ENVIRONMENTAL SYSTEMS DIVISION NEWSLETTER

01 MARCH 2021

The ESD Newsletter is a monthly newsletter involving ALL members of ESD. Members are encouraged to forward materials, authored papers on Environmental and Environmental Systems topics, and comments on newsletter topics or current events to the Editor. Your participation is greatly appreciated.

The ESD newsletter features **Five** Sections:
(Please use the **blue** links below to navigate within the newsletter)

1. ESD DIVISION NEWS

ASME ENERGY STORAGE COMMITTEE

The Energy Generation and Storage Technology Group (EGSTG) formed a new Energy Storage Committee (ESC) in the Spring of 2020. The ESC is dedicated to the advancement of energy storage systems: for both utility and distributed systems. The focus of ESC extends across most of the other ASME Divisions and Sectors. This Committee works with the government, industry, academia, ASME Codes & Standards, ASME Government Relations and other relevant professional and regulatory organizations to discuss, review, and promote practices that lead to the development, enhancement, and deployment of energy storage technologies.
The core values of ESC are to:

- Support international/intersociety professionals wishing to advance the application of energy storage thru basic research applied research, development, and implementation
- Create and publish peer-reviewed high-value content, reference documents
- Facilitate the creation, dissemination, and application of knowledge (science, engineering, technology) and information in energy storage within and outside ASME
- Attract students and young engineers into this area and provide them a forum to grow and advance their careers
- To encourage and facilitate a process for members to provide their expertise in the standards-setting process for energy storage
- To promote codes and standards for new areas energy storage
- To provide closer interface within and outside ASME through joint efforts/collaboration
- To help members keep pace with the latest developments

The main purposes of the Committee are fivefold:

- To develop and maintain the Energy Storage Matrix so that all (not only those on the Committee) know the status of the various technologies
- To develop standards (both ASME and IEEE as well as others) for energy storage: the Committee is a resource (e.g., people, volunteers, knowledge) for the various groups working on standards
- As central coordinating Committee (group) for sharing knowledge and answering questions on Energy Storage
- As a networking center for those directly (and indirectly) working on Energy Storage
- To develop events on Energy Storage such as webinars, forums, and conferences

ESC members include engineers (and others) conducting research and practicing engineers in energy storage, storage equipment design, regulatory programs, operations, design, maintenance, and testing of energy storage systems. Membership on the ESC is open to all ASME members, other professional society's (e.g., IEEE, AIChE, etc.), the governmental and regulatory community, and other interested individuals. Membership on the Committee is free to all. The intent is for the ESC to transition into an ASME Energy Storage Division in approximately one to two years. If you are interested in becoming a member of the Committee or need more information, please contact Arnie Feldman, Chair (jjdsenv@att.net).

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ASME Environmental Systems Division ACES Representative

ESD intends to partner once again as a member division with the ASME Alternative Clean Energy Summit (ACES) event; this will be the 3rd annual event and once again it will be a virtual event. ESD is looking for an ESD member to be its representative on the Planning Committee. If interested please contact Ryan Neil ESD Chair @ *ryanneil84@hotmail.com*.

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ASME E-Fests® ESD Student/Early Career Environmental Competition

ESD in conjunction with ASME E-Fests® held its first ever ESD Student/Early Career Environmental Competition. The Competition is open to all College, Post Graduate and Early Career engineers and is divided into three rounds. This year there was an insufficient number

of abstracts submitted for the Post Graduate and Early Career levels but there were 18 submittals in the undergraduate level. The judges have determined the ten (10) winners of the 1st round (written abstracts) who will move onto the 2nd round (video presentation of their abstracts). The ten winning teams are (in alphabetical order by abstract subject):

