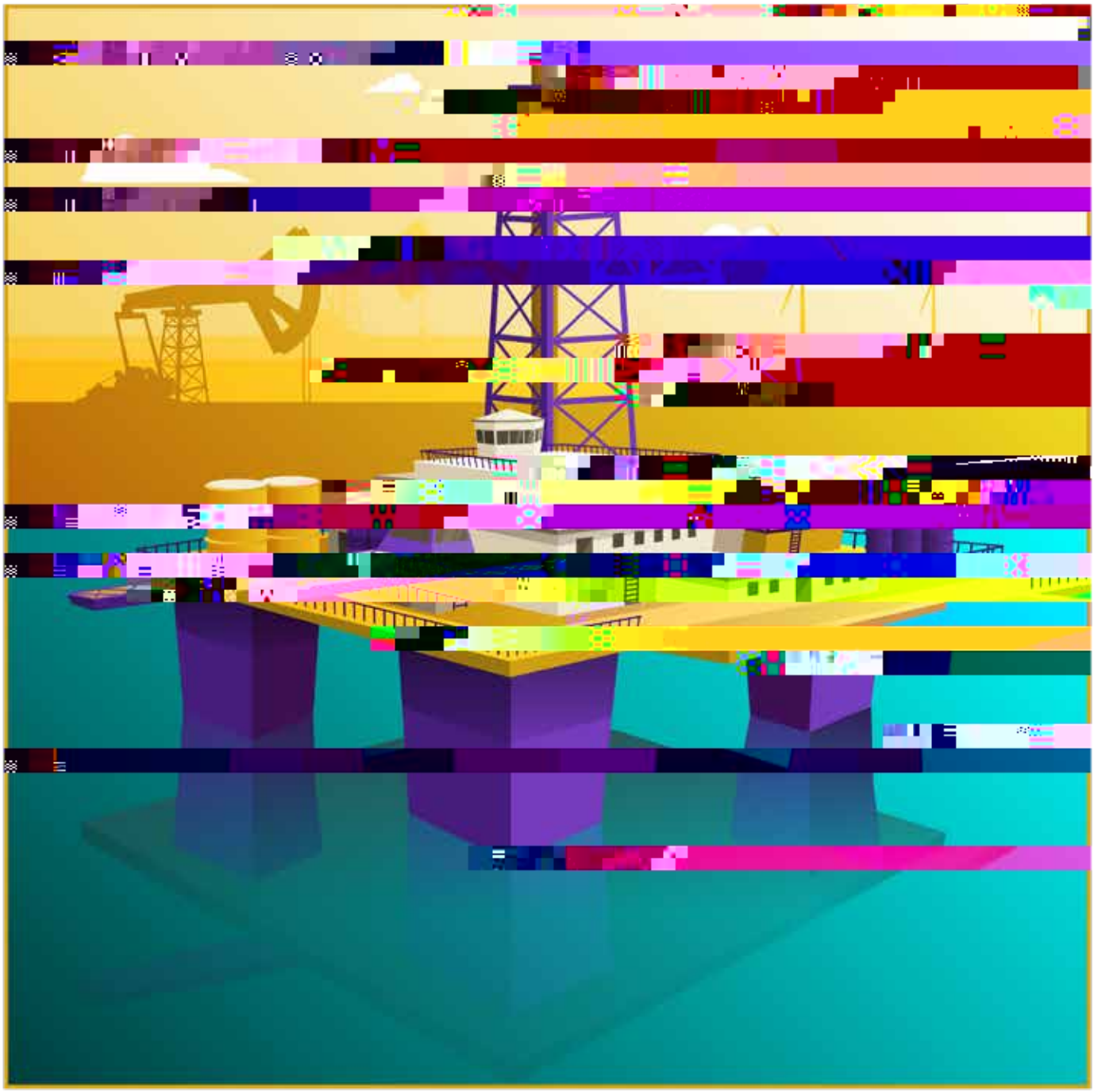

ANNUAL REPORT

2020

Center for Energy Studies
Minerals Processing
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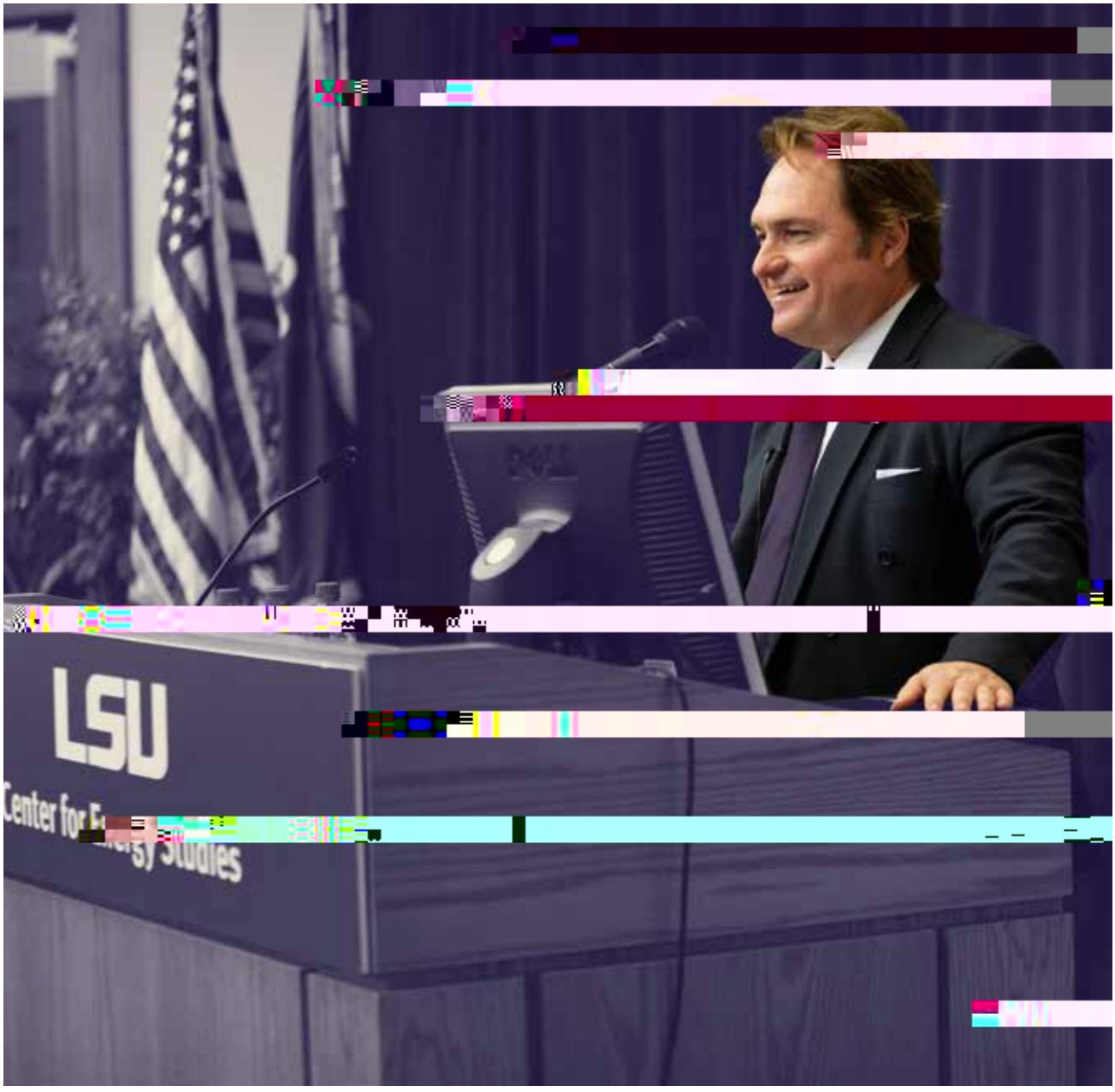

LSU

Research Highlights

Center Releases 2021 *Gulf Coast Energy Outlook*

On November 18, 2020, the LSU Center for Energy Studies released the 2021 edition of the *Gulf Coast Energy Outlook* (*GCEO*) with a virtual kickoff. The 2021 *GCEO* examines the impacts of the COVID-19 pandemic, the 2020 hurricane season, trade negotiations with China, and potential policies of a Biden administration on the region's upstream oil and gas activity, downstream investments in refining and petrochemicals, energy exports, electricity demand, and energy sector-specific employment. David E. Dismukes, executive director and professor, LSU Center for Energy Studies, and Greg Upton, associate professor, LSU Center for Energy Studies, authored the report.

