALITY-1

A cost-effective mobile device for measuring air quality has been developed by UCLA Researchers. This device works by detecting pollutants and then determining their size and concentration by using a mobile microscope attached to a smartphone and a machine-learning algorithm capable of automatically analyzing the images of the pollutants. The UCLA platform, known as c-Air, is just



## 1. ENVIRONMENTAL TECHNOLOGIES

### **LENS-FREE MICROSCOPY SYSTEM FOR MONITORING AIR QUALITY-2**

as precise as the current higher-end equipment, but could cost tens of thousands of dollars less. It is made up of an air sampler and a holographic microscope, which is the size of a computer chip. It is capable of screening 6.5 liters of air in 30 seconds and produces images of the airborne particles. It can be wirelessly connected to a smartphone and functions with a remote computer server by employing a machine-learning algorithm that has the potential to analyze particle size from the images produced. (Ref 15)

### **PAPER FROM LANDFILL BIOGAS**

The Rolland company in Montreal, Canada operates the only paper mill in North America powered by biogas. This energy transformation in the early 2000s from coal-fired energy to biogas began as a suggestion from an employee. In 2002, the Director of Purchasing at Rolland watched a TV documentary about energy and carbon emissions. The program inspired him to dig deeper into what his company could do about pollution. After researching the idea of using biogas produced from decomposing landfill waste, he took his concerns to management.

Within two years, the company had forged multiple community partnerships, built the infrastructure, and began powering their mill operations with renewable biogas from a nearby landfill. An 8-mile long pipeline supplies purified methane gas captured at a landfill supervised by the Waste Management company. The arrangement reduces Rolland's CO<sub>2</sub> footprint by 70,000 tons - the equivalent of taking 23,400 compact cars off the road for one year. (Ref 16)

## 1. ENVIRONMENTAL TECHNOLOGIES

### ASPHALT-LITHIUM BATTERIES

Researchers at Rice University have found that adding asphalt to the anode of lithium metal batteries produce models that charge faster and are less likely to short circuit and fail. To make their new battery, the Rice researchers used untreated Gilsonite - a derivative of asphalt - and mixed it with conductive graphene nano-ribbons. That composite was then coated in lithium metal through the process of electrochemical deposition to create an anode. Combining this anode with a cathode of sulfurized carbon makes the final battery.

The team tested these new asphalt-lithium metal batteries over more than 500 charge-discharge cycles, and found the porous carbon material from the asphalt made the battery more stable. The batteries were found to have a power density of 1,322 watts per kg, and an energy density of 943 watt-hours per kg. Meanwhile, a high current density of 20 mA per square cm means that these batteries could be recharged from empty much faster than standard lithium-ion batteries. (Ref 17)

### NANOMATERIAL EXTRACTS HYDROGEN FUEL FROM SEAWATER - 1

University of Central Florida (UCF) researchers have developed a new hybrid nanomaterial that harnesses solar energy and uses it to generate hydrogen from seawater more cheaply and efficiently than current materials. Tiny nano-cavities were chemically etched onto the surface of an ultrathin film of titanium dioxide, the most common photo-catalyst. Those nano-cavity indentations were coated with nano-flakes of molybdenum disulfide, a two-dimensional material with the thickness of a single atom.

## 1. ENVIRONMENTAL TECHNOLOGIES

### **NANOMATERIAL EXTRACTS HYDROGEN FUEL FROM SEAWATER - 2**

By controlling the density of sulfur vacancy within the nano-flakes, they can produce energy from ultraviolet-visible to near-infrared light wavelengths, making the film at least twice as efficient as current photo-catalysts. Fabricating the catalyst is relatively easy and inexpensive. The UCF team is continuing its research by focusing on the best way to scale up film fabrication. (Ref 18)

### **MORE VALUE FROM RECYCLED POLYSTYRENE**

Employing a proprietary thermo-catalytic process, GreenMantra Technologies (GMT) of Brantford, Ontario in Canada is planning to build a demonstration plant that will recycle 1,000 metric tons per year of polystyrene waste into salable end products. Construction for the plant is slated to begin in 2018. The polymer products resulting from the GMT recycling process have been validated for use in printer ink cartridges applications and can be augmented to produce materials for construction applications, such as insulation. Waste polystyrene is the primary raw material for the GMT process. The company says it has achieved 90% yield of its target products with a minimal production of byproducts. (Ref 19)

### **IEA LIFTS 5-YEAR RENEWABLES FORECAST**

The International Energy agency (IEA) expects global renewable electricity capacity to rise 43% by 2022. In 2016, IEA noted that renewable energy capacity - hydro, solar, wind, bioenergy, wave and tidal grew by 165 GW – 6% more than in 2015. For the first time, Solar PV capacity grew by 50% (74 GW) - faster than any other fuel. The agency sees renewable power rising to 8,169 TWh in 2022 - from 6,012 TWh in 2016 - which is equivalent to the combined electricity consumption of China, Germany and India. IEA in the past has been criticized for underestimating the growth of renewables versus fossil fuels. (Ref 20)