- "Converting Waste to Hydrogen Fuel", Elon Goliger & Nico Pesci, San Francisco State University
- "DSSC", Samim Molla' IIEST Shibpur
- "Ecowarriors", Roma Patoriya & Pushprajsinh Chauhan, Marwadi University
- "Electricity from Flue Gas", Arya Vyavahare, MKSSS Cummins College of Engineering for Women
- "Energy Solutions from Urban Waste", Itay Rubin, NYC College of Technology
- "Garbage Disposal", Anand D Revgade & Shreyas N Dhisale, Walchand College of Engineering
- "Green Energy from Agriculture Waste", Frenny Luvania Paye Yucra, Universidad Nacional del Altiplano
- "Integrated Waste Management", Jalil Satria Wibowo & Nikita Mayllenia Soebagio,Universitas Gadjah Mada
- "Waste from Vegetable Market", Md. Fahim Hossain & Md. Mahadi Hassan, Chittagong University of Engineering & Technology
- "Waste to Energy", Kamlesh Sahu & Ankan Mann, IIEST Shibpur

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2. ENVIRONMENTAL TECHNOLOGIES

Smart Solutions Help Farmers Adapt to Changing Climate

No industry is immune from the effects of climate change, but agriculture is among the most vulnerable. As farmers learn to adapt to a changing climate, the industry must also reduce its own carbon intensity by 2030 in alignment with the Paris Agreement to reduce greenhouse gas emissions. Farm machinery, fertilizers, and even livestock contribute to emissions that need to come under tighter controls. Efficiency saves time, saves money, and supports a profitable future by allowing agricultural enterprises to scale and grow. For example, xFarm, a digital platform for agriculture, enables farmers to keep up with regulations and certifications, and track every step and location of an agricultural product. Field sensors and IoT technology make this possible. Similarly, a company called Agricolus provides data collection technology to monitor and forecast weather, disease, pests, fertilizers, and other adversities as a tool for crop optimization. SinaSens Smart Agri uses sensors to reduce water consumption, increase crop quality and yield, and anticipate and reduce leaf-borne diseases.
Back In 2013, during the Obama administration, The United States Department of Agriculture (USDA) released a report about farming adaptation, calling for research into this type of sensor technology to improve management tools. Today's advances in machine learning and artificial intelligence (AI) have enabled a shift from older polluting industrial agriculture methods to

more sustainable approaches. Take, for instance, 3Bee Hive-Tech, an IoT (Internet of Things) monitoring system that uses AI to diagnose disease and anomalies in farm animals at an early stage, allowing for a reduction in chemical and antibiotic treatments. Solutions now exist, but getting them into the mainstream is sometimes more challenging. The agriculture industry is not alone in its reluctance to change. The Union of Concerned Scientists writes that the "industrial model that dominates agriculture – a model that neglects soils, reduces diversity, and relies too heavily on fertilizers and pesticides – makes US farms susceptible to climate impacts in several ways." The Solar Impulse Foundation addresses climate impacts by finding and validating at least 1000 solutions that support a green economy through profitable approaches that protect the environment. Agricultural systems are now capable of effectively zapping weeds with solar and wind-powered electricity instead of using chemical herbicides. Patented steam technology eliminates weeds and improves soil conditions without pesticides, and increases yield by 70 percent. Not only does this keep pesticides out of our foods, but also out of our water supply by eliminating runoff. Farms are starting to use zero-emission battery-powered electric tractors charged by wind or solar instead of diesel. Natural food additives are helping to achieve 85% methane reduction in dairy cows and beef cattle. And seed-coating technology boosts water and nutrient intake to increase yield without fertilizers.. (Ref. 1)
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NREL looks at barriers to lithium-ion battery recycling and sees opportunities

Researchers at the National Renewable Energy Laboratory (NREL) released a report detailing the technological, market, and regulatory hurdles to creating a circular economy for lithium-ion batteries. The battery technology is increasingly in demand for energy storage and use in electric vehicles (EVs). But its current lifecycle is almost entirely one-way, from manufacture to consumption to disposal, with little thought given to reuse or recycling. Only one U.S. lithium-ion battery recycling facility exists today. To start to rethink the one-way lifecycle, the NREL team assessed the current state of reuse and recycling of large-format lithium-ion batteries used in EVs and battery energy storage. They found that reusing and recycling the batteries could create U.S. market opportunities, stabilize the supply chain, reduce environmental impacts, and ease resource constraints. And they found that a circular economy would derive more value from battery energy storage systems. Materials would be reused, recycled, or refurbished for multiple lifetimes rather than one-and-done, which uses up finite resources and creates waste. The researchers said that technology, infrastructure, and processes are current barriers. For example, lithium-ion battery designs and makeup vary by manufacturer, making it hard to design a standard process to cost-effectively reuse or recover materials. In addition, scant reliable, publicly available information exists on the state or volume of retired lithium-ion batteries, or on the cost to recondition them for other uses. The analysts recommended government-funded research, development, analysis, and incentives, as well as information exchanges, to increase knowledge and boost private investment. Based on their findings, NREL analysts highlighted existing regulations that could impact the installation and grid interconnection of repurposed lithium-ion batteries. (Ref. 2)
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3. ENVIRONMENTAL REGULATIONS

