



ENVIRONMENTAL ENGINEERING DIVISION NEWSLETTER

APR - 2018

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 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:

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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

1. IRISH HOTEL POWERED BY UNDERGROUND RIVER

Europe's "First Sustainable Hotel" opened in Ireland in February 2018. The Iveagh Garden on [Harcourt Street](#) in Dublin will source all of its energy from an underground river - running 50 meters below the hotel. Large turbines will convert power from the river Swan to meet all of the hotel's energy requirements. The entire heating, plumbing, cooling and hot water systems in the 40-year old original structure were removed and replaced with a new natural energy system. (Ref 1)



1. ENVIRONMENTAL TECHNOLOGIES

2. WORLD'S FIRST FLOATING WIND FARM

During its first three months in service, the STATOIL Hywind Scotland floating wind farm - the first of its kind - was put to the test and performed better than expected. Hurricane Ophelia in October 2017 pummeled the wind farm with 80 mph winds and 100 mph winds were recorded two months later during Storm Caroline - which added to the test for the wind farm with 26-foot waves! The plant can close down during the worst of the weather, but can automatically come back on stream when conditions improve. Special motion control systems, meanwhile, turn the turbine blades to counter potential wind stress. Operating at about 65% of total design capacity, STATOIL said the plant performed better than its anchored counterparts. Hywind has a design capacity of 30 megawatts. It is located 15 miles off the Scottish coast and can produce enough energy to service 20,000 average households. (Ref 2)

3. USAF AUTOMATES PAINT REMOVAL

A new US AIR FORCE paint removal system uses a laser-equipped robotic arm that moves over an aircraft surface and essentially vaporizes its paint coatings - layer by layer. The process is completely contained. All waste materials - as well as harmful chemicals - are automatically vacuumed up by the system. A vision subsystem recognizes when the stripping reaches the appropriate stopping point. The completely automated process removes the direct human element - both in terms of error and exposure. Operators guide the effort from a computer console in a nearby control room. The laser de-paint process is much safer since the human interface is removed from the immediate work area. The fully automated process does not require maintenance crews to be in the paint stripping area. Since the process is wholly contained, waste is automatically removed to a collection area - thus requiring little cleanup by personnel. The process is also faster and saves significant labor hours and associated costs. (Ref 3)



1. ENVIRONMENTAL TECHNOLOGIES

4. FARMING CROPS WITH ROCKS

Pioneering research by scientists at the University of Sheffield suggests that adding fast-reacting silicate rocks to croplands could capture CO₂ and give increased protection from pests and diseases while restoring soil structure and fertility. The new farming procedure involves amending soils with abundant crushed silicate rocks - like basalt – which are left over from ancient volcanic eruptions. As these minute rock grains dissolve chemically into soils, they take up carbon dioxide and release plant-essential nutrients.

Benefits of the new farming technique include a reduction in the usage of agricultural fertilizers and pesticides, thereby lowering the total cost of food production and an increase in the profitability of farms. Arable farms already apply crushed rock in the form of limestone to reverse acidification of soils. Managed crops, therefore, have the logistical infrastructure such as the road networks and machinery needed to undertake this approach at scale. These considerations make the new process fairly straightforward to adopt. (Ref 4)

5. MAKING “DUMB” GLASS “SMART” - 1

SMART GLASS windows can be electronically tinted to block the sun's hot rays, thus reducing the need to run air-conditioning systems. Such systems still require electricity to operate. Now, scientists from Australia's RMIT University have developed a coating that allows existing glass to become smart - no power required. The self-regulating coating is just 50-150 nanometers thick. At surface temperatures below 67 °C (153 °F), vanadium dioxide acts as an insulator, helping to keep indoor heat from escaping through the window glass. It also allows the full spectrum of sunlight to enter from the outside. At temperatures above 67 °C, however, it transforms into a metal that blocks heat-causing infrared solar radiation from entering.



