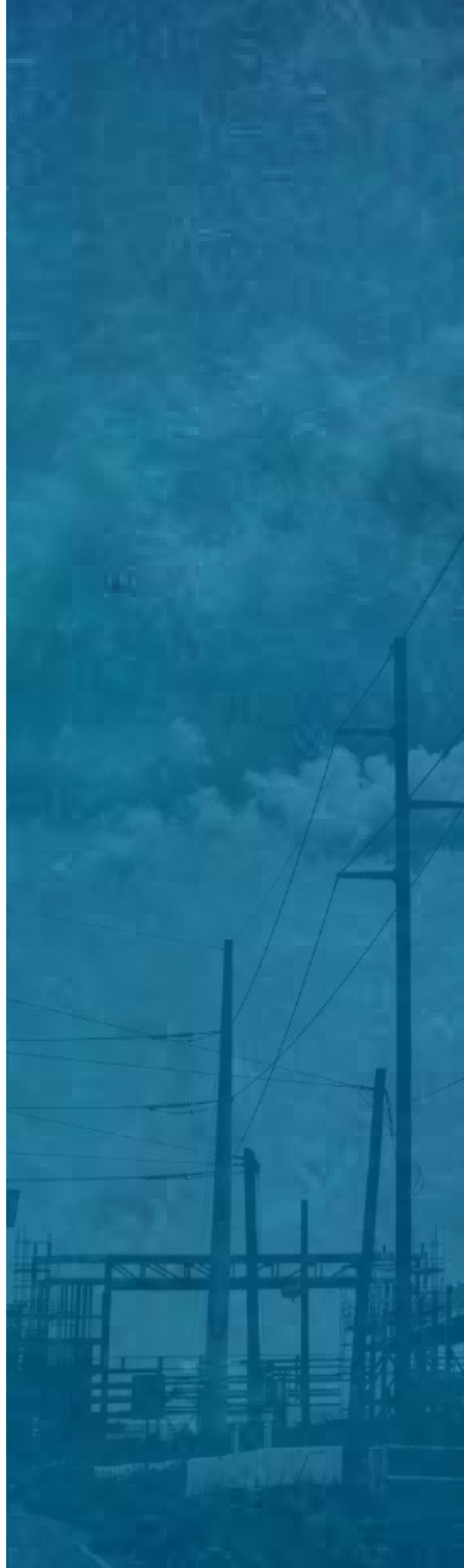


ANNUAL REPORT 2017

LSU | CENTER FOR ENERGY STUDIES



A blue-tinted photograph of an industrial facility, likely a refinery or chemical plant. Several tall smokestacks are visible, with thick plumes of white smoke rising from them. The facility consists of various towers, pipes, and structural steel frameworks. The overall scene is hazy and atmospheric. The text is overlaid on the left side of the image.

**Center for Energy Studies
Minerals Processing Research Division
Louisiana Geological Survey
Radiation Safety Office**

CONTENT

Center for Energy Studies	1
DOE CO ₂ Storage Research	3
Gulf Coast Energy Outlook™	4
Jackup Rig Construction Market	5
Publications	7
Events, Outreach & Education	9
Scholarships Awarded	18
Minerals Processing Research Division	19
Pipeline Failure Detection Study Underway	19
Energy Sustainability Remote Lab	20
Research, Publications, Programs Available Online	20
Research on Resilient Critical Infrastructure	21
Louisiana Geological Survey	25
Portfolio of Published Maps	25
Geophysics Section	26
Research Highlights	26
Publications & Presentations 2017	27
LGS Outreach	29
Radiation Safety Office	31
National Nuclear Security Administration Training	31
LDEQ Inspections	32
Scholarly Activities	34

CENTER FOR ENERGY STUDIES

DAVID DISMUKES, EXECUTIVE DIRECTOR • www.ces.lsu.edu



On November 16, the Center was saddened by the passing of Professor and former CES Executive Director Allan Pulsipher. Allan was a very well-accomplished energy economist, scholar and writer, and his leadership was a catalyst for what the Center has become today.



Allan Pulsipher (second from right) was senior staff economist with the President's Council of Economic Advisers, 1973-75.

Allan had an old rickety rocking chair in his office that appeared to have some kind of significant sentimental value, but was acquired from somewhere that was never very clear to me. Allan often kept a stack of manuscripts, books, and other reading material firmly lodged in the seat of that chair, I think to keep unwelcomed academics from parking in his office for any extended period of time. However, I appear to have been an exception, since Allan frequently invited me to pull the material off the chair, where he would not only provide me with important advice and guidance, but tell me stories of his interesting career experiences and events. Allan's career spanned the most important period of time in the modern energy industry, and it seems that Allan, like a hero in a fictional novel, was in the middle of some of the industry's most significant and challenging events.

The 1970s was a period of high inflation, stagnant economic output, and high energy prices. It was perplexing time to be an economist and explain the nature of these economic ills, much less offer any policy solutions to what were systemic and difficult-to-understand problems. It was during this time period that Allan left academia to work directly with the White House, and the Council of Economic Advisers, being one of the first advisers to address energy and natural resource issues at a time when these were new and emerging subfields in economics.

Allan, in fact, was one of the early energy economists during a time period when the moniker was just beginning to be used.



In the 1970s, Pulsipher (far right) worked directly with the White House and the Council of Economic Advisers on energy and natural resource issues, which were then emerging subfields in economics.



During the 1980s, Pulsipher (right) was chief economist for the Congressional, Monitored Retrievable Storage Review Commission and the chief economist of the Tennessee Valley Authority.

I will never forget the stories that Allan would tell me of his time with the CEA and the leading economic thinkers with whom he collaborated, such as Herb Stein and George Akerloff. His stories of this period, like many of his stories, were both insightful and entertaining. He often told me that Herb Stein, his boss at the time, was far more entertaining and humorous than his more-well-known son, Ben Stein, the actor, writer, and comedian (who was in *Ferris Bueller's Day Off* and did many of the Clear Eyes eye-drop commercials), and sometime economic and financial commentator.

After his stint with the CEA, Allan ultimately worked in another “crisis sector” of the energy business: nuclear power. Allan worked for many years as the chief economist at the Tennessee Valley Authority (TVA), during a time when TVA was struggling with an amazingly expensive and controversial nuclear power development program. I can only imagine the likely blunt and pointed advice Allan provided to TVA administrators during this time period. Allan’s work at TVA was not

limited to just the nuclear program but also involved many of TVA’s day-in and day-out responsibilities such as managing the sale of electricity from hydroelectricity facilities, managing wholesale transactions between TVA and many of the municipal utilities and rural cooperatives that received their electricity from TVA, forecasting electricity loads and regional economic output, among a host of other activities. After leaving TVA, Allan worked on nuclear waste storage issues, another area that has been, and continues to be, controversial and unresolved.

Allan came to LSU in 1992, when the Center was re-creating itself into a more stand-alone institution conducting its own internal research and externally-funded projects. Allan helped to set the research agenda for the Center and build up a staff of younger faculty, research associates, and librarians to conduct and facilitate our growing research load. Allan emphasized the importance of being well-grounded and balanced in how our research projects were conducted,

blending scholarship and academic rigor with industry and subject matter expertise.

Allan hired me during this time period as an assistant professor and gave me, as well as all of my other colleagues, amazing opportunities for growth and professional development. He was a great administrator, often a very balanced and calm voice during tense periods, a gifted writer and editor, an amazing and exceptionally patient boss, a great mentor, and a good friend. I know I speak for everyone at the Center when I say that he has been, and will continue to be missed.

Normally, I would use this introduction to, as my mother would say, “carry on” about the Center’s achievements and accomplishments over the past year. And, while the last year has been a period of continued growth and productivity for the Center, I think it is best to let the balance of this report make that point and leave this introduction as a testament to a great man and his important contributions to energy economics, Louisiana, and the LSU Center for Energy Studies.

Research Highlights

CES Continues DOE CO₂ Storage Research with New Subsea Project

In the fall of 2017, the U.S. Department of Energy (DOE) announced its intention to fund a cutting-edge research project, associated with offshore carbon capture and storage (CCS), for several LSU researchers who are working as part of a multi-regional team headed up by the Southern States Energy Board (SSEB). The LSU-SSEB team was one of only two selected by DOE for this highly competitive research project. The team, led by CES Executive Director David Dismukes, includes researchers from the Craft & Hawkins Department of Petroleum Engineering (Professor-in-Residence Richard Hughes and Assistant Professor Mehdi Zeidouni) and the Department of Environmental Sciences (Assistant Professor Brian Snyder).

The award leverages LSU's ongoing work in carbon capture and storage that includes a large 2016 DOE-funded award designed to explore the feasibility of capturing carbon emissions from industrial facilities in Louisiana and sequestering those emissions in onshore geologic formations.

Dismukes notes that this DOE award is an important supplement to the Center's ongoing carbon capture work that will "clearly help establish LSU as a leading research institute on the important technical, economic and policy issues associated with carbon capture and storage in this region, as well as nationally."

Under the new DOE award, the LSU team will specifically focus on the opportunities to capture industrial emissions from the state's petrochemical and industrial gas plants and how those captured emissions can be used for potential enhanced oil recovery (EOR) opportunities in the offshore areas of the Gulf of Mexico. The LSU engineering team will assist in estimating the static and dynamic capacities of a series of underground formations in the Gulf of Mexico and will also examine the risk factors associated with these forms of underground storage in the offshore areas of the Gulf.

Dismukes said the award "underscores LSU's strengths in researching applied energy-related topics and providing answers on how we can transform our current energy industries into those compatible with a more carbon-neutral future."