FDA retains oversight of genetically modified animals for therapeutics

On former president Donald Trump's last day in office, the US Department of Health and Human Services (HHS) and US Department of Agriculture (USDA) agreed that oversight of genetically modified (GM) animals for food will move from the FDA to the USDA. The FDA, however, retains oversight of gene editing intended for any purpose other than agricultural use, including Bio/pharma and gene therapies. The Trump administration's decision to relax oversight of GM animals for food prioritises big businesses and the livestock industry, while overriding FDA scientists in decisions around GM animal use. The then–FDA commissioner Stephen Hahn expressed concerns about potential public health consequences of relaxing regulations around certain GM products. After the announcement he tweeted, "FDA has no intention of abdicating our public health mandate." It is unclear whether President Biden's administration or the FDA commissioner to be nominated will support these regulatory changes to agricultural biotechnology. A GM animal is one whose genetic material has been altered by adding, changing, or removing certain DNA sequences in a way that does not occur naturally. GM animals are in development for many potential uses in Bio/pharma, including for pharmaceutical drug production, as research models of human disease, and in xenotransplantation to make cells, tissues, or organs for transplantation into humans.

According to the GlobalData Pharma Intelligence Center Drugs database, several therapeutic recombinant biologic drugs are produced in transgenic (GM) animal expression systems, including four marketed drugs (Figure 1). In 2009, the FDA approved rEVO Biologics' antithrombin (recombinant) produced in the milk of GM goats for patients who have a rare disease known as antithrombin (AT) deficiency. Pharming's Conestat alfa, a human recombinant C1 esterase inhibitor purified from the milk of GM rabbits, was approved by the FDA in 2014 for the treatment of hereditary angioedema. In 2015, the FDA approved Alexion Pharmaceuticals' sebelipase alfa for a rare genetic disease known as lysosomal acid lipase (LAL) deficiency, produced in the egg whites of GM chickens. In 2019, the FDA's Center for Veterinary Medicine (CVM) approved a GM rabbit that produces the active ingredient of LFB's coagulation factor VIIa (recombinant). The therapeutic was approved in 2020 for the treatment and control of bleeding episodes occurring in adults and adolescents with haemophilia A or B with inhibitors. In addition, Pharming Group has one Phase III and two preclinical-stage candidates in development, which are produced using the company's transgenic rabbit platform. (Ref. 3)

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State regulatory crackdowns may swing low-CO_2 electricity

Utility regulators in several states are taking the unusual step of telling electric companies to redo their long-term energy road maps, a move that could dramatically alter the trajectory of fossil fuels and renewables. The action from Mississippi to Virginia is aimed at bringing more carbon-free sources online and could force utilities to close their remaining coal-fired power plants early and add more battery storage, wind and solar to their systems. Removing fossil fuels and adding renewables also will inch states closer to meeting President Biden's proposal

to decarbonize the power sector by 2035. For climate advocates, the shift is a breath of fresh air: State utility regulators are known for rubber-stamping an electric company's integrated resource plan (IRP) or brokering deals that lead to small, inconsequential changes. Now many regulators are changing course so electric companies' plans fall in line with state clean energy laws enacted in the past few years. The shift currently is apparent in three states, although others could follow, depending on when and how they handle IRPs, analysts say.