1. ENVIRONMENTAL TECHNOLOGIES

5. MAKING “DUMB” GLASS “SMART” – 2

This means that rooms stay warmer when temperatures are lower and cooler when they're higher - allowing for less use of both heating and air-conditioning systems. Additionally, if users wish, they can override the coating's ray-blocking effect using a dimmer switch. Previously, in order to apply vanadium dioxide coatings, specialized layers – or platforms – had to be created on the surface. The RMIT team, however, has developed a method of applying the coatings directly to surfaces such as window glass, without the need for platforms. The RMIT research team is working diligently to commercialize the system quickly. (Ref 5)

6. HUMAN-MADE EARTHQUAKE RISK REDUCED IN FRACKING

The risk of human-made earthquakes due to fracking operations is greatly reduced if high-pressure fluid injection used to crack underground rocks is 895m away from faults in the Earth's crust, according to new research. The recommendation, from the ReFINE (Researching Fracking) consortium, is based on published data from 109 fracking operations carried out predominantly in the USA. Researchers used micro-seismic data to estimate how far fracking-induced fractures in rock extended horizontally from borehole injection points.

The results indicated there was a 1% chance that fractures from fracking activity could extend horizontally beyond 895m in shale rocks. There was also a 32% chance of fractures extending horizontally beyond 433m, which had been previously suggested as a horizontal separation distance between fluid injection points and faults in an earlier study. The latest findings go further than a 2017 ReFINE study that recommended a maximum distance of 433m between horizontal boreholes and geological faults. That research was based upon numerical modeling in which a number of factors, including fluid injection volume and rate, and fracture orientation and depth, were kept constant. (Ref 6)



1. ENVIRONMENTAL TECHNOLOGIES

7. WIND AND SOLAR POWER IN USA

The United States could reliably meet 80% of its electricity demand with solar and wind power generation, according to scientists at UC Irvine; Cal Tech and the Carnegie Institute. However, meeting 100% of electricity demand with only solar and wind energy would require storing several weeks' worth of electricity to compensate for the natural variability of these two resources. The team analyzed 36 years of U.S. weather data (1980 to 2015) to understand the fundamental geophysical barriers to supplying electricity with only solar and wind energy.

The researchers said that expansion of transmission or storage capabilities would require substantial investment. The cost of the new transmission lines could be \$100B. In comparison, storing electricity with today's cheapest batteries would likely cost more than \$1T. Other forms of energy stockpiling, such as pumping water uphill to later flow back down through hydropower generators, are attractive but limited in scope. The U.S. has a lot of water in the East but not much elevation, with the opposite arrangement in the West. (Ref 7)

8. NEW CROPS NEED LESS WATER - 1

An international team of scientists - led by the University of Illinois - discovered that a specific protein called Photosystem II Subunit S (PsbS) could be increased to force a plant to partially close its stomata. The stomata – which are tiny pores in a leaf - open and close to either let carbon dioxide in or oxygen out, regulating the process of photosynthesis. The initial hypothesis was that by limiting the stomata opening, a plant would not lose as much water through transpiration and subsequently not need as much water to grow. Since atmospheric carbon dioxide has increased by 25% in less than a century, the researchers suspected that a plant could take in the carbon dioxide it needs with less opening of the stomata.

1. ENVIRONMENTAL TECHNOLOGIES

8. NEW CROPS NEED LESS WATER - 2

The hypothesis was tested on a tobacco crop and the results were incredible. By increasing PsbS capacities, stomata openings were reduced, and the ratio of carbon dioxide going into a plant to water escaping improved by 25%. This effectively meant the plant would need 25% less water to achieve the same rate of photosynthesis. The experiment also showed no significant difference in overall yield or size between modified and non-modified plants. While the easy modification and fast lifecycle of tobacco crops proved a successful case study for the process, the next stage of the research is to test it in food crops in conditions simulating water-limited conditions. The research suggests that since the role of PsbS in plants is relatively universal this process should be similarly effective when transferred to common food crops. (Ref 8)

9. REPLACING LITHIUM ION BATTERIES

Researchers from RMIT University in Melbourne, Australia have demonstrated for the first time a working rechargeable "proton battery" that could rewire how we power our homes, vehicles and devices. The rechargeable battery is environmentally friendly, and has the potential, with further development, to store more energy than currently available lithium ion batteries. Potential applications for the proton battery include household storage of electricity from solar photovoltaic panels, as done currently by the Tesla 'Power Wall' using lithium ion batteries. The working prototype proton battery uses a carbon electrode as a hydrogen store, coupled with a reversible fuel cell to produce electricity. It's the carbon electrode plus protons from water that give the proton battery its environmental, energy and potential economic edge. (Ref 9)

1. ENVIRONMENTAL TECHNOLOGIES

10. NUCLEAR FUSION FUTURE

The dream of nuclear fusion is on the brink of being realized, according to a major new US initiative that says it will put fusion power on the grid within 15 years. A collaborative effort between scientists at MIT and the Commonwealth Fusion Systems Company will take a radically different approach to transform fusion from an expensive science experiment into a viable commercial energy source. The team intends to use a new class of high-temperature superconductors they predict will allow them to create the world's first fusion reactor that produces more energy than it needs to be input to get the fusion reaction going. The private company has attracted \$50 million in support of this effort from the Italian energy company Eni.