A major component of this project will be to engage stakeholders in assessing the opportunities for industrial CCS. Dismukes will be working with our Industry Advisory Council, as well as our other industrial stakeholders, to identify companies interested in working on this project. Any CES industrial stakeholders that are interested in participating should contact Dismukes at their earliest convenience.



Study Estimates Greater than \$800 Million Economic Impact from Bayou Bridge Pipeline



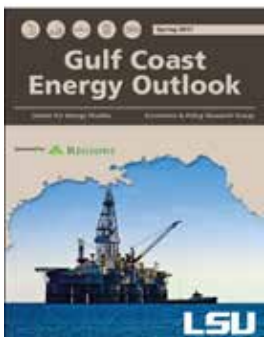
The Bayou Bridge Pipeline delivers multiple grades of crude oil from terminal hub facilities in Nederland, Texas, to terminal facilities and refineries in Lake Charles, La. The expansion project underway will consist of approximately 163 miles of buried 24-inch pipe and will run from Lake Charles to St. James, La. Crude from the St. James terminalling facilities will then be redistributed to refineries in the Baton Rouge area.

A 2017 CES study determined the Bayou Bridge Pipeline would create significant economic benefits for Louisiana during both the construction and operations into the future. The project was estimated to generate more than \$829 million in new economic activity in 2017; more than 4,000 jobs and over \$400 million in new wages.

“The Bayou Bridge Pipeline will help expand Louisiana’s energy economy by creating jobs and leveraging existing in-state energy infrastructure such as refineries, processing and storage assets,” said David Dismukes. “When completed, the pipeline will further diversify Louisiana’s crude oil supplies and provide new growth in both the immediate and long-terms.”

The report notes that the Bayou Bridge Pipeline project will likely create additional benefits not easily quantified, including the diversification of Louisiana’s crude oil supply and expansion of its refining and petrochemical manufacturing base, as well as a broadening of opportunities related to the state’s energy economy.

LSU Researchers Release Inaugural Gulf Coast Energy Outlook™



In June, CES released the inaugural *Gulf Coast Energy Outlook™* (GCEO™). The publication provides a broad overview of the current status and trends guiding energy markets with an emphasis on the Gulf Coast. The Outlook seeks to become an annual report. A PDF version is available for download on the CES website.

For the project, CES Executive Director David Dismukes and Assistant Professor Greg Upton worked with Christopher K. Coombs, energy adviser, and Dek Terrell, director and professor, both with the LSU Economics & Policy Research Group.

The collaborative research initiative focuses on upstream oil and gas production and downstream refining and petrochemicals, as well as the contribution of the energy sector to the broader Gulf Coast economy. The report includes forecasts of future employment in relevant energy sectors.

Findings show that, over the past decade, worldwide energy markets have been fundamentally changed due to the advent of U.S. shale oil and gas development and that these changes have not only impacted the regions in which hydrocarbons are produced, they have also created significant changes to transportation, processing and final products.

“Our research shows that the Gulf Coast has seen large increases in oil and gas production, with these increases concentrated in the state of Texas,” said Upton. “The growth of federal offshore production observed in the 1990s has been offset by U.S. onshore shale producers over this

past decade. We are truly experiencing the next era of oil and gas production spearheaded by technological advancements made right here in our own Gulf Coast region.”

The new production has created significant investment opportunities in refining, petrochemicals and transport of hydrocarbons.

“We expect that these investments will continue in upcoming years,” Upton said.

Content from the 2017 *GCEO*™ was featured in more than one dozen local media articles, and Upton presented the material at a number of business gatherings across the state. The publication was made possible by a generous donation from Regions Bank, as well as in-kind support from DrillingInfo, which supplied data and analytics tools used as valuable inputs to the production and labor market forecasts.

Kaiser Examines Jackup Rig Construction Market

The jackup rig is one of the most popular types of mobile offshore drilling units (MODU) for offshore exploration and development. Jackups are self-elevating units that can drill in waters up to 500 feet deep. In his recent publication, “The Jackup Rig Construction Market in the U.S. Gulf Coast” (*Ships and Offshore Structures* 12[5]: 662-678), Professor Mark Kaiser examines the U.S. construction market that supplies jackup rigs to the region.

Between the years 2000 and 2010, it was estimated that between 1,000 and 3,500 people were directly employed by the rig newbuild industry along the U.S. Gulf Coast and that the industry generates about \$360 million in annual revenue; however, because shallow water drilling has been in steep decline due to onshore shale gas plays and the growing deepwater sector, the long-term outlook for the domestic jackup construction industry is uncertain and difficult. To estimate the economic impacts of a downturn in the industry, Kaiser describes the specification classes and basic components of a jackup, as well as the U.S. and international construction markets. He develops a model to estimate steel weight requirements, and he estimates capital costs and those of labor and materials. Kaiser concludes that the direct economic impacts of a reduction in the industry would be mostly limited to the Brownsville, Texas, and Vicksburg, Mississippi, areas, noting that Brownsville’s AmFELS shipyard is equipped to survive a market contraction. But because the vast majority of components used in U.S. jackup construction—i.e., steel, derricks, drilling systems, and engines—are supplied by companies throughout the U.S., a downturn in the industry will likely have more widespread indirect effects, unless other industries’ shipbuilding needs replace those of the jackup rig industry.



Upton, Snyder Analyze Economics of Renewable Portfolio Standards



In a 2017 *Energy Economics* article titled “Funding renewable energy: An analysis of renewable portfolio standards,” Greg Upton, CES assistant professor, and Brian Snyder, assistant professor, LSU Dept. of Environmental Sciences, examine the impacts of renewable energy policies on electricity markets and their customers.

Renewable portfolio standards (RPSs), adopted by 30 U.S. states, typically mandate implementation of a system of renewable energy credits, in which the provider generates one credit for every megawatt-hour of renewable electricity produced.

The study’s synthetic control (SC) model finds that states with RPSs have experienced increases in electricity prices and decreases in electricity demand relative to non-RPS states with similar economic, political and renewable natural resource characteristics. While both RPS and non-RPS SCs experienced increases in renewable energy generation over the sample time period, there was no evidence that RPS states have experienced increases in renewable energy generation relative to SCs and weak evidence of emissions reductions.

In a related piece in the September 2017 issue of *Public Utilities Fortnightly*, Upton discusses some policy implications of these results. The political push for these standards is summarized by two major talking points. First, it is argued that these policies will create high-quality well-paying jobs for local residents, instead of spending those same dollars importing fossil fuels from other parts of the country and world. Second, it’s argued that these policies will lead to a decrease in electricity prices. Often short periods of low or even negative prices associated with surges in renewable power are cited. This article questions these claims, as empirical results suggest that RPS states have not experienced faster increases in renewable energy generation and electricity prices have increased in these states—not decreased—relative to similar non-RPS states.

Publications 2017

Dismukes, D.E. Efficiency and emissions reduction opportunities at existing Louisiana combined heat and power applications. Baton Rouge, LA: Louisiana Department of Natural Resources, December 17, 44 pp.

-- . Louisiana industrial combined heat and power applications: status and operations. Baton Rouge, LA: Louisiana Department of Natural Resources, December 17, pp. 54.

-- . Low cost hydrocarbons continue to benefit the Gulf Coast. *10/12 Industry Report*. Baton Rouge Business Report. Q:2.

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-- . Reading the tea leaves for 2017's crude oil markets. *10/12 Industry Report*. Baton Rouge Business Report. Q:1.

-- . A summer of discontent. *10/12 Industry Report*. Baton Rouge Business Report. Q:3.

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Dismukes, D.E. and G.B. Upton. Economic impact and re-employment assessment of PES Philadelphia refining complex. Report prepared on the behalf of Philadelphia Energy Solutions. August 31, 43 pp.

-- . The potential economic impacts of the Bayou Bridge Project. Report prepared on behalf of Energy Transfer, LLC. 23 pp.

-- . The potential economic impacts of the Washington Parish Energy Center. Report prepared on behalf of Calpine Corporation. 5 pp.

Dismukes, D.E., M.D. Terrell, C. Coombs, G.B. Upton. *Gulf Coast Energy Outlook*. Center for Energy Studies/Applied Economics Group, 18 pp.

To view or download
visit www.lsu.edu/ces/

Iledare, O.O. Shale gas and the future of energy: Law and policy for sustainability. *Economics of Energy & Environmental Policy* 6 (2): 144-147.

Kaiser, M.J. FERC pipeline decommissioning cost in the U.S. Gulf of Mexico, 1995-2015. *Marine Policy* 82: 167-180.

-- . The jackup rig construction market in the U.S. Gulf Coast. *Ships and Offshore Structures* 12(5): 662-678.

-- . A new approach to refinery complexity factors. *Engineering Economist* 62 (4): 336-368.

-- . Offshore pipeline construction cost in the U.S. Gulf of Mexico. *Marine Policy* 82: 147-166.

-- . A review of refinery complexity applications. *Petroleum Science* 14 (1): 167-194.

-- . Rigless well abandonment remediation in the shallow water U.S. Gulf of Mexico. *Journal of Petroleum Science and Engineering* 151 (2017): 94-115.

-- . U.S. Gulf of Mexico deepwater pipeline construction: A review of lessons learned. *Marine Policy* 86: 214-233.

Kaiser, M.J. (with M. Liu). Assessment of floater equipment capacity underpins successful development plan. *Offshore* 77 (9): 52-54.

-- . Review of GOM platform inventory offers preview of future decommissioning requirements. *Offshore* 77 (8).

Upton, G.B. Jobs, electricity prices and renewable energy policies: Costs versus benefits. *Public Utilities Fortnightly*. 155(9):32-33, 37.

Upton, G.B. (with M. McCollum). Asymmetric effects of housing wealth on college enrollment. *Applied Economics Letters*. April 2017. p. 1-5.