In March of 2020, the outlook for the energy industry changed rapidly when the COVID-19 pandemic essentially shut down the global economy. Oil markets were rocked by a historic decline in demand and a failed OPEC deal to curtail output and sustain prices. For its economic modeling, the *GCEO* assumes that COVID-19 attenuates globally and that the world will return to some level of normalcy over the next two years. The *GCEO* assumes that trade talks with China will not deteriorate, that new tariffs will not be implemented, and that export commitments on net do not impact demand for Gulf Coast energy products. The *GCEO* also assumes that the Biden policy of banning permits offshore will not go into effect, at least over the forecast horizon. If some version of this proposed policy were to be enacted, it could have significant negative economic implications for the Gulf Coast region.

Findings include:

- By May of 2020, Gulf Coast oil production was down 13.7 percent from the prior May. Gulf Coast natural gas production declined by 7.1 percent in May of 2020 relative to May of 2019. On an annualized basis, both U.S. and Gulf Coast oil production are anticipated to decline over the next three years.
- Today, futures markets are anticipating that there will be enough supply to meet global demand at between $40 and $50 per barrel for the next decade.
- While natural gas prices are currently lower than markets predicted at this time last year, prices are expected to be higher in 2021 and 2022 than futures markets suggested over the past two years.
- The U.S. electricity load has been relatively flat over the past decade, while the Gulf Coast load has grown. As a result, the share of electricity usage from Gulf Coast states increased from 15 percent in 2007 (i.e. 2009 pre-recession) to 17 percent in 2019 (the

and weight, such a tax would be able to deliver pollution and congestion reductions similar to a diesel tax, while also saving lives and preserving roads by reducing truck weights.

Tarufelli White Paper Examines Demand Response Potential in Louisiana

A 2020 white paper by LSU Center for Energy Studies Assistant Professor Brittany Tarufelli analyzes a method

Overlooked Opportunity: Incentivizing Carbon Capture through Carbon Tax Revenues. Brittany Tarufelli, Principal Investigator. Alliance for Market Solutions. Washington, D.C. August 2020 to December 2020. $27,232.

Preliminary Preparation for GHG Update. David E. Dismukes, Principal Investigator. The Nature Conservancy of Louisiana. $9,994.

Southeast Regional Carbon Storage Partnership: O□shore Gulf of Mexico. David E. Dismukes, Principal Investigator. Southern States Energy Board. $545,875

Updated Louisiana Greenhouse Gas Inventory and Emissions Analysis for the Governor's O□ce on Coastal Activities. David E. Dismukes, Principal Investigator. Louisiana O□ce of the Governor. $65,830

Publications 2020

Dismukes, David E. (with B.F. Snyder and M. Layne). "A Cash Flow Model of an Integrated Industrial CCS-EOR Project in a Petrochemical Corridor: A Case Study in Louisiana." *International Journal of Greenhouse Gas Control* 93 (February).

Dismukes, David E. "Current Trends and Issues in Reforming State-level Solar Net Energy Metering Policies." *LSU Journal of Energy Law & Resources* 8(2):419-451.

Dismukes, David E. "Insight: Irreparable Changes Are Coming to the American Oil and Gas Industry." *10/12 Industry Report* 5(1):55.

Dismukes, David E. "Opportunities for Carbon Capture, Utilization and Storage in Louisiana." LOGA Industry Report. Summer: 18-21.

Dismukes, David E. and Sid Narra (with Brian Snyder and Valentine Gomez). "Use and Limits of Ecosystem Services Valuations in the Gulf of Mexico." New Orleans (LA): Department of the Interior, Bureau of Ocean Energy Management. Contract No.: M17AC00018, Report No.: OCS Study BOEM 2020-0xx. 80 pp.

Iledare, Omowumi O. (with O. Ogolo, P. Nzerem, I.S. Okafor, E. Iloegbunam, and I.P. Ekeoma). "Assessing the Impact of Deep O□shore and Inland Basin Production Sharing Contract Amendments on the Economics of Deep O□shore E&P Assets in Nigeria." Paper prepared

Kaiser, Mark J. “O□shore Oil and Gas Records circa 2020.” *Ships and O shore Structures* (October).