IRPs arguably are the most important part of what an electric company does outside of producing and distributing power. They are the blueprint to how much and what type of megawatts — whether fossil fuel or low carbon — the utility wants to add to the grid over the next 10 to 20 years. More broadly, the plans are a window into whether the power company is hanging on to a century-old model of building gigantic power plants or is moving with industry trends that include distributed generation sources. What's more, they tee up what's next: a request to bill customers for those investments. "Basically saying that you are going green is not controversial for the utilities". The detailed blueprints also highlight the tug of war that utilities face by sticking with routine investments or overhauling their power grids to support new technologies and cleaner sources of electricity. The latter typically is costlier and requires changes in state policies. The speed of the change, however, clashes with the protracted nature of utilities looking out two decades or more and figuring out how much and what type of generation they need to keep electrons flowing on the power grid. It also takes between three and six months for regulators to vet and approve an IRP because of the time needed for others to weigh in via written testimony and hearings. While it's clear that traditional renewable fuels such as solar and wind continue to get cheaper and more plentiful, the industry is banking on storage to do so as well. Then there are unknowns such as the future of carbon capture for natural gas, next-generation nuclear reactors that are likely to be smaller and the emergence of hydrogen. Even with those unknowns, many utilities are including those technologies in their IRPs. (Ref. 4)

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4. EDITORIAL BOARD SELECTIONS

Accelerating Decarbonization of the U.S. Energy System

The world is transforming its energy system from one dominated by fossil fuel combustion to one with net-zero emissions of carbon dioxide (CO_2), the primary anthropogenic greenhouse gas. This energy transition is critical to mitigating climate change, protecting human health, and revitalizing the U.S. economy. To help policymakers, businesses, communities, and the public better understand what a net-zero transition would mean for the United States, the National Academies of Sciences, Engineering and Medicine convened a committee of experts to investigate how the U.S. could best decarbonize its transportation, electricity, buildings, and industrial sectors. This report, Accelerating Decarbonization of the United States Energy System, identifies key technological and socio-economic goals that must be achieved to put the United States on the path to reach net-zero carbon emissions by 2050. The report presents a policy blueprint outlining critical near-term actions for the first decade (2021-2030) of this 30-year effort, including ways to support communities that will be most impacted by the transition. In order to reach net-zero carbon by 2050, the United States must begin taking action now to accomplish five main technology goals.

Meeting these objectives over the current decade (2021-2030) will be essential to making the net-zero transition possible on a 30-year timeframe, so that long-lived energy infrastructure can be replaced with zero-carbon alternatives. The nation needs to double the share of electricity generated by non-carbon-emitting sources to at least 75% by 2030. This will require record-setting deployment of solar and wind technologies, scaling back coal and some gas-fired power plants, and preserving operating nuclear plants and hydroelectric facilities where possible. By 2030, the nation should aim for 50% of new vehicle sales across all classes to be zero-emission vehicles. The U.S. should replace 20% or more of fossil fuel furnaces with electric heat pumps in buildings and initiate policies so that new construction is all electric except in the coldest climate zones. Where industrial processes cannot be fully electrified, they should begin the transition to low-carbon heat sources. By 2030, total energy use by new buildings should be reduced by 50%. In existing buildings, energy used for space conditioning and plug-in devices should be lowered every year to achieve a 30% reduction by 2030. Goals for industrial energy productivity (dollars of economic output per energy consumed) should increase each year. By 2030, the nation should increase overall electrical transmission capacity by approximately 40% in order to better distribute high quality and low-cost wind and solar power from where it is generated to where it can be used across the country. The nation should also accelerate the build-out of the electric vehicle recharging network and initiate a national CO2 capture, transport, and disposal network to ensure that CO2 can be removed from point sources across the country. (Ref. 5) **Back to Newsletter's Page 1**

Stark warning: Combating ecosystem collapse from the tropics to the Antarctic

Eminent scientists warn that key ecosystems around Australia and Antarctica are collapsing, and propose a three-step framework to combat irreversible global damage. Their report, authored by 38 Australian, UK and US scientists from universities and government agencies, is published today in the international journal Global Change Biology. Researchers say I heralds a stark warning for ecosystem collapse worldwide, if action if not taken urgently. Lead author, from the Australian Antarctic Division, said that the project emerged from a conference inspired by her ecological research in polar environments. The resulting paper and extensive case studies examine the current state and recent trajectories of 19 marine and terrestrial ecosystems across all Australian states, spanning 58° of latitude from coral reefs to Antarctica. Findings include:

- Ecosystem collapse (defined as potentially irreversible change to ecosystem structure, composition and function) is occurring now in 19 case studies. This conclusion is supported by empirical evidence, rather than modelled predictions.
- No ecosystems have collapsed across their entire range, but for all case studies there is evidence of local collapse.
- The 19 ecosystems include the Great Barrier Reef, mangroves in the Gulf of Carpentaria, the Mediterranean forests and woodlands, the arid zone of central Australia, Shark Bay seagrass beds in Western Australia, Great Southern Reef kelp forests, Gondwanan conifer forests of Tasmania, Mountain Ash forest in Victoria, and moss beds of East Antarctica.
- Drivers of ecosystem collapse are pressures from global climate change and regional

human impacts, categorised as chronic 'presses' (eg. changes in temperature and precipitation, land clearing) or acute 'pulses' (eg. heatwaves, storms, fires and pollution after storms).

The paper is a further wake-up call that shows ecosystems are in varying states of collapse from the tropics to Antarctica. These findings from Australia are a stark warning of what is happening everywhere, and will continue without urgent action. The implications for human health and wellbeing are serious. The paper recommends a new '3As' framework to guide decision-making about actions to combat irreversible damage:

- Awareness of the importance of the ecosystem and the need for its protection;
- Anticipation of the risks from current and future pressures
- Action on reducing the pressures to avoid or lessen their impacts.

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Will California's desert, Salton Sea be transformed into Lithium Valley?

California's desert is littered with remnants of broken dreams — hidden ghost towns, abandoned mines and rusty remains of someone's Big Idea. But nothing looms larger on an abandoned landscape than the Salton Sea, which languishes in an overlooked corner of the state. The water shimmers and broils in the desert like a rebuke: born of human error, made worse by 100 years of neglect and pollution. California's largest lake is also one of its worst environmental blights, presenting a problem so inverted that its toxic legacy intensifies as its foul water disappears. For generations, Imperial Valley residents have been breathing in a Periodic Table of minerals and metals, as well as agricultural chemicals. But for all the misery that these receding waters have unleashed — asthma and other respiratory ailments triggered by dust clouds — the Salton Sea now offers a potential way out: A bounty of lithium, called "white gold," one of the planet's most prized elements, used to manufacture batteries that power electric cars and drive a fossil-fuel-free future.

And the state of California wants to be in on it. The California Energy Commission has stepped in as an angel investor, doling out $16 million in grants to a handful of companies to determine if it's technically and commercially feasible to extract lithium from the brine that geothermal plants are already pulling from the Salton Sea. One of the recipients, CalEnergy Resources, a subsidiary of the giant Berkshire Hathaway Energy Renewables, is using $6 million in state grants to piggy-back a lithium-extraction pilot project onto its existing geothermal plants near Calipatria, at the southeast end of the dying sea. The company, which expects to break ground soon, will build a small-scale demonstration plant to begin operating next year. Should all go well, it envisions that it could eventually produce nearly a third of the world's lithium. From the standpoint of California public policy, the project offers a unique intersection of two state priorities: increasing sources of renewable energy and encouraging new battery technology for electric cars and energy storage. The state's target for electric cars, for example, could use a boost. Gov. Gavin Newsom last year directed the state to ban all new gasoline-powered cars by 2035. (Ref. 7) **Back to Newsletter's Page 1**

GMO 'scarecrow': What's keeping Africa from embracing genetically engineered crops?