Upton, G.B. (with B.F. Snyder). Funding Renewable Energy: An Analysis of Renewable Portfolio Standards. *Energy Economics* 66 (2017): 205-216.

**CES publications,
research/bibliographies**



Events, Outreach & Education

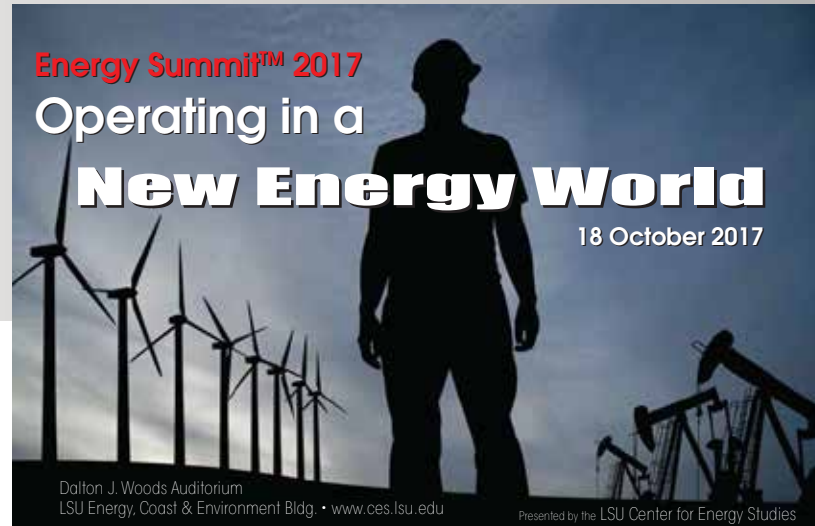
Energy Summit™ 2017

On October 18, the Center hosted its annual premiere event, Energy Summit™. The program explored the theme “Operating in a New Energy World,” with presenters providing insights into developments in transportation infrastructure, federal energy policy trends, how cybersecurity challenges impact future critical energy infrastructure operations and development, and the fate of energy workers laid off during the downturn.

The event kicked off with a compelling presentation on the life of Nicola Tesla by featured speaker John Wasik, who later greeted attendees at a book signing and sale for his *Lightning Strikes: Timeless Lessons in Creativity from the Life and Work of Nikola Tesla*. Campanile Charities sponsored Wasik’s talk.

Energy Summit™ 2017 attracted a diverse group of approximately 150 attendees representing industry, government agencies, academia and the media. The event boasted our largest-ever level of student attendance.

Energy Summit™ 2017 was made possible with the generous support of **our sponsors**.



Campanile Charities



1 The Energy Summit™ featured speaker, presented by Campanile Charities, was award-winning journalist and author John Wasik, who shared details and insights from his book *Lightning Strikes: Timeless Lessons in Creativity from the Life and Work of Nikola Tesla*.



2 CES Executive Director David Dismukes was the master of ceremonies for Energy Summit™ 2017.



3 Energy Summit™ 2017 attracted a record number of students, thanks to support from sponsor Campanile Charities.



4 Bob Lockhart of the Utilities Technology Council provided an update on cybersecurity from the perspective of utilities.

5 ClipperData director of commodity research Matt Smith gave an animated presentation on the market outlook.

6 John Moura of the North American Electric Reliability Corporation discussed distributed energy resources.

7 Panelists for the Transportation Infrastructure Development roundtable were, l-r, Aaron Wimberly, business development manager, EnLink Midstream; Marjorie McKeithen, partner, Jones Walker; Allen Fore, VP public affairs, Kinder Morgan; and Tyler Gray, chief counsel to Louisiana Mid-Continent Oil and Gas Association.

8 C. Kyle Simpson, senior adviser, Hogan Lovells US LLP, discussed current federal energy policies and trends.

9 Christiane Spitzmueller, associate professor, industrial organizational psychology, University of Houston, discussed the behavior and psychology of laid-off energy industry workers.



CES Hosts Petroleum Administration, Fiscal Framework Workshop for Nigerian Officials



CES Professor Emeritus Wumi Iledare and Executive Director David Dismukes (third and fourth from right), welcomed oil and gas regulators from Nigeria for a fiscal framework workshop in October.

During the week of Oct. 16-20, the Center hosted a workshop for oil and gas regulators from Nigeria. The group of 12 officials, representing the Department of Petroleum Resources (DPR) Nigeria, were guests of CES Professor Emeritus Wumi Iledare, who serves as director of the Emerald Energy Institute, University of Port Harcourt, Nigeria.

During the first day of the workshop, CES Assistant Professor Greg Upton discussed Louisiana's royalty and severance tax computation process, and Laborde Energy Center Interim Director Patrick H. Martin provided insight into the state's petroleum resources management, governance and regulation.

Later, the delegation met with officials from the La. Department of Revenue about the state's petroleum taxation schemes, administration and management, as well as with representatives from the La. Department of Natural Resources, who discussed licensing, industry governance, regulation and mineral revenue collection.

Keith B. Hall, professor and director of the LSU Law Center's Mineral Law Institute, talked about upstream regulations and governance, and Jim Richardson, professor, LSU Department of Economics, gave a presentation on Louisiana petroleum revenue forecasting and management.

As part of the workshop, participants attended the Center's annual fall conference, Energy Summit™, which featured a broad scope of current energy topics, including energy industry cybersecurity, labor issues, developments in power generation, energy infrastructure, global energy prices and more.

"The workshop provided a valuable opportunity for these officials to learn about Louisiana's approach to managing its petroleum resources," said Iledare. "Our colleagues at LSU and officials from the state agencies we met with were most helpful. They generously shared their experience and knowledge, and I know that the participants from DPR were most appreciative."

Workshops Provide International Energy Conservation Code Training to La. Builders, Contractors

Throughout the fall of 2017, Brian Snyder, assistant professor in the College of the Coast & Environment, and Bobby Parks, building science practitioner and owner of Healthy Homes of Louisiana, LLC, conducted several workshops that fulfilled part of the Center's "Success with 2009 International Energy Conservation Code (IECC) for Louisiana" project. The Center coordinated the workshops on behalf of the Southeast Energy Efficiency Alliance, in collaboration with the La. State Energy Office at the La. Department of Natural Resources. Builders, contractors, subcontractors and code officials were instructed on best practices for optimized energy savings in construction, in compliance with the energy conservation portion of the 2009 IECC. The workshops, held in Baton Rouge, New Orleans, Lake Charles and Shreveport, were cosponsored by area building associations, offered continuing professional development hours to participants and averaged approximately 20 attendees.



Bobby Parks (left), building science practitioner and owner of Healthy Homes of Louisiana, LLC, and Brian Snyder, assistant professor in the College of the Coast & Environment, conducted energy efficiency workshops on behalf of the Southeast Energy Efficiency Alliance.

Dismukes Meets with La., Canadian Officials on CCUS Technologies

In January, David Dismukes met with Scott Moe, Saskatchewan's Minister of Environment, Tom Harris, Louisiana Department of Natural Resources secretary, and David Boule, assistant secretary for Mineral Resources, to discuss the commercialization of carbon capture, utilization and storage (CCUS) technologies. The market-driven initiative, led by the Southern States Energy Board, aims to accelerate the commercialization of CCUS technologies within the industrial sector.

The Central Gulf Coast region provides an ideal setting for industrial carbon capture due to the large number of facilities that produce and vent CO₂ in relatively high concentrations. The region also has an existing CO₂ transportation network and numerous oil fields that are suitable for CO₂-enhanced oil recovery.



CES Local Host for Pink Petro's HERWorld Energy Forum

In March, the Center hosted an innovative one-day learning event featuring La. State Sen. Sharon Hewitt as the local guest speaker. The theme was "New Frontiers in the Energy Industry: Where Business, Workforce, Innovation and Policy Intersect."

Participating universities, companies and facilities enjoyed the international portion of the event via web streaming technology. Assistant Professor Mallory Vachon coordinated the local event.



Energy Bar Association NOLA Chapter Holds Annual Meeting at CES

On May 10, the Center hosted the annual meeting of the Energy Bar Association, New Orleans Chapter. The full-day CLE event drew more than 50 attendees and featured La. Public Service Commissioner Eric Skrmetta as keynote speaker. Energy leaders in the law, government and industry from Washington, D.C., Louisiana, and elsewhere met to discuss regulatory and jurisdictional issues impacting Louisiana energy professionals. Topics included energy infrastructure hardening and storm preparation and response; an overview of the Federal Energy Regulatory Commission, its organization and structure; and current issues in carbon capture, utilization, and sequestration (CCUS). The event included a chapter business meeting and networking reception.

DOE, NETL Representatives Meet for Carbon Capture & Storage Discussion

The Center's collaboration with the Southern States Energy Board (SSEB) on carbon capture and storage (CCS) feasibility analyses led to an informal industry stakeholder group meeting in August, held in conjunction with a regional visit by Grace M. Bochenek, director of the National Energy Technology Laboratory (NETL). The agenda included an update on the state of integrated CCS in the Louisiana chemical corridor by David Dismukes and overviews of work by the NETL and SSEB on central Gulf Coast CCS. Attendees included representatives from the SSEB, La. Department of Natural Resources, La. Mid-Continent Oil & Gas Association, La. Chemical Association, La. Geological Survey, LSU's Department of Petroleum Engineering and College of the Coast & Environment.



LPS Commissioner Erik Skrmetta provided the keynote address at the Energy Bar Association, New Orleans Chapter meeting on May 10.



The EBA meeting included a panel discussion on carbon capture, utilization and storage.



The EBA NOLA meeting included a chapter business meeting, conducted by Chapter President Dan Pancamo.

CES Faculty Share Research with Regional, International Audiences



// In 2017, CES faculty spoke at more than 20 meetings and events, on topics ranging from electricity market restructuring to carbon capture and storage, to the outlook for crude oil and natural gas markets.