Kaiser, Mark J. *The O shore Pipeline Construction Industry: Activity Modeling and Cost Estimation in the U.S. Gulf of Mexico*. Cambridge (MA): Gulf Professional Publishing. 502 pp.

Kaiser, Mark J. (with J.D. Shively and J.B. Shipley). “An Update on the Louisiana and Texas Rigs-to-Reefs Programs in the Gulf of Mexico.” *Ocean Development and International Law* 51(1):73-93.

Nehiba, Cody. “Taxed to Death? Freight Truck Collision Externalities and Diesel Taxes.” *Regional Science and Urban Economics* 85(November).

Nehiba, Cody. “Transportation and Energy Policy in Louisiana.” LSU Center for Energy Studies White Paper. June 2020.

Nehiba, Cody. (with A. Luttmann). “The E□ects of Employee Hours-of-Service Regulations on the U.S. Airline Industry.” *Journal of Policy Analysis and Management* 39(4):1043-1075.

Pike, Ralph W. *Continuous Renewable Energy Generation with Lithium Ion Battery Storage on the Micro Grid*. Seattle (WA): Kindle Direct Publishing. 185 pp.

Tarufelli, Brittany. “Foundations for an Intelligent Energy Future: Demand Response Potential in Louisiana.” LSU Center for Energy Studies White Paper. May 2020.

Tarufelli, Brittany. “Overlooked Opportunity: Incentivizing Carbon Capture through Carbon Tax Revenues.” LSU Center for Energy Studies White Paper. December 2020.

Upton, Gregory B. (with M. Agerton and B. Gilbert). “The Economics of Natural Gas Flaring: An Agenda for Research and Policy.” 54 p. USAEE Working Paper No. 20-460.

Upton, Gregory B. (with R.A. Decker and M. McCollum). “Boom Town Business Dynamics: Finance and Economics Discussion Series 2020-081.” Washington: Board of Governors of the Federal Reserve System. September 2020.

Upton, Gregory B. and David E. Dismukes. 2021 “Gulf Coast Energy Outlook.” LSU Center for Energy Studies and the E.J. Ourso College of Business. LSU White Paper. Fall 2020.

Upton, Gregory B. (with F. Ferdowsi and S. Mehraeen). “Assessing Distribution Network Sensitivity to Voltage Rise and Flicker under High Penetration of Behind-the-Meter Solar.” *Renewable Energy* 152(June): 1227-1240.

Upton, Gregory B. (with M. Oliver). “Are Energy Endowed Countries Responsible for Conditional Convergence?” 39 p. USAEE Working Paper No. 19-414, 2019.

Upton, Gregory B. (with J.A. Richardson). Mineral Revenues in Louisiana. LSU Center for Energy Studies White Paper. March 2020.

Upton, Gregory B. (with L.C. Scott). *Louisiana Economic Outlook: 2021-2022*. Economics & Policy Research Group, E. J. Ourso College of Business, Louisiana State University. Baton Rouge, LA. September 2020.

Speaking Engagements

David E. Dismukes

Baton Route Advocate 2020 Economic Outlook Summit. Panelist. Baton Rouge, LA. January 8.

"Opportunities for carbon capture, utilization, and storage in the Louisiana chemical corridor." Air and Waste Management Association, Louisiana Section Luncheon. Gonzales, LA. January 16.

"The 2020 Gulf Coast Energy Outlook." University of Louisiana Lafayette, Southern Unconventional Resources Center for Excellence. Lafayette, LA. February 16.

"Pipeline industry: economic trends and outlook." Joint Industry Association Annual Meeting. Louisiana Mid-Continent Oil and Gas Association and the Louisiana Oil and Gas Association. Lake Charles, LA. March 5.

"Ratepayer benefits of reforming PURPA." Harvard Electricity Policy Group Webinar "PURPA: A time to reform or reduce its role?" March 26.

"The 2020 Gulf Coast Energy Outlook: COVID-19 update." Baton Rouge Area Chamber of Commerce Business Webinar: COVID-19 and Global Supply Impacts on the Capital Region and Louisiana Economies. Baton Rouge, LA. June 3.