A newly available superconducting material – a steel tape coated with a compound called yttrium-barium-copper oxide, or YBCO – has allowed scientists to produce smaller, more powerful magnets. This potentially reduces the amount of energy that needs to be generated to get the fusion reaction off the ground. The experimental reactor is designed to produce 100MW of heat. The scientists anticipate the output would be more than twice the power used to heat the fusion plasma, thus achieving the ultimate technical milestone: positive net energy from fusion. (Ref 10)

11. CARBON WASTE IMPROVES CONCRETE - 1

A Washington State University (WSU) research team is solving a high-tech waste problem while addressing the environmental challenge of storm water run-off. The researchers have shown they can greatly strengthen permeable pavements by adding waste carbon fiber composite material. Furthermore, their recycling method doesn't require using much energy or chemicals.

1. ENVIRONMENTAL TECHNOLOGIES

11. CARBON WASTE IMPROVES CONCRETE - 2

Unlike the impermeable pavement that is used for most roads and parking lots, permeable concrete allows rainwater to freely drain and seep into the ground underneath. Because of increasing concerns about flooding in urban areas and requirements for controlling storm water run-off, several cities have tried using the permeable concrete in parking lots and low-traffic streets. But because it is highly porous, it is not as durable as the traditional concrete used on major roads.

The WSU researchers added carbon fiber composite scrap that they received from Boeing manufacturing facilities to their permeable concrete mix. They used mechanical milling to refine the composite pieces to the ideal sizes and shapes. The added material greatly increased both the durability and strength of the permeable concrete.

The WSU researchers used inexpensive milling techniques instead of heat or chemicals to create a reinforcing element from the waste carbon fiber composites. They maintained and made use of the original strength of the composites by keeping them in their cured composite form. Their mix also required using a lot of the composite material – producing an ideal market for waste producers.

The composite materials were dispersed throughout the pavement mix to provide uniform strength. While they have shown the material works at the laboratory scale, the researchers are beginning to conduct real-world tests on pavement applications. They are also working with industry to begin developing a supply chain. The research for this project was made possible through a partnership with the Boeing Company. (Ref 11)



1. ENVIRONMENTAL TECHNOLOGIES

12. A CLOSED-LOOP WASTE MANAGEMENT SYSTEM

In Canada, the city of [Surrey Biofuel Facility](#) officially opened in British Columbia. The \$68 million facility is the first fully integrated closed-loop organic waste management system in North America. It converts curbside organic waste into renewable biofuel for the City's fleet of gas-powered waste collection and service vehicles. Under this closed loop system, waste collection trucks will literally be collecting their fuel source at curbside. Excess fuel will go to the new district energy system that heats and cools Surrey's City Center. The Biofuel Facility will divert 115,000 tons of organic waste from landfills and produce 120,000 Gigajoules of [renewable natural gas](#) plus 45,000 tons of nutrient-rich compost annually. The City of Surrey collects 65,000 tons of organic waste per year but the processing capacity of the facility can meet a demand of 115,000 tons per year.

The facility uses a [non-thermal Anaerobic Technology](#) (AT) to process organic waste. The biogas that is naturally generated from this process is captured and upgraded onsite to create Renewable Natural Gas (RNG) that is then injected directly into the local gas grid. The remaining organic matter is placed inside composting tunnels where nutrient-rich compost is produced. A portion of the compost produced will be used within the City's parks and boulevards. The 40 compressed natural gas (CNG) waste collection vehicles that operate in the city will collectively consume approximately [65,000 Gigajoules of the RNG annually](#). The remaining RNG will be used to fuel the growing number of CNG municipal fleet vehicles servicing the city as well as a number of municipal buildings including their district energy system. While the Surrey Biofuel facility is owned by the city, it was established via a [Public-Private Partnership](#). The Government of Canada funded 25% of the cost of the facility and Renewi PLC funded the remaining 75%. Based in the UK, Renewi is responsible for the design and build of the facility and will operate and maintain it on behalf of the City of Surrey for a 25-year period. (Ref 12)