In March, Dismukes “braved the ‘Blizzard of 2017’” on his visit to the **National Energy Technology Lab (NETL)**, where he outlined LSU’s Integrated Carbon Capture and Storage Research project. The \$1.3 million grant for the project, provided by the U.S. Department of Energy, and administered by NETL, was awarded to 13 institutions to develop pre-feasibility studies for industrial applications for carbon capture and storage. The LSU project focuses on industrial applications along the Gulf Coast between Baton Rouge and New Orleans.

Later in March, Greg Upton began a series of presentations based on the *Gulf Coast Energy Outlook™*, including community advisory groups in Iberville and St. James Parishes, as well as the **American Petroleum Institute (API) Delta Chapter Joint Society Luncheon** in New Orleans and the **American Council of Engineering Companies of Louisiana** in Baton Rouge. Presentations of the 2017 *GCEO™* continue in 2018.

At the June 20 **Greater Baton Rouge Industry Alliance’s (GBRIA’s)** monthly operations maintenance and engineering technology exchange meeting, Dismukes shared LSU’s technical capabilities and potential industry partnerships.



On June 15, Dismukes provided an oil and gas industry update as part of an economic trends panel for the **Corpus Christi Regional Economic Development Corporation**.



Also in June, Greg Upton presented on the distributional effects of electricity market restructuring at the **International Association for Energy Economics** meeting in Singapore and at a meeting of the **Asian Law and Economics Association** in Ho Chi Minh City, Vietnam.

In August, Dismukes presented an update on LSU research into industrial carbon capture and storage (CCS) applications along the Gulf Coast, at a meeting sponsored by the **U.S. Dept. of Energy National Energy Technology Laboratory**. It was the second annual NETL meeting examining a range of subsurface technologies that include CCS, geothermal and advanced oil and gas extraction.

In September, at the **National Academies of Sciences, Engineering, and Medicine** coastal zone dynamics meeting in New Orleans, Dismukes participated in a panel discussion of energy-related infrastructure and support along the Gulf Coast. He also represented CES and LSU at a **Energy Export Association** reception in New Orleans, where energy industry representatives discussed the current status of liquefied natural gas projects in Louisiana and the state's energy export economy.

2017 Presentations

"Electric Power: Industry Overview, Organization, and Federal/State Distinctions." Gregory B. Upton, Jr., Ph.D. EUCI. FERC Electricity 101 Seminar, San Diego, Calif., January 30.

"Integrated Carbon Capture, Utilization and Storage in the Louisiana Chemical Corridor." David E. Dismukes, Ph.D. National Energy Technology Laboratory CarbonSAFE kick-off meeting, Pittsburgh, Pa., March 14.

"Gulf Coast Energy Outlook." Gregory B. Upton Jr., Ph.D. East Iberville Community Advisory Panel Meeting, March 23.

"Recent Trends in Energy: Overview and Impact for the Banking Community." Oil and Gas Industry Update, Louisiana Bankers Association. Baton Rouge, La., March 24.

"Natural Gas Issues and Recent Market Trends." Michigan State University Institute of Public Utilities, GridSchool Regulatory Studies Program, East Lansing, Mich., March 29.

"Mid-Stream Investment in the Era of Shale." Gregory B. Upton, Jr., Ph.D. Kinetica Shipper Meeting, Lake Charles, La., April 6.

"The Gulf Coast Energy Economy: Trends and Outlook." Society for Municipal Analysts. New Orleans, La., April 21.

"Integrated Carbon Capture, Utilization and Storage in the Louisiana Chemical Corridor." David E. Dismukes, Ph.D. Energy Bar Association Meeting: New Orleans Chapter, May 10.

"The 2017-2018 Louisiana Energy Outlook." Junior Achievement of Greater New Orleans, JA BizTown Speaker Series. New Orleans, La., May 12.

"Navigating through the Energy Landscape." David E. Dismukes, Ph.D. Baton Rouge Rotary Club Luncheon, May 24.

"Gulf Coast Energy Outlook." Gregory B. Upton Jr., Ph.D. St. James Community Advisory Panel Meeting, June 6.

"Crude Oil and Natural Gas Outlook: Where Are We and Where Are We Going?" CCREDC Economic Trends Panel. Corpus Christi, Tx., June 15.

"An Analysis of the Distributional Effects of Electricity Market Restructuring." Gregory B. Upton Jr., Ph.D. International Association for Energy Economics, Singapore, June 19.

"Capacity Utilization, Efficiency Trends, and Economic Risks for Modern CHP Installations." U.S. Department of Energy, Industrial Energy Technology Conference, New Orleans, La., June 21.

"An Analysis of the Distributional Effects of Electricity Market Restructuring." Gregory B. Upton Jr., Ph.D. Asian Law and Economics Association, Ho Chi Minh City, Vietnam, June 22.

"Gas Supply Planning and Procurement: Regulatory Overview and Issues." Michigan State University Institute of Public Utilities, Basic Regulatory Studies Program, East Lansing, Mich., Aug 17.

"Natural Gas Supply Issues and Challenges." Michigan State University Institute of Public Utilities, Basic Regulatory Studies Program, East Lansing, Mich., Aug 17.

"Incentives, Risk and Changes in the Nature of Regulation." Michigan State University Institute of Public Utilities, Basic Regulatory Studies Program, East Lansing, Mich., Aug 18.

"The Changing Nature of Gulf of Mexico Energy Infrastructure." Session 3B: New Directions in Social Science Research. 27th Gulf of Mexico Region Information Technology Meetings. U.S. Department of the Interior, Bureau of Ocean Energy Management, Environmental Studies Program. New Orleans, La., August 24.

"Critical Energy Infrastructure: The Big Picture on Resiliency Research." National Academies of Science, Engineering, and Medicine. New Orleans, La., September 18.

"Econometric Forecasting and Energy Regulation." Gregory B. Upton Jr., Ph.D. Michigan State University Institute of Public Utilities, Advanced Regulatory Studies Program, East Lansing, Mich., October 2.

"Traditional and Alternative Forms of Regulation: Background and Overview." Michigan State University Institute of Public Utilities, Advanced Regulatory Studies Program, East Lansing, Mich., October 2.

"Traditional and Alternative Forms of Regulation: Utility and Policy Motivations for Risk and Change." Michigan State University Institute of Public Utilities, Advanced Regulatory Studies Program, East Lansing, Mich., October 2.

"Traditional and Alternative Forms of Regulation: Incentives and Formula Based Methods." Michigan State University Institute of Public Utilities, Advanced Regulatory Studies Program, East Lansing, Mich., October 2.

"The Outlook for Natural Gas and Energy development on the Gulf Coast." Louisiana Chemical Association, Annual Meeting, New Orleans, LA. October 26.

"Gulf Coast Energy Outlook." Gregory B. Upton Jr., Ph.D. American Petroleum Institute (API) Delta Chapter Joint Society Luncheon, New Orleans, La., November 8.

"The Future of Solar In Louisiana: An Analysis of the Technical and Economic Implications of Solar P.V. Growth on Louisiana's Economy and Electric Grid. Gregory B. Upton Jr., Ph.D. United States Association for Energy Economics, Houston, Tex., November 14.

"Gulf Coast Energy Outlook." Gregory B. Upton Jr., Ph.D. American Council of Engineering Companies of Louisiana, Project Outlook 2017, Baton Rouge, La., November 16.

View or download CES
presentations at [www.lsu.edu/
ces/presentations](http://www.lsu.edu/ces/presentations)

Noteworthy

Campanile Charities, Inc., Provides Grant

In spring 2017, Campanile Charities, Inc., awarded the Center for Energy Studies two grants totaling \$15,000 in support of Energy Summit™. The awards were part of the Campanile Charities' grant program for 2016-17 comprising several grants of up to \$20,000 each for selected LSU academic units and research programs associated with the energy industry. The grant was used to support Energy Summit™ student scholarships and speaker travel, as well as an honorarium for keynote speaker, author John Wasik.

Dismukes Meets with Consul General of Canada

On Monday, April 17, David Dismukes met with Canadian Consul General Sara Wilshaw and Consul Vasken Khabayan, public affairs manager. The purpose of the meeting, held at the request of the Office of the Consul General, was to provide her with an overall picture of the status of the oil and gas sector in the Gulf and how Mexico's involvement might affect the region.



Groat Returns to LGS

In July, Charles "Chip" Groat, Ph.D., came aboard as professor and acting director of the Louisiana Geological Survey (LGS,

or the Survey). Groat returned to LSU after many years in academia, government, independent research, and administrative positions. Groat's prior tenure at LSU included serving as the LGS director and state geologist (1978-1990) and as the executive director for Coastal, Energy, and

Environmental Resources (1992-1995). He will work as acting LGS director with CES Executive Director David E. Dismukes to explore new research and growth opportunities for LGS and for LSU's overall energy, coastal and environmental research initiatives.

Atlanta Fed CEO Feted

In September, David Dismukes took part in "An Evening with Raphael Bostic, 15th President and Chief Executive Officer of the Federal Reserve Bank of Atlanta." As president of the Atlanta Fed, Bostic leads one of the 12 regional Reserve Banks that, with the Board of Governors, make up the Federal Reserve System, the nation's central bank. The Atlanta Fed is responsible for the Sixth Federal Reserve District, which encompasses Alabama, Florida and Georgia and portions of Louisiana, Mississippi and Tennessee.

Dismukes Named to NPC

U.S. Secretary of Energy Rick Perry appointed David Dismukes to serve as a member of the National Petroleum Council (NPC). The NPC, in existence since World War II, responds to requests from the Secretary of Energy for analysis and guidance on energy matters, with a particular focus on crude oil and natural gas.