"Evaluation of Louisiana's Depleted Gas Reservoirs for Geological Carbon Sequestration." Louisiana Mid-Continent Oil and Gas Association Carbon Capture and Underground Storage Committee Meeting. August 25.

"Consumer Perspectives on the Rate Design of the Future." National Association of State Utility Consumer Advocates ("NASUCA"). Annual Conference. November 10.

Cody S. Nehiba

"The Time-of-Day Travel Demand Elasticity Paradox." Association of Environmental and Resource Economists

“Gulf Coast Energy Outlook.” Southeastern Geophysical Society of New Orleans (SGS). Webinar. September 10.

“Gulf Coast Energy Outlook.” Professional Landmen's Association of New Orleans (PLANO). Webinar. September 16.

“Gulf Coast Energy Outlook.” Louisiana Government Finance O□cers Association. Webinar. October 7.

“Mineral Revenues in Louisiana.” Southern Energy Conference. Webinar. October 21.

“Gulf Coast Energy Outlook.” LSU Center for Energy Studies GCEO Kicko□. November 18.

“Gulf Coast Energy Outlook.” Society of Louisiana Certified Public Accountants. Webinar. November 20.

“Electricity Market Restructuring and Retail Rates." Southern Economic Association. Webinar. November 23.

Faculty Highlights

and recommendations on oil and natural gas industry issues. Recent studies undertaken by the NPC include "Meeting the Dual Challenge: A Roadmap to At-Scale Deployment of Carbon Capture, Use, and Storage" and "Dynamic Delivery: America's Evolving Oil and Natural Gas Transportation Infrastructure."

Tarufelli on Advisory Board for Roosevelt Project Gulf Coast Case Study

CES Assistant Professor Brittany Tarufelli was chosen to serve on the study advisory board for the MIT Energy Initiative's Roosevelt Project Gulf Study. The Roosevelt Project is a multidisciplinary effort considering the transition of the U.S. economy toward decarbonization, with a focus on minimizing worker and community

CES in the News 2020

In the tumultuous year 2020, CES faculty were sought by news media for commentary and expert input regarding several energy-related topics, including the duel hits of the coronavirus and an oil price war between Saudi Arabia and Russia, resulting in historic oil production cuts and a severe drop in oil prices in the spring. Also in the news were potential impacts of the Biden administration's energy policies, the hurricanes that devastated southwest Louisiana, and the shutting down of Shell's Convent refinery.

Both CES Executive Director Professor David Dismukes and Associate Professor Greg Upton were interviewed on the findings of the annual *Gulf Coast Energy Outlook*, which was covered by more than one dozen outlets, including *The Advocate*, *The Greater Baton Rouge Business Report*, *Daily Advertiser*, and *The Houma Courier*, as well as WWL radio's Firoveb2l2001 Tm[(a of theen-US)/ BT-0.005 T5005.5 0 00ƀD0 Tc 0Greg rl'MoortGriEM5ort222en-US

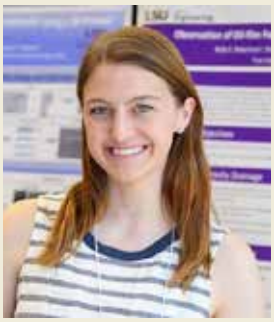
Scholarships

2020-2021 Scholarships Awarded

The Center for Energy Studies awarded scholarships for the 2020-2021 academic year to three LSU students pursuing energy-related fields of study and careers.

LMOGA/Brooksher Scholarship

Kelly Robertson, a senior majoring in chemical engineering, from Alexandria, La.



F. Malcolm Hood Scholarship

Felix Rodrigue, a junior majoring in electrical engineering, from Slidell, La.

GCPA emPOWERing Women Scholarship

Ti□any Aucoin, a junior majoring in coastal environmental science, from Berwick, La.

The Center congratulates our scholarship recipients and wishes them well as they continue their studies.