2. ENVIRONMENTAL REGULATIONS

1. RENEWABLES CATCH UP TO NUCLEAR POWER

The Sustainable Energy in America Fact Book showed renewable energy made up 18% of the nation's electricity production spurred on by two countervailing factors in the energy market: the reduction in natural gas-fired electricity and a rise in hydro-electric output in the West. Nuclear power likewise provides around 19% of the U.S. total electricity output. Renewables achieved new heights partly due to a rebound in hydro as reservoir levels on the West Coast recovered after a severe, prolonged drought. In the same time, a chart-busting number of wind and solar projects built in 2016 had their first full year of operation in 2017, bolstering non-hydro renewable generation by 15%.

Over 18 Gigawatts of new additions came online in 2017, marking another boom year for renewables - second only to 2016's 22.7 Gigawatts of new wind and solar. To provide some scale, 1 Gigawatt is the combined power output of 500 utility-scale wind turbines and 4.6 million solar photovoltaic solar panels, according to the US Energy Department. Despite the surge in solar and wind, fossil energy remained on top - with natural gas retaining its position as the No. 1 producer of U.S. power - as electricity production from coal slipped. (Ref 1)

2. EUROPEAN CITIES FACE MORE EXTREME WEATHER - 1

New research, by Newcastle University, UK, has for the first time analyzed changes in flooding, droughts and heat waves for all European cities using all climate models. Southern European cities will see the biggest increases in the number of heat wave days, while central European cities will see the greatest increase in temperature during heat waves -- between 2°C to 7°C for the low scenario and 8°C to 14°C for the high scenario.

2. ENVIRONMENTAL REGULATIONS

2. EUROPEAN CITIES FACE MORE EXTREME WEATHER - 2

For changes in droughts and floods, the cities that are affected depend on the scenario. For the low impact scenario, drought conditions only intensify in southern European cities while river flooding only worsens in northern ones. The British Isles have some of the worst overall flood projections. Even in the most optimistic scenario, 85% of UK cities with a river -- including London -- are predicted to face increased river flooding, while for the high scenario, half of UK cities could see at least a 50% increase on peak river flows.

Of the European capitals, Dublin, Helsinki, Riga, Vilnius and Zagreb are likely to experience the most extreme rise in flooding. For the high impact scenario, several European cities could see more than 80% increases on peak river flows, including Santiago in Spain, Cork and Waterford in Ireland, Braga and Barceló in Portugal and Derry/ Londonderry in the UK.

Stockholm and Rome could see the greatest increase in number of heat-wave days while Prague and Vienna could see the greatest increase in maximum temperatures during heat waves. Lisbon and Madrid are in the top capital cities for increases in frequency and magnitude of droughts, while Athens, Nicosia, Valletta and Sofia might experience the worst increases in both drought and heat wave instances.

The United Nation's Intergovernmental Panel on Climate Change (IPCC) has recognized the important role cities must play in tackling climate change and will hold its first Cities and Climate Change Science Conference, in Edmonton, Canada. (Ref 2)



2. ENVIRONMENTAL REGULATIONS

3. ARLINGTON COUNTY, VA WINS US GREEN BUILDING AWARD

Arlington County, VA is the first community in the country to win a top award for environmentally friendly policies from the U.S. Green Building Council. USGBC said the certification recognizes the county's creation of a "sustainable and resilient urban environment that has long-proven success in reducing greenhouse gas emissions, managing storm water, ensuring economic prosperity and focusing on education, affordable housing, health and safety for residents and businesses."

Arlington's sustainability story began with thoughtful Metrorail planning in 1960, followed by the Smart Growth strategies outlined in the county General Land Use Plan of 1961

The County launched its Arlington Initiative to Rethink Energy (AIRE) effort in 2007. AIRE set a target to reduce Arlington County government's carbon emissions by 10 percent by 2012, compared to 2000 levels, and achieved it by improving energy efficiency in the County government's buildings, vehicles and infrastructure and other efforts.

The 2013 County Community Energy Plan (CEP) established a goal of reducing greenhouse gas emissions 75 percent by 2050. Arlington's green building policies support the plan's goals by encouraging the construction of buildings that are energy and water efficient while providing healthy indoor environments.