CES in the News 2017

“ In 2017, CES faculty shared expert commentary in more than 35 news items published by 20+ media outlets.

In 2017, CES faculty shared expert commentary in more than 35 news items published by 20+ media outlets, including state news organizations like *The Advocate*, *Greater Baton Rouge Business Report*, *NOLA.com*, and *New Orleans CityBusiness*. Other outlets included *Natural Gas Intelligence*, *American Press*, *Utilities Fortnightly*, Louisiana Public Television, KATC-TV and Talk 107.3. Topics included oil price projections, uncertainty caused by OPEC’s cuts, the impact of a “business-friendly” Trump administration on the energy industry, factors driving liquefied natural gas demand and the economic impacts of the Bayou Bridge Pipeline.




In June, Greg Upton appeared on a segment of Louisiana Public Broadcasting’s *Louisiana: The State We’re In*, discussing oil and gas prices and their impacts on the state’s economy. Upton commented on the 30 percent drop in oil and gas industry jobs between 2014 and 2016, the effects of the severance tax rate and differences between the 1980s’ oil and gas crisis and the recent downturn.

Meeting Video

In January, at the American Economic Association Meeting in Chicago, Upton was interviewed on the boom and bust cycle of the shale industry and the welfare of the people who live in shale regions. The video was associated with the working paper, “Local Labor Market Shocks and Residential Mortgage Payments: Evidence from Shale Oil and Gas Booms,” released as part of the United States Association of Energy Economics Working Paper Series in 2016. The working paper, available for download on Upton’s website, shows that borrowers with properties located in areas with shale oil and gas booms experienced a six percent reduction in the probability of missing a mortgage payment.

Local Labor Market Shocks & Residential Mortgage Payments: Evidence from Shale Oil & Gas Booms


Meagan N. McCallum, Department of Real Estate, Baruch College, City University of New York
Gregory B. Upton Jr., Center for Energy Studies, Louisiana State University




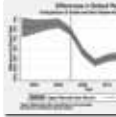
Abstract
In this research, we test the impact of shale oil and gas booms on mortgage payment activity in areas that experience large increase in oil and gas production associated with technological developments that allowed for the extraction of hydrocarbons from shale geological formations. To investigate the dynamics of this relationship, we examine mortgage payment choices of homeowners who purchased property in areas that later experienced a positive shock to local economic conditions via the shale oil and gas boom. Using a large loan-level dataset with detailed information on mortgage originations and monthly payments, we find that borrowers with properties located in areas with shale oil and gas booms experienced a 6 percent reduction in the probability of missing a mortgage payment.

Introduction
After many years of declining crude oil production in the United States, recent technological developments have made the extraction of previously inaccessible energy resources feasible. Specifically, the advent of horizontal drilling and hydraulic fracturing techniques have enabled the exploration and production of oil and gas from “shale” geological formations, and led to significant new drilling activity over the past decade. Contemporaneously, widespread declines in residential housing values and sharp increases in mortgage default rates in 2007-2009 were a central component of the Great Recession. Notably, in the midst of the Great Recession, the technological innovations that enabled shale oil and gas extraction provided a catalyst for an economic “boom” to clearly specified local areas where these previously inaccessible resources could now be profitably extracted. This research focuses on how this natural resource boom impacted local residents of areas where these resources were extracted.

The Data
We study approximately 32,000 loans and 1.7 million payment records in six geographic areas that allow for shale oil and/or gas extraction, namely: **Bakken, Eagle Ford, Haynesville, Marcellus, Niobrara, and Utica**. We estimate the impact of the shale boom on mortgage payment activity of individuals who purchased property in one of these areas prior to the natural resource discovery. We examine the impact of the shale boom on the probability of mortgage default during a time period where aggregate default rates nationwide were sharply increasing. **Findings** Using a differences-in-differences framework, we find that borrowers with properties in counties with shale oil and gas resources experience, on average, a 6 percent reduction in the probability of mortgage default as compared to similar mortgages in non-shale areas during the boom began. This reduction in the probability of mortgage default reaches a maximum of approximately 7-9 percent during the peak of the shale boom and attenuates to approximately 3-4 percent by the end of 2012. The duration and magnitude of the treatment effect varies by “county” (Haynesville, Marcellus, Utica, Eagle Ford, Bakken).



“Borrowers with properties located in areas with shale oil and gas booms experienced a 6 percent reduction in the probability of missing a mortgage payment.”



Scholarships

Brooksher, Hood, GCPA Scholarships Awarded for 2017-2018

CES awards several scholarships to students majoring in energy-related fields. In the spring of 2017, the Center for Energy Studies Scholarship Committee awarded the following scholarships for the 2017-18 academic year:

LMOGA/Brooksher Scholarship: John Lorence, a senior majoring in petroleum engineering from Shreveport.

F. Malcolm Hood Scholarship: Andrew Chenevert, a senior majoring in accounting from Baton Rouge.

David Olver Memorial Scholarship: Sean Guillory, a senior majoring in chemical engineering, from Lafayette.

GCPA emPOWERing Women Scholarship: Breanna Lee, a junior majoring in electrical engineering, from Baton Rouge.

The Center congratulates these outstanding students and thanks our scholarship donors for their support of these students as they prepare for careers in the energy industry.



John Lorence



Andrew Chenevert



Sean Guillory



Breanna Lee

Personnel

Administration

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

Allan G. Pulsipher, Ph.D., associate executive director and Marathon Oil Company Professor of Energy Policy in the Center for Energy Studies

Diana Reynolds, assistant to the executive director

Marybeth Pinsonneault, communications manager

Division of Policy Analysis

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

Mallory Vachon, Ph.D., assistant professor

Mike McDaniel, Ph.D., professional-in-residence (retired)

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

Division of Research & Development

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

Siddhartha Narra, Ph.D., research associate

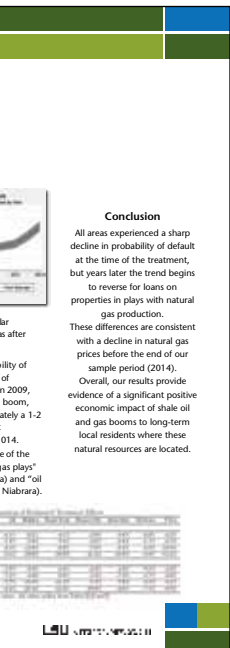
Division of Energy Information & Data

Omowumi (Wumi) Iledare, Ph.D., professor emeritus

Ric Pincomb, research associate

Stacy Retherford, computer analyst

Mike Surman, computer analyst



MINERALS PROCESSING RESEARCH DIVISION

RALPH PIKE, DIRECTOR • F. CARL KNOPF, CO-DIRECTOR • www.mpri.lsu.edu



The Minerals Processing Research Division (MPRD) of the Center for Energy Studies, established in 1979 by Federal legislation as one of 31 State Mineral Institutes associated with the U.S. Department of Interior, facilitates research and public service programs in process research and technology transfer, sustainable development, energy management, and inherently safer design. The division's research and public service complement and benefit from the energy research and geological research performed by the Center for Energy Studies and the Louisiana Geological Survey.

The Division continues its research to evaluate the resilience of the infrastructure of the Chemical Processing Industry (CPI) to determine the capability of the complex to absorb and recover from adverse events and of the impact of these events on the supply chain of critical chemicals. Research is continuing for mixed-integer nonlinear optimization (MINLP) to have the best way to evaluate resiliency options. Also, MPRD is continuing with development of web-based energy education and learning modules. These modules are currently being used to promote key energy technologies to engineering students (sophomore to senior year) at 10+ universities.

Pipeline Failure Detection Study Underway

The MPRD has begun a study of pipeline failure detection. The study supports infrastructure for the chemical industry as pipeline failure often results in both loss and environmental damage. The MPRD is applying existing expertise in data reconciliation, gross error detection and thermodynamics to more rapidly detect and quantify pipeline problems. For example, the November 17, 2017, release of 210,000 gallons of oil from the Keystone Pipeline in South Dakota took about 15 minutes for detection and shut down.





Energy Sustainability Remote Lab Utilized by Partner Universities

The Center continues to host the Energy Sustainability Remote Laboratory (ESRL) www.esrl.lsu.edu. ESRL allows partner universities to implement authentic experiences by providing data from actual operating energy or energy-intensive manufacturing systems – a natural gas-based cogeneration unit, a nuclear power plant, a coal-fired plant, a photovoltaic solar facility, and bench-scale units for biomass

processing to chemicals, and biomass gasification - as well as pre-tested background materials and suggested inquiry-based assignments. Currently, ESRL is used by engineering programs at LSU, Auburn, University of Alabama, University of South Alabama, UNLV, FSU, and several other schools.

Research, Publications, Programs Available Online

The Division's web site www.mpri.lsu.edu has been moved to the LSU web server, and in the process, it was expanded, revised and extended with new research results, including journal articles, conference proceeding, technical reports, theses, dissertations and computer programs. The programs have installation files, users' manuals and tutorials. These programs have been developed using actual plants, and the process models can be applied to comparable plants. The interactive heat exchanger synthesis program THEN has been rewritten and enhanced with an Excel interface and graphical display.

Two programs that can give immediate and substantial energy savings for chemical plants and refineries are "pinch technology" and "on-line optimization." Large companies have corporate level groups that routinely apply pinch



technology and on-line optimization. Small- to medium-sized chemical companies in Louisiana do not have the trained personnel needed to apply this technology. Two short courses on these topics are available by request by contacting the Division at www.mpri.lsu.edu.

The extensive website includes updated professional development self-study courses for professional engineers' PDH requirements. These courses and computer program are part of the website materials that are continually being revised and extended.



Research on Resilient Critical Infrastructure for the Chemical Industry Continues

// The Chemical Complex Analysis System has been used to demonstrate the integration of new plants for products from carbon dioxide and chemicals from biomass into an existing infrastructure of existing plants.

Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. Research is underway with the objective to improve the resilience of the infrastructure of the Chemical Processing Industry (CPI). The project uses the Chemical Complex Analysis System for a chemical production complex based on multiple plants in the lower Mississippi River corridor to evaluate the capability of the complex to absorb and recover from adverse events and of the impact of these events on the supply chain of critical chemicals.

The Chemical Complex Analysis System has been revised and extended recently with the assistance of industrial collaborators who were involved with the initial development. This system is quantitative description of the plants in the agricultural chemical chain and the methanol and benzene chains that were developed for a complex of interconnected plants in the Mississippi River corridor. Material and energy balances, rate equations and equilibrium equations describe 13 production units and their interconnections, plus associated utilities for power, steam and cooling water and facilities for waste treatment. A production unit contains more than one plant; for example, the phosphoric acid production unit contains four plants owned by three companies.

Raw materials used in the chemical production complex include air, water, natural gas, sulfur, phosphate rock,

ethylene and benzene. The products are mono- and di-ammonium phosphate (MAP and DAP), granular triple super phosphate (GTSP), urea, ammonium nitrate, and urea ammonium nitrate solution (UAN), phosphoric acid, ammonia, methanol, acetic acid, ethylbenzene and styrene. Intermediates are sulfuric acid, phosphoric acid, ammonia, nitric acid, urea, carbon dioxide and ethylbenzene. The intermediates are used to produce MAP and DAP, GTSP, urea, ammonium nitrate, acetic acid, UAN, and styrene. Ammonia is used in direct application to crops and other uses. MAP, DAP, UAN and GTSP are used in direct application to crops. Phosphoric acid can be used in other industrial applications. Methanol is used to produce formaldehyde, methyl esters, amines and solvents, among others, and is included for its use of ammonia plant byproduct - carbon dioxide. Acetic acid, ethylbenzene and styrene are used as feedstock in other chemical processes. Emissions from the chemical production complex include sulfur dioxide, nitrogen oxides, ammonia, methanol, silicon tetrafluoride, hydrogen fluoride and gypsum.

The Chemical Complex Analysis System has been used to demonstrate the integration of new plants for products from carbon dioxide and chemicals from biomass into an existing infrastructure of existing plants. Optimal configuration of new and existing plants was determined by maximizing the triple bottom line of product sales and economic, environmental, and sustainable costs, and satisfying process

constraints. Detailed results are given on the Division's web site www.mpri.lsu.edu. This web site was transferred to the LSU server from the departmental server and was extensively improved with the assistance of the LSU Office of Strategic Communications.

Current research is employing the Chemical Complex Analysis System in its present form as a solution to a mixed integer nonlinear programming problem to estimate potential failures in one of the plants or on the periphery of the complex on the impact of the other plants and products. These sets of scenarios, chosen deterministically and randomly, are giving static results that can be interpreted for resilient optimization of the complex. Extensions to dynamic impact of incidents will require that the system be expanded to include residence times for the process units and storage capacities among units. The system will become a coupled set of ordinary differential equations with appropriate initial and boundary conditions that will be used to predict the dynamic response to incidents that can occur over a short time, such as hours for a terrorist attack, to days, such as can occur from a national disaster like a hurricane.

National Academies of Sciences Resiliency Research Evaluated

Research reports from numerous sources have been evaluated for methodologies used to analyze resiliency in multiunit industrial systems. There have been several National Academies of Sciences reports on disaster residency, resiliency in the nation's power grid and threat of improved explosive devices.

A detailed and comprehensive report titled "Disaster Resilience: A National Imperative," released in 2012 by the Committee on Increasing National Resilience to Hazards and Disasters; Committee on Science, Engineering, and Public Policy; and National Academies, emphasized understanding, managing, and reducing disaster risks for hazards to cause adverse effects on life, health, and economic well-being by using risk management. Risk management strategies require regular reevaluation, and some residual risk will always be present.

A detailed and comprehensive report titled "Enhancing the Resilience of the Nation's Electricity System" was released in 2017 by the Committee on Enhancing the Resilience of the Nation's Electric Power Transmission and Distribution System; Board on Energy and Environmental Systems; National Academies of Sciences. This report focuses on large-area, long-duration outages—considered herein as blackouts that last several days or longer and extend over multiple service areas or states caused by natural disasters or pernicious physical or cyber-attacks.

A detailed and comprehensive report titled "Reducing the Threat of Improvised Explosive Device Attacks by Restricting Access to Explosive Precursor Chemicals," was released in 2017 by the Committee on Reducing the Threat of Improvised Explosive Device Attacks by Restricting Access to Chemical Explosive Precursors, Board on Chemical Sciences and Technology, Division on Earth and Life Studies; National Academies of Sciences. To project opportunities to improved resiliency in a process complex, it is necessary to evaluate munitions available to insurgents. Restricting access to explosive precursor chemicals reduces the threat of improved explosive devices, and the report gives a short list of precursor chemicals of greatest concern including: TATP: triacetone triperoxide; HMTD: hexamethylene triperoxide diamine; EGDN: ethylene glycol dinitrate; AN: ammonium nitrate; NM: nitromethane; CHP: concentrated hydrogen peroxide; KClO₃: potassium chlorate. R-salt: cyclotrimethylenetrinitrosamine. Explosive charges can range in mass from approximately 40 pounds to tens of thousands of pounds, depending on the carrying capacity of the vehicle. Precursor chemicals utilized to produce these explosives tend to be fertilizers (e.g., AN and urea), potassium chlorate, and concentrated hydrogen peroxide (CHP). Explosives can be encountered in backpacks, brief cases, small bags, and suicide bombing vests, belts, etc. and the charge mass ranges from approximately one to 40 pounds. Typically, they employ a mass of fragmentation material, shrapnel. Based on this information, locations of potential sites for explosives can be approximated for simulation and analysis, e.g., rail car delivery points and tank farms.

DHS Research on Impacts of Disruptive Events Informs MPRD Approach

The Department of Homeland Security (DHS) has sponsored several projects at the Sandia National Laboratories to assess the impacts of disruptive events on chemical plants and supply chains, and conducted resilience evaluations considering electrical, crude oil and natural gas networks. These evaluations are summarized below, and their results have been used for direction in the current research.

In a 2014 DHS sponsored project, a linear programming supply chain analysis was formulated to assess the impacts of disruptive events on chemical plants and supply chains using mathematical models of chemical-plant production scheduling, spatial-economic models of chemical buying, selling, and shipping and a multi-modal network model of chemical transport. An example of the baseline and disruption characteristics of a small chemical supply chain model subject to a disruptive event was used to illustrate modeling capabilities.

from a North American network and used to evaluate the resiliency of the Southern California natural gas system to a hypothetical large San Andreas Fault earthquake, and the results demonstrated the uncertainty over how gas in storage might be used in an emergency.

In a 2017 publication, "Assessment of Attack Likelihood to Support Security Risk Assessment Studies for Chemical Facilities," a European research group developed a probabilistic risk model based on Bayesian networks to address the quantitative assessment of attack likelihood, and they incorporated functional analysis of physical protection systems as applied the security of process and storage installations. A case study of industrial interest was analyzed to exemplify the methodology, and this procedure can be adapted as part of the current resiliency research to estimate probabilities of facility attacks.





Pike Co-chairs Technical Sessions at National Meetings

A technical session on “Innovative Processes for Chemicals and Fuels from Renewable Resources” has been planned for the American Institute of Chemical Engineers’ 2018 Annual Meeting in Pittsburgh, Oct. 27-Nov 2, that is being co-chaired by Ralph Pike and Jeffrey Seay. The technical session will have eight presentations from industry engineers and university researchers on numerous aspects of developing innovative processes to produce fuels and chemicals from renewable resources with an average of 50 attendees in the session.

Three technical sessions on Sustainable Chemicals: Advances in Innovative Processes, Sustainable Fuels from Renewable Resources, and Advances in Environmental Fundamental were held at the AIChE Annual Meeting, Minneapolis, on Oct. 29-Nov. 3, 2017.