Personnel

Administration

David E. Dismukes, Ph.D., executive director, director of the Policy Analysis Division, and professor

Diana Reynolds, assistant to the executive director

Marybeth Pinsonneault, communications manager

Division of Policy Analysis

Gregory B. Upton, Jr., Ph.D., assistant professor

Mike McDaniel, Ph.D., professional-in-residence (retired) and an adjunct professor of environmental sciences in the School of the Coast and Environment

Don Goddard, Ph.D., associate professor (retired)

Cody S. Nehiba, Ph.D., assistant professor

Brittany L. Tarufelli, Ph.D., assistant professor

Division of Research & Development

Mark J. Kaiser, Ph.D., director of the Research & Development Division and professor

Siddhartha Narra, Ph.D., research associate

Division of Energy Information & Data

Omowumi (Wumi) Iledare, Ph.D., Professor Emeritus, director of the CES Energy Information and Data Division, professor of petroleum economics and policy research, adjunct professor of petroleum economics at the Craft & Hawkins Department of Petroleum Engineering at LSU, and director of the Emerald Energy Institute, University of Port Harcourt, Nigeria.

Ric Pincomb, research associate

Stacy Retherford, computer analyst

Mike Surman, computer analyst

Minerals Processing

Minerals Processing Research Division

Ralph Pike, Director | F. Carl Knopf, Co-Director | lsu.edu/mpri

The Minerals Processing Research Division (MPRD) of the Center for Energy Studies was established in

percent of total electricity generation compared to coal's 20 percent. Record generation from wind and near-record generation from solar contributed to the overall rise in renewable electricity generation. Wind generation reached a record monthly high in April 2019 of 30.2 million megawatt hours (MWh). Solar generation—including utility-scale solar photovoltaics and utility-scale solar thermal—reached a record monthly high in June 2018 of 7.8 million MWh and will likely surpass that level in the summer of 2021.

Using energy storage with lithium-ion battery technology from wind farms and solar arrays, these sites can now provide continuous power to the grid. With battery storage, power generated by renewable resources is stored when it is produced, and then used when demand is high.

Applications of lithium ion battery technology have gone from replacing primary (non-recharge) batteries with secondary (recharge) batteries that are being used: in appliances and cell phones, in vehicles such as cars and large industrial manufacturing and mining prime movers, in microgrids in combination with solar energy and wind power, and replacing natural gas peaker plants for regulating the frequency of the electric grid.

Lithium ion batteries have advantages of high energy density, light weight, no memory effect and better environmental performance and are used for powering all types of electric vehicles (EVs). EVs produce zero tailpipe emissions, operate quietly and smoothly, have stronger acceleration, and require less maintenance.

Lithium ion battery demand is forecast to grow about tenfold between 2018 and 2030, mostly due to the electric vehicle (EV) boom. The top five lithium-ion manufacturers by capacity (2018) are Korea's LG

age to the environment by emissions discharged within permitted regulations. When only maximizing companies' profits, the optimal solution was $550 million per year for companies' profit and sustainable credits/costs were -$12 million per year. When only maximizing sustainable credits/costs the optimal solution was $411 million per year for companies' profit and sustainable credits were +$211 million per year. One of the intermediate optimal values was a profit of $411 million per year and sustainable credits of +$4.5 million. per year. It is another decision to determine the specific value of the weight that is acceptable to all concerned.

The methodology presented here can be applied to other sources of carbon dioxide. For example, flue gases from gas-fired turbines have 3.0 mol percent CO2 and coal-fired plants have 10 percent-12 percent CO2. The standard process of amine scrumming gives essentially pure CO2 from flue gases, and costs range from $50-$60 per ton of CO2 captured. Research is continuing for new, more e□cient methods to remove carbon dioxide from combustion gases.

On-Line Research, Publications and Programs

Continuous Renewable Energy Generation with Lithium-Ion Battery Storage on the Micro Grid, 180 pages, (2020), ISBN-10: 9798670042307, The book is available both in print and e-book. Kindle Direct Publishing ASIN: B08DSZ2YTH print edition, ASIN: B08P3X7KVM electronic edition for $39.00.

Essentials of Optimization for Chemical Engineering, 500 pages (2019), now available on Amazon/Kindle, has chapters on analytical methods, LP, SVS, NLP, MILP, MINLP, GO, On-Line (Real-Time) Optimization, GP, DP and CofV. The book is available both in print and e-book, ASIN: 1645700968 print editions, ASIN: B07ZWNFMWC e-book edition for $29.00.