Most recently, the County became the first locality in the state to approve a Commercial - Property Assessed Clean Energy (C-PACE) program – a public-private partnership to provide affordable, long-term financing for projects to improve the Energy Efficiency of commercial buildings in the County. (Ref 3)



2. ENVIRONMENTAL REGULATIONS

4. LOS ANGELES RESILIENCE PLAN

Facing the risks of earthquakes, rising heat and bustling urban demands for energy, Los Angeles is kicking off a strategy to make itself more resilient by the end of 2018. Plans include strengthening infrastructure, promoting renewable energy, and protecting residents and neighborhoods said officials from the City and team members from the Rockefeller Foundation's 100 Resilient Cities project.

The strategy aims to combine preparations for sudden shocks such as earthquakes or wildfires with chronic stresses such as climate change, they said. "We can't wait for catastrophes to hit before confronting them," LA Mayor Eric Garcetti said in a statement. "We need a comprehensive, strategically coordinated approach to urban resilience."

One goal is to make earthquake early-warning technology available to all LA residents by the end of 2018. Another is to reduce urban heat islands - when pavement and buildings replace natural land cover - in part by planting more trees. Additional efforts will involve preparing residents to be self-sufficient for at least seven days by 2022, modernizing the power grid to boost the use of renewable energy by 2036, and investing in storm water retention to reduce flooding risks by 2028. The Rockefeller Foundation "Resilience Project" provided seed money to help design the program strategies. (Ref 4)

5. MICRO-GRID PLANS IN CALIFORNIA - 1

California is hoping that lessons learned from a new micro-grid project at Humboldt County's regional airport will help create a road map for micro-grid integration in the state. The system - designed by the Schatz Energy Research Center at Humboldt State University in Arcata, CA - features a 2.3-MW solar PV array and an 8-MWh-battery storage system.



2. ENVIRONMENTAL REGULATIONS

5. MICRO-GRID PLANS IN CALIFORNIA – 2

It will support 18 electric accounts, including the airport in Humboldt County and the U.S. Coast Guard Air Station at Humboldt Bay. The California Energy Commission in February awarded a \$5 million grant through its Electric Program Investment Charge (EPIC) program that will support \$6 million in matching funds from the Redwood Coast Energy Authority (RCEA) for final development of the micro-grid. The Schatz Center said that the micro-grid - which will be the first multi-customer micro-grid in the Pacific Gas and Electric service territory - will provide a test bed for the policies, tariff structures, and operating procedures necessary to integrate micro-grids into California's electric grid.

"The Redwood Coast Energy Authority is excited to be partnering with the Schatz Center, PG&E, and the County," Matthew Marshall, executive director of the RCEA, said in a statement. "This project will allow us to provide enhanced resiliency and emergency-response capabilities for the airport and Coast Guard and deliver the environmental and economic benefits of developing our local renewable resources." (Ref 5)

3. EDITORIAL BOARD SELECTIONS

1. HEAT RESISTANT MAGNETS FOR ELECTRIC MOTORS - 1

Toyota Motor Corporation has developed the world's first neodymium-reduced, heat-resistant magnet. Neodymium (Nd) magnets are used in various types of motors such as the high-output motors found in electrified vehicles. The new magnet uses significantly less neodymium, a rare-earth element, and can be used in high-temperature conditions.



3. EDITORIAL BOARD SELECTIONS

1. HEAT RESISTANT MAGNETS FOR ELECTRIC MOTORS - 2

The newly developed magnet uses no terbium (Tb) or dysprosium (Dy)—rare earth materials that are also regularly categorized as critical materials for highly heat-resistant neodymium magnets. A portion of the neodymium has been replaced with lanthanum (La) and cerium (Ce) – both elements that are low-cost rare earths - reducing the amount of neodymium used in the magnet.

Neodymium plays an important role in maintaining high coercivity (the ability to maintain magnetization) and heat resistance. Merely reducing the amount of neodymium and replacing it with lanthanum and cerium results in a decline in motor performance. Accordingly, Toyota adopted new technologies that suppress the deterioration of coercivity and heat resistance - even when neodymium is replaced with lanthanum and cerium - and developed a magnet that has equivalent levels of heat resistance as neodymium magnets - while reducing the amount of neodymium used by up to 50%.