Personnel

Ralph W. Pike, director,
Emeritus Professor of Chemical Engineering

F. Carl Knopf, co-director,
Emeritus Professor of Chemical Engineering

Undergraduate student assistants

Jessica Lee

Will Fernandez

Miguel Clouatre

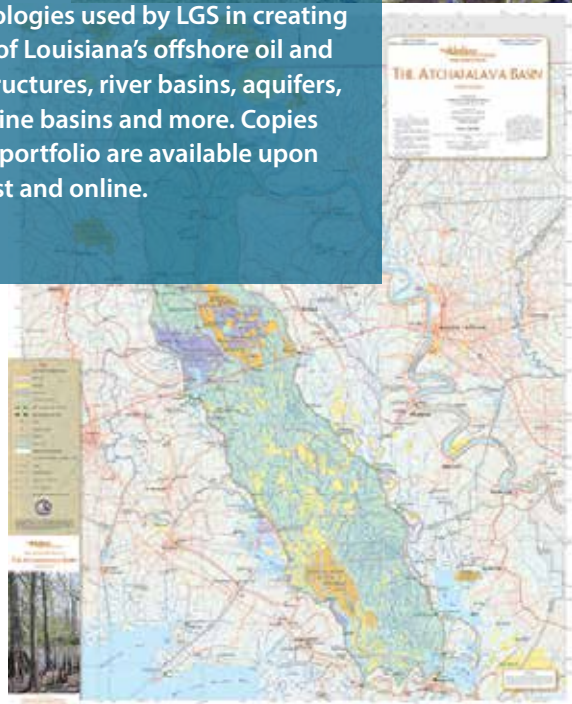
LOUISIANA GEOLOGICAL SURVEY

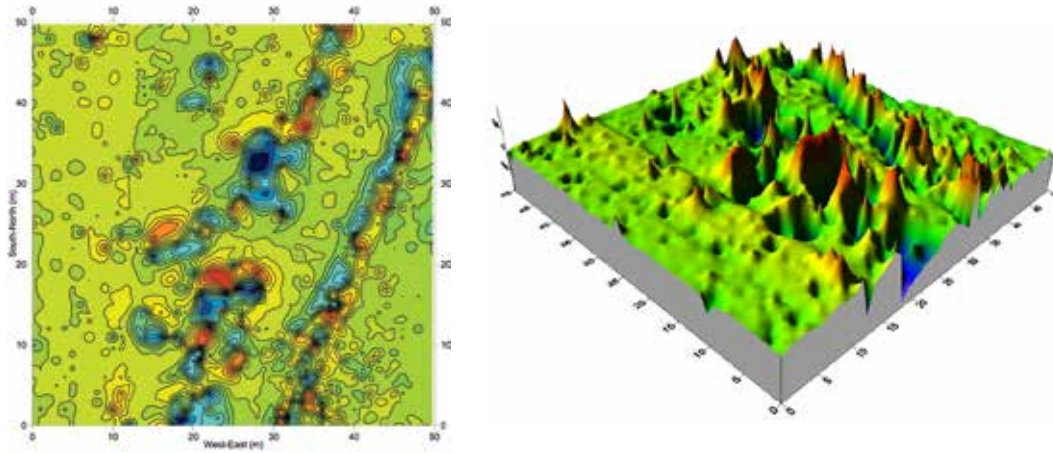
CHARLES "CHIP" GROAT, ACTING DIRECTOR • CHACKO J. JOHN, Associate Director • www.lsu.edu/lgs

The Louisiana Geological Survey (LGS) originated in 1869 and was later officially established by the Louisiana legislature in 1934 (Act 131). LGS is presently a research unit affiliated with Louisiana State University, having been legislatively transferred in 1997 from the Louisiana Department of Natural Resources. LGS currently reports through the Executive Director of the Center for Energy Studies to the LSU Vice President of Research and Economic Development.

LGS Offers Portfolio of Published Maps

Louisiana Geological Survey has created *A Portfolio of Published Maps*, a 66-page example of maps produced by the Survey's Cartographic Services section since 1980. The full-color publication showcases the wide-ranging cartographic design technologies used by LGS in creating maps of Louisiana's offshore oil and gas structures, river basins, aquifers, estuarine basins and more. Copies of the portfolio are available upon request and online.





Geophysics Section

The Louisiana Geological Survey develops and applies geophysical techniques to shallow subsurface conditions in civil engineering, archaeology, natural resources, and geologic investigations. Anthropogenic features, such as historic ruins, human burials, and buried utilities, are located and mapped based upon electrical resistivity and magnetic field data. Lithostratigraphic layering and its kin - concentrations of Earth materials, water table topology, and fault zone movement - are resolvable with electrical and seismic refraction methods. Natural hazards, such as slumping, creep, and fault displacement, and man-made hazards related to earthen structures, buried utilities, and buried waste are amenable to analysis using all three techniques.

These tools provide information that is vital to the management of natural and historic resources and assessment and mitigation of natural and man-made hazards in the unique geological setting of Louisiana and the greater Gulf Coast province. These techniques have proven successful in a variety of situations and, in collaboration with student and professional geologists, geophysicists, archaeologists, and forensic scientists, LGS continues to expand its capability and applications.

Research Highlights

A Comparison of Holocene Climatic Optimum Periods: Are they as Warm as the Post-Little Ice Age Period and Are Greenhouse Gas Concentrations Similar?

Douglas Carlson

There have been a number of studies that have observed that there is a variability of temperature as indicated from analysis of stable isotope data throughout the Holocene. The Holocene includes six warm periods (including the current one) and five cool periods, some of which have been named. Named warm periods include Holocene Climate Optimum, first portion, 6200 to 7700 years before present (BP); Holocene Climate Optimum, second portion, 3500 to 4700 BP; Roman Climate-Optimum, 300 BC to 400 anno domini (AD); and Medieval Warm Period, 700 to 1300 AD. Named cool periods include Dark Age, 400 to 700 AD; and Little Ice Age, 1300 to 1850 AD. Another unnamed period is a cool period that was between 750 and 300 BC.

The question to consider is how similar each of the periods is to the current Modern Warm Period in terms of temperature and concentrations of greenhouse gas and other measured properties as recorded in either ice cores, cave formations, or fossils. This involved compiling records of greenhouse gas concentrations, temperature data from oxygen isotope data, sulfate, and total dust concentrations and comparing distribution of these concentrations among the different climate periods within the Holocene by two statistical tests: Mann-Whitney ranks and Wilcoxon rank sum used to determine the statistical confidence of the differences between climate periods. That is, is the current warm period similar to other warm periods? It appears that the current warm period has statistically significant higher concentrations of greenhouse gases than earlier warm periods. However, the temperature data appear to be more equivocal. Overall, it appears that solar irradiance has had more of an effect on temperature than greenhouse gases.



What are the Impacts of a Dense Field of Septic Systems on Groundwater Quality?

Douglas A. Carlson and Marty Horn

This research was initiated to address public concerns about the chemicals present within the fracturing solution to be used in development of an unconventional hydrocarbon deposit in southeastern Louisiana as a possible source of contamination of drinking water. Establishment of baseline water

quality by testing existing residential water wells was done prior to fracturing and revealed significant variability of water quality. This variability maybe due to residential septic system density as apparent between areas with average lot sizes of about 0.5 acres to those over 1.5 acres.

Samples were collected from 100 domestic water supply wells mainly screened across a shallow sand that is less than 300 feet below the surface. Each sample was analyzed for the following ions and compounds: arsenic, benzene, boron, bromide, butane, cadmium, calcium, chloride, chromium, copper, ethane, ethylbenzene, fluoride, iron, lead, magnesium, manganese, methane, nickel, nitrate, nitrite, pentane, pH, phosphate, phosphorous, potassium, propane, silicon, sodium, specific conductance, strontium, sulfate, toluene, xylenes, zinc, and total dissolved solids (TDS). Within the study area is a subdivision that can be split into residential developments of two different densities, which contained approximately half of all of the study's wells. The southern half of the development has lots typically between 1.5 and 2.5 acres. The northern half of the development has lots typically less than 0.5 acres.

Results are such that the septic system density appears to influence ion concentrations. Ground water concentrations of aluminum, barium, bromide, calcium, chloride, copper, iron, magnesium, manganese, methane, nitrate, phosphorous, potassium, sodium, strontium ions, and TDS are significantly higher for the more-dense portion of the subdivision than for the lower density portion of the subdivision.

Publications & Presentations 2017

Carlson, D. A comparison of Holocene climatic optimum periods: Are they as warm post little ice period and are greenhouse gas concentrations similar? Gulf Coast Association of Geological Societies Transactions, v. 67, p. 39-78.

-- . Influences on water quality of the Wilcox Aquifer in Northwest Louisiana: Louisiana Geological Survey & Louisiana Water Resources Research Institute's 11th Annual Louisiana Groundwater, Surface Water, and Water Resources Symposium, April 11, 2017.

-- . Has initial development of Haynesville Gas Play impacted water quality of the overlying Wilcox Aquifer?: Louisiana Geological Survey & Louisiana Water Resources Research.

Institute's 11th Annual Louisiana Groundwater, Surface Water, and Water Resources Symposium, April 11, 2017.

-- . Influences on and Changes of Water Quality of the Wilcox Aquifer in Northwestern Louisiana: Baton Rouge Geological Society, Baton Rouge, Louisiana, April, 7, 2017.

Heinrich, P., and R.P. McCulloh.
Broussard 7.5 Minute Geologic
Quadrangle.

--. Lafayette 7.5 Minute Geologic
Quadrangle.

--. Milton 7.5 Minute Geologic
Quadrangle.

--. Youngsville 7.5 Minute Geologic
Quadrangle.

Carlson, D. and M. Horn. What are the
Impacts of a Dense Field of Septic
Systems on Groundwater Quality?:
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Societies Transactions, v. 67, p. 79-94.

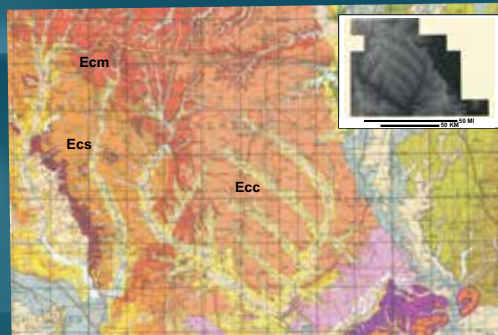
Horn, M. Geophysical Investigations
of Chalmette Battlefield and National
Cemetery, Jean Lafitte National
Historical Park and Preserve, St.
Bernard Parish, La.

McCulloh, R. P. The challenge(s) of
surface-geologic mapping in Louisiana;
Presentation to the monthly meeting
of the New Orleans Geological Society
on 10 July, 2017, (recorded and now
posted online by NOGS at <https://www.youtube.com/watch?v=ygtVMdqT2VA>).

-- . Surface indicators of possible
basement structure in Louisiana;
Presented to the first Louisiana Coastal
Geology Framework Symposium on 26
July, 2017.

The following papers are available in their entirety online in the LGS
newsletter at www.lsu.edu/lgs/publications/newsletter/2017_Newsletter2.pdf

Surface Indicators of Possible Basement Structure in Louisiana
by Richard P. McCulloh



Lineaments developed in Eocene strata of the Claiborne Group, on a labeled excerpt from a 1:500,000-scale geologic map (Snead and McCulloh, 1984): the Little River drainage basin. Inset is an image prepared from a mosaic of 1:24,000-scale digital elevation models. Ecc, Cockfield Formation; Ecm, Cook Mountain Formation; Ecs, Sparta Formation.