A companion book, *Essentials of Economic Decision Analysis for Chemical Engineering*, 200 pages (2015) is

Radiation Safety

Wei-Hsung Wang, Director | lsu.edu/radiation-safety

gram. During the laboratory visits, they checked the inventoried source location, radiation levels, the function and calibration of in-laboratory survey meters, the posting and barrier requirements, the storage of radioactive waste, and the Radiation Safety Manual. They also reviewed the source inventory and disbursement logs, the in-laboratory training records, the in-laboratory radiation surveys, and the functions of the fume hoods. In addition, the lead inspector questioned the approved radiation workers (e.g., faculty member, laboratory manager, and clinical technologist) about the research/clinical protocols involving uses of radiation sources, the designated radiation areas, the patient workload and release limits, the operation and quality assurance/quality control of radioanalytical equipment, the physical operational parameters and safety features of analytical and diagnostic radiation producing equipment, wearing of personal radiation monitoring devices, the procedures of ordering and receiving radioactive materials, and the practice for radioactive waste labeling/storage/disposal. After the walk-through, an exit interview was held, and no areas of concern were listed on the LDEQ's Field Interview Form.

Impact on Operations by COVID-19

Because of the implementation of remote working plans by LSU in response to Governor Edwards' declaration of a statewide public health emergency, all LSU employees, except those who had been considered essential personnel, were asked not to report to campus effective March 17, 2020. All campus buildings were locked and could be accessed by only essential personnel beginning March 19, 2020. Due to the nature and operation of the RSO, remote working was not feasible to fully meet the compliance requirements. Therefore, all staff of the RSO reported to campus to perform their duties, with prevention control measures (e.g., close monitoring of common signs of COVID-19, COVID-19 testing, personal protection equipment, social distancing, and sound personal hygiene practice). Although tasks regarding physical protection for sensitive radioactive materials were completed in a timely manner, certain routine compliance activities (e.g., diagnostic X-ray inspections, semi-annual radiation laboratory audits, survey meter calibrations, exchange of radiation monitoring devices, and in-laboratory training) could not be completed due to the campus closure. The LDEQ acknowledged the difficulties for the licensees to maintain compliance during these trying times and consequently issued a guidance protocol to mitigate regulatory requirements. The RSO followed the compliance relief as well as documented and caught up all unfinished compliance tasks by the end of 2020.

Professional Contributions and Recognitions

Wang Named Chair of American Board of Health Physics

Wei-Hsung Wang, RSO director and Center for Energy Studies professor, was appointed chair of the American Board of Health Physics (ABHP) for 2021. Wang was installed as a board member of the ABHP in 2019 and served as vice chair in 2020. The ABHP grants professional certification in the field of health physics. The certification process is accredited by the Council of Engineering and Scientific Specialty Boards.

The ABHP board includes representatives from Mirion Technologies, Inc., the U.S. Environmental Protection Agency, the U.S. Nuclear Regulatory Commission, Worcester Polytechnic Institute, and Y-12 National Security Complex. Wang's term as a board member ends in 2023.

Health Physics is the area of public health and environmental health engineering that deals with the safe use of ionizing and non-ionizing radiation in order to prevent harmful e□ects of the radiation to individuals, population groups, and the biosphere via the application of diverse scientific principles. Health physicists are responsible for the safety and security aspects in the design of processes, equipment, and facilities utilizing radiation sources as well as for the adequate disposal of radioactive waste, ensuring that radiation exposure to personnel is minimized and is at all times within regulatory limits.

Wang Invited to the U .S. Environmental Protection Agency Review Panel

Wei-Hsung Wang, RSO director and Center for Energy Studies professor, was invited to serve as a member of the U.S. Environmental Protection Agency Science Advisory Board Radiation Advisory Committee augmented for the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) Revision 2 review

Send correspondence to Marybeth Pinsonneault, Communications Manager, at mpinsonn@lsu.edu or 1077 Energy, Coast & Environment Building, Louisiana State University, Baton Rouge, LA 70803

Designed by Stephen W. Radcli□e.

LSU | Center for Energy

CES Scholarships

To donate to the Center's scholarships, in support of LSU students pursuing energy-related fields, fill in the form below and mail to

Center for Energy Studies
1067 Energy, Coast & Environment Building
Louisiana State University
Baton Rouge, LA 70803

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Amount of donation: $_____

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Thank you for your support.