## 2. ENVIRONMENTAL REGULATIONS

### SOLAR PANELS HAVE HIT 2020 COST GOALS

A new report from the Department of Energy (DOE) reveals the cost of solar power has hit its 2020 goal three years early. The DOE has found solar panels have a price of one dollar per watt and \$0.06 per kilowatt-hour. That price hits a milestone set by the DOE Sunshot Initiative in 2010. A new report from the Solar Energy Industries Association (SEIA) notes that utility-scale solar installations accounted for nearly 60 percent of photovoltaic panels installed within the second quarter of 2017. (Ref 1)

### DOE PLEDGES \$32M FOR GRID RESILIENCY - WITH RENEWABLES

DOE has allocated \$32M to develop a more resilient and reliable grid utilizing micro-grids powered by solar energy and renewables. The projects are:

**GRIP** — The Grid Resilience and Intelligence Platform will deploy advanced analytics to shepherd distributed renewables through grid disruptions.

**RADIANCE** — The Resilient Alaskan Distribution System Improvements using Automation, Network Analysis, Control, and Energy Storage focuses on a “zonal” approach that networks micro-grids while reducing the chance of any widespread outages that may occur from either cyber threats or extreme weather.

**Open FMB** is an open-source specifications platform for power systems to improve resiliency through a combination of conventional power sources and distributed renewable energy sources – from biofuels to solar and wind.

**HEMS** — Home Energy Management Systems will leverage new “smart grid” technology to enable interactive energy management for optimal operation down to the granular level of individual households and business facilities.

**Clean Start-DERMS** — The project is interesting in terms of the potential to leverage Distributed Energy Resources (DER) for storm recovery.

**Resilient Distribution Systems** looks at paths to improve integrated energy resource plans with energy storage and regional partnerships. (Ref 2)

### 3. EDITORIAL BOARD SELECTIONS

#### **HYBRID OFFICE BUILDING CUTS CORD TO ELECTRICITY GRID**

The \$8 million Fluid Solar (FS) headquarters in Adelaide, NZ contains more than 2 MWh of energy storage capacity comprised of 90 per cent thermal storage and 10 per cent battery storage. The FS facility has been operating OFF the national electricity grid since April 2017. Surplus electricity generated at the site is used as part of a TESLA car-charging network - with provision of 11 electric vehicle bays that are charged by wind and solar power harvested from a 98 KW array of 378 photovoltaic (PV) solar panels on the building roof. A sustainable “tiny house” was also been built – in just three days – in the building car park to showcase the company’s low cost, low energy accommodation. FS Managing Director Roger Davies has been working on the technology since 2008 and said that the solar thermal element was the key to the building’s success.

Solar PV cells could not produce enough energy to run the building air conditioning system. “Even if you could, the cost of the battery pack becomes so large that it’s difficult to pay the battery pack off before it wears out,” said Davies. “Storage of heat is dramatically cheaper than battery storage and because we also produce the other end - which is the devices that use thermal energy directly for their heating and cooling - it means that 60-70 per cent of the building’s energy requirements are met using solar thermal as opposed to solar PV technology. That allows us to use the rest of the roof – about 60 per cent – to do a conventional PV. So we have a hybrid model between a smaller battery pack running the lights, the lift, the fan systems and so on and the heavy lifting being done by the solar thermal. System.” (Ref 1)

**(CONTRIBUTED BY DR. JAMES ZUCCHETTO, EED NEWSLETTER ASSOCIATE EDITOR)**



## 4. CHAIRMAN/DIVISION NEWS

### ASME ENVIRONMENTAL ENGINEERING DIVISION LOGO

The Environmental Engineering Division (EED) has a Newsletter and is looking to establish social media accounts. We have noted that some of the other ASME Divisions have similar accounts and have Logos that represent them. EED is looking for Logo ideas that we can use in the Newsletter and on social media accounts. We would for you to send us your ideas. We are limiting the search to EED members only at this time. If you have an idea for a Logo, please send it to the following address: Arnie Feldman. Chair, EED, [jjdsenv@att.net](mailto:jjdsenv@att.net)

## 5. EED NEWSLETTER READER COMMENTS

YOU ARE ENCOURAGED TO FORWARD YOUR COMMENTS ON THE TOPICS AND DISCUSSIONS PRESENTED IN THE EED NEWSLETTER. PLEASE FORWARD YOUR COMMENTS BY EMAIL TO ANY MEMBER OF THE EED NEWSLETTER EDITORIAL BOARD. THEIR EMAIL ADDRESSES APPEAR IN THE SECTION BELOW

## 6. EED NEWSLETTER EDITORIAL BOARD

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## 9. EDITORIAL BOARD SELECTION REFERENCES

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**NOTE: IN ORDER TO VIEW THE REFERENCES LISTED ABOVE, IT IS NECESSARY TO SWIPE OVER THE REFERENCE TEXT ON YOUR SCREEN – THEN COPY THE REFERENCE TEXT – AND THEN ENTER THE TEXT COPY INTO A WEB ADDRESS AREA ON A SECOND WINDOW SCREEN TO VIEW THE REFERENCE MATERIAL.**

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