Toyota expects this new magnet to be useful in expanding the use of motors in various products such as automobiles and robotics as well as in maintaining a balance between the supply and demand of valuable rare earth resources. Toyota will work to enhance motor performance in new products while accelerating the development of the associated motor mass-production technologies. (Ref 1)

2. GLOBAL RENEWABLE POWER CITIES - 1

The global environmental impact non-profit CARBON DISCLOSURE PROJECT (CDP) holds information from over 570 of the world's cities. In a new listing, CDP names over 100 cities that are now getting at least 70% of their electricity from renewable sources such as hydro, geothermal, solar and wind.



3. EDITORIAL BOARD SELECTIONS

2. GLOBAL RENEWABLE POWER CITIES - 2

The CDP listing includes large cities such as Auckland (New Zealand), Nairobi (Kenya), Oslo (Norway), Seattle (USA) and Vancouver (Canada). The new listing more than doubles the 42 cities that reported being powered by at least 70% clean energy in 2015. Cities now powered by 100% renewable electricity include:

Burlington, USA: Vermont's largest city now obtains 100% of its electricity from wind, solar, hydro, and biomass. The city has its own utility & citywide grid.

Reykjavik, Iceland: sources all electricity from hydropower and geothermal, and is now working to make all cars and public transit fossil-free by 2040. The country of Iceland has almost entirely transitioned to clean energy for power.

Basel, Switzerland: is 100% renewable powered. 90% of electricity comes from hydropower and 10% from wind. In May 2017, Switzerland voted to phase out nuclear power in favor of renewable energy. (Ref 2)

3. BATTERIES FROM RECYCLED BOTTLES - 1

Batteries made with silicon anodes could help boost battery life. Now a team at the University of California Riverside (UCR) has shown that these batteries can be environmentally friendly too - by being sourced from glass bottles headed for the scrap heap! While they have the potential to store up to 10 times more energy than graphite, silicon anodes aren't quite as durable. The expansion and contraction that comes with regular battery use results in the cracking of anode material and wears the silicon anodes down much faster than their graphite partners. Past work has found that crushing the silicon first helped to overcome the extension problem. With durability addressed, the UCR research team has now found a new source of silicon for producing batteries: discarded glass bottles.



3. EDITORIAL BOARD SELECTIONS

3. BATTERIES FROM RECYCLED BOTTLES - 2

First, the bottles are crushed and ground down into a fine, white powder. Next, the powder is reduced to a nano-structured silicon array with the application of hot magnesium. Finally, the nanoparticles arrays are coated with carbon - which makes them more stable and improves their energy storage capacity. When tested in coin cell batteries over 400 cycles, the bottle-based silicon anodes demonstrated a capacity of about 1,420 mAh/g (milliamp hours per gram) - a huge improvement over the storage capabilities of graphite anodes that typically manage only about 350 mAh/g. The researchers say that the process is viable, thanks to the low-cost chemical reaction and the fact that each bottle can create enough nano-silicon to make hundreds of coin cell batteries. The team has filed a patent to commercialize the process and products. (Ref 3)

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

4. CHAIRMAN/DIVISION NEWS

The National Academy of Sciences (NAS) recently released report, "Indicators for Monitoring Undergraduate STEM Education," explains that policy makers and the public face challenges in understanding whether STEM education initiatives are, "accomplishing their goals and leading to nationwide improvement in undergraduate STEM education."

The report proposes a conceptual framework for a national STEM Education Indicator System that would examine the current state of STEM education and the necessary steps to improve outcomes. It provides 3 overall goals, along with 21 progress indicators for monitoring trends in the quality of STEM education. To view the full report, click here: <https://www.nap.edu/catalog/24943/indicators-for-monitoring-undergraduate-stem-education>



5. EED NEWSLETTER READER COMMENTS

FORWARD YOUR COMMENTS ON THE EED NEWSLETTER BY EMAIL TO THE NEWSLETTER EDITORIAL BOARD. THEIR EMAILS APPEAR BELOW.

6. EED NEWSLETTER EDITORIAL BOARD

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2. https://www.triplepundit.com/2018/02/100-global-cities-get-majority-electricity-renewables/?utm_source=Daily+Email+List&utm_campaign=59fb30a71e-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_9dedefcee3-59fb30a71e-220508121
3. <https://newatlas.com/glass-bottle-recycled-batteries/49148/>

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

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