The advent of climate change, coupled with new plant pests and diseases, has worsened the plight of Ghanaian farmers, relegating them to remain in poverty as their crop yields and incomes plunge. Modern, climate-smart agricultural technologies, such as genetically modified crops (GMOs), can help combat these threats. However, scare-mongering and misinformation, which Ghanaians term "scarecrow," make farmers perceive such technology as man's witchcraft. Since they see it unnatural, they are stuck with crude, unproductive farming methods — the "hoe." The adoption of GM insect-resistant cowpea and nitrogen use-efficient (NUE) rice could help farmers in Ghana to improve their yields, their incomes and their lives. These crops have been vetted and recommended by the CSIR of Ghana. But regulatory delays that prevent farmers from accessing these improved seeds, and lingering fears about technology, may erode these benefits in both Ghana and Africa at large.

In Africa today, nearly two out of three people depend on food production for their livelihoods. With its abundance of natural and human resources and favorable climate, Africa is well-positioned to expand agricultural production. However, the current crop production management practices in Africa are unable to produce satisfactory yields to feed the increasing population. Africa has one of the youngest populations on Earth while being the only continent where food production per capita is falling and hunger and malnutrition afflict at least one in three people. The population of Africa currently represents 17 percent of the world's population and is swiftly increasing even now. By 2050 about one third of the world's population will live in Africa. To feed this rapidly growing population, agricultural yields in Africa must be increased. In an endless quest for higher yields from more resilient crops, technological breakthroughs and advancements in biotechnology gave birth to genetically modified (GM) foods. GM foods have become a critical solution to meet the demands for food on a national and global scale. GM foods are developed and marketed because there is a perceived advantage to either the producer or consumer or both. This advantage often translates into a product with a lower price, longer shelf-life, lower production costs, higher nutritional value, better yields, pest-resistance, drought-tolerance, etc. These crops could help African farmers, whose plight has worsened with the advent of climate change and the new pests (such as fall armyworm) and plant diseases that come with it. A lack of climate-resilient farming practices and devotion to tradition have contributed to the low yields on the continent.Agricultural transformation remains a strong policy priority for the government of Ghana. For the better part of two decades, Ghana has emphasized "agricultural modernization" in its national agricultural policies. (Ref. 8)

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ARS Research Boosts Strawberry Production

Strawberries have been a valuable crop for many years, but not without escaping disaster along the journey. In the 1950s, America's strawberry production was being ravaged by a root-rotting fungus known as red steele. Agricultural Research Service (ARS) came to the rescue, saving the industry by breeding dozens of strawberry cultivars that could stand up to red steele and many other challenges growers face, such as insects, diseases, short growing seasons, and the rigors of harvest and transport. ARS's work in strawberry research goes well beyond the '50s, though. "Strawberry breeding at the ARS facility in Beltsville, MD, predates

traffic lights". USDA began strawberry research in 1910 and discovered how to keep strawberries red even after canning or freezing. "Strawberry plants developed by USDA were the first to survive shipping, which created a strawberry industry." ARS creates strawberry varieties that have natural resistance to fruit rot and produce fruit that stays fresh longer after harvest. "Farmers don't have to use pesticides that prevent rot, and consumers can enjoy all their strawberries' great flavor longer after purchase."

ARS is helping to advance technology that promises to improve the environmental footprint for strawberry farmers. ARS, with the Appalachian Fruit Research Station in Kearneysville, WV, is working with industry colleagues to develop a machine that eliminates the need for pesticides. It works by shining ultraviolet (UV) light on the plants and their pests at night. "UV-C irradiation kills microorganisms and arthropod pests by damaging their DNA". UV-C light is routinely used to kill microorganisms in the sterilization of air in hospitals, water treatments, laboratory benches, and the treatment of meat and poultry products. "The use of UV light in crop production has been limited because the doses required to kill plant pathogens usually cause plant damage, such as leaf and flower burns and defoliation". They discovered that treating strawberries at night allowed them to use much lower doses of UV-C light to effectively kill the targeted pathogens and pests, while not damaging the strawberry plants. The result is a more sustainable strawberry farm that saves money and helps the environment by using less chemicals. As it has for many decades, the research performed by ARS scientists will continue to improve the quality and quantity of strawberries for American consumers. plastics production, another sustainable solution to non-degradable petroleum-based plastics. (Ref. 9)

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5. ESD NEWSLETTER READER COMMENTS

None received this month.

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ABOUT 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 Systems Division (ESD) 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.

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