Progress Report on Determination of Chloride, Nitrate and Other Ion Concentrations in Mississippi Alluvial Aquifer in Northeast Louisiana
by Douglas Carlson

An Overview of Trends within Hydraulic Fracturing in Louisiana
by Douglas Carlson



LGS Outreach Activities

LGS Co-Hosts Inaugural La. Coastal Geology Framework Symposium

The Louisiana Geological Survey hosted the Louisiana Coastal Geology Framework Symposium on July 26. The event, co-sponsored by the Center for Energy Studies and the School of Coast and the Environment and coordinated by John Johnston III, was designed to showcase cutting-edge research into Louisiana's coastal geology that had not yet reached the publication stage. Presentations were made by Chris McLindon, Sherwood Gagliano, Jeff Hanor, Nancye Dawers, Rick McCulloh, John Lopez, Elizabeth McDade, and John Johnston III. A poster session featuring works by numerous graduate students and faculty of various Louisiana universities accompanied the presentations. After the presentations an enlightening joint question and answer session was held. The symposium was viewed as a great success and will be reprised in July 2018.

Earth as Art Exhibit on Display

Inspired by the success of last year's Earth as Art exhibit at the Gallery at Manship in the Shaw Center for the Arts, R. Hampton Peele of Louisiana Geological Survey teamed with R. Eugene Turner, professor, Dept. of Oceanography and Coastal Sciences, to design and install a mini display of four satellite images of Earth from space. The images were originally produced by USGS and NASA through their joint project, "Earth as Art". The project was designed to reach a broader constituency of supporters for their earth-imaging satellite programs. While the original intent for the "Earth as Art" project was to showcase the artistry of satellite images, Peele and Turner said that they saw the images as powerful educational resources for LSU students, faculty, and their guests.

An additional panel has been developed by Peele and DeWitt Braud of the Coastal Studies Institute, with assistance from LGS cartographer Lisa Pond, to explain the science and technology of satellite remote sensing. Four new satellite images will be rotated into the display regularly. This mini Earth as Art series is on display near room 1209 in the Energy, Coast and Environment building.

LGS Hands-On Exhibit Attracts Crowd at Annual “Rockin’ at the Swamp” Event

In March, LGS participated in “Rockin’ at the Swamp,” a one-day educational outreach event for schools and the general public organized by Baton Rouge Parks and Recreation Bluebonnet Swamp Nature Center. The LGS exhibit booth displayed a poster of the Brushy Creek Meteorite Impact Crater in St. Helena Parish, rocks and minerals specimens found in Louisiana and other places, and thin sections of rocks and the Greenwell Springs Meteorite, which was discovered in 1987 in Livingston Parish. The LGS’s Scope-on-a-Rope was set up to view rock and mineral specimens, or anything else attendees desired to view (i.e. skin, plant parts etc.) on a TV/ monitor screen. Fossils specimens from Louisiana and around the world were also displayed. The LGS booth proved to be one of the star attractions for the hundreds of children and adults attending the event. The event also featured gem and mineral vendor booths and other natural science exhibits, including a “gold” mine, treasure trial, stone crafts, fossil quarry, rock climbing wall and Rockhound Market.



Johnston, Milner Present at Sunrise

On September 8, John Johnston and Riley Milner made requested geological presentations at the Sunrise assisted living center on Siegen Lane in Baton Rouge. Johnston delivered a presentation about the fundamental processes of the Earth, and Milner delivered a hands-on presentation about the rocks, minerals, and fossils of the Earth. The presentations were well-received by the residents and staff.

Noteworthy

Peele Named La. National Hydrographic Dataset Editor

Research Associate R. Hampton Peele was asked to serve as the editor of the National Hydrographic Dataset for Louisiana (NHD). He will perform the required research and data development as needed to correct existing errors and update the NHD as changes to Louisiana’s hydrography occur. Due to the dynamic nature of water, the NHD is a “living dataset” that will always require maintenance. NHD data have been developed for the entire country through a joint effort by the U. S. Environmental Protection Agency and the U. S. Geological Survey. These data are used for a wide range of applications, from cartography, to water quality monitoring, to flood modelling and mapping. This research project is funded by Louisiana Department of Environmental Quality with an assistance grant from USGS.



Personnel

Administrative Personnel

Charles “Chip” Groat, acting director and state geologist, professor

Chacko J. John, Ph.D., associate director, professor

Patrick O’Neill, research associate, LGS Publications Sales and Resource Center

Basin Research Energy Section

John Johnston, research associate (retired-part-time)

Brian Harder, research associate (retired-part-time)

Reed Bourgeois, computer analyst

Geological Mapping & Minerals Mapping Section

Richard McCulloh, research associate

Paul Heinrich, research associate

Water & Environmental Section

Douglas Carlson, assistant professor-research

Riley Milner, research associate

Geophysical Section

Marty Horn, assistant professor-research

Cartographic Section

John Snead, cartographic manager (retired-part-time)

Lisa Pond, research associate

Robert Paulsell, research associate

R. Hampton Peele, research associate

Staff

Melissa Esnault, administrative coordinator

Jeanne Johnson, accounting technician

RADIATION SAFETY OFFICE

WEI-HSUNG WANG, DIRECTOR • www.radsafety.lsu.edu

Research and Economic Development, is an essential, unique, independent and vital regulatory radiological control unit. The RSO not only directly supports but also dynamically engages in research, teaching and clinical activities involving the use of sources of ionizing and non-ionizing radiation at LSU. The LSU System's broad-scope Radioactive Material License, issued by the Louisiana Department of Environmental Quality (LDEQ), allows the University maximum flexibility to accomplish legitimate and realistic research and teaching objectives through the effective and efficient operation of a regulatory-mandated radiation protection program carried out by the RSO. Under the direction of the Radiation Safety Committee, the RSO develops and implements radiological control policies and procedures such that radiation exposure to faculty, staff, students, the general public and the environment will be maintained as low as reasonably achievable and that no radiation exposure will be received without societal benefits. Administrative authorization for the radiation protection program from the University is contained in LSU System's Permanent Memorandum-30 (PM-30): *Radiation Protection Program*. Enforcement actions for radiation safety violations are authorized under LSU Policy Statement-99 (PS-99): *Radiation Safety Violations*.

In fiscal year 2016-2017, the RSO reviewed and approved 53 grant proposals involving the use of radioactive materials or radiation producing equipment. Funds requested by these proposals were \$62,669,595. Actual funds granted to LSU were \$25,011,824. Fourteen out of the 53 grant proposals are still

Currently, there are 994 approved radiation workers (including 94 radiation principal investigators) in 190 radiation laboratories with 7,084 annual radiation monitoring devices issued under LSU's radiation protection program.

under review by the funding agencies. Currently, there are 994 approved radiation workers (including 94 radiation principal investigators) in 190 radiation laboratories with 7,084 annual radiation monitoring devices issued under LSU's radiation protection program, which covers the Agricultural Center and its research stations, the Pennington Biomedical Research Center, and associated facilities under LSU such as the Center for Advanced Microstructures and Devices (CAMD), the National Center for Biomedical Research and Training, and School of Veterinary Medicine. The RSO provides training and monitoring for radiation workers and performs surveys, inspections, survey meter calibrations, leak tests, and radioactive waste management to fully comply with regulatory requirements and licensing/ registration conditions. The RSO also evaluates and inspects inventoried Class 3B and Class 4 laser systems for laser intra beam hazards and provides user training. There are 85 active Class 3B and Class 4 laser systems, 53 approved laser users (including 14 laser principal investigators), and 34 laser laboratories.

RSO, LSU Police Receive Training through National Nuclear Security Administration

To provide reasonable assurance of the security of risk-significant radioactive materials in quantities of concern (i.e., Category 1 and Category 2 radioactive materials per International Atomic Energy Agency's Code of Conduct on the Safety and Security of Radioactive Source) by protecting them from theft or diversion, the U.S. Nuclear Regulatory Commission (NRC) established 10 CFR Part 37-Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material on March 19, 2013. Consequently, the LDEQ issued and implemented compatible requirements to incorporate these federal mandates into Louisiana Administrative Code Title 33, Part XV, in November 2015.

In March 2016, the RSO entered into a contract with the Office of Global Material Security (GMS), under the National Nuclear Security Administration (NNSA) of the U.S. Department of Energy, to secure extramural funds to implement upgrade of the security control measures. This agreement also included training for selected LSU police officers and RSO staff by NNSA's Office of Radiological Security. Upon completion of the installation of the security system, the GMS radiological security team visited the RSO and



RSO Radiation Specialist Amin M. Hamideh (left), RSO Operations Manager Jabari Robinson (center), and CAMD Radiation Safety Officer Charles A. Wilson IV (right) conduct radiation response calibration on an ionization chamber at the LSU J. Bennett Johnston Sr. Center for Advanced Microstructures and Devices (CAMD).

conducted an assurance test to validate the security enhancements and system integration on January 25, 2017.

It was concluded that the security enhancements met the broad goals of the Statement of Work.

In July 2017, the training session on “Radiological Incident Response” was held at the Y-12 National Security Complex in Oak Ridge, Tenn. This three-day training covered fundamentals of radiation properties, radiological threat and consequences, security equipment, protection strategies and response planning, radiation monitoring instrumentation and both tabletop and practical exercises. Along with representatives from the FBI, other state and local law enforcement agencies and academic and medical institutions, there were nine individuals from LSU’s Police Department and the RSO participating in this training.

LDEQ Inspections Successful

There were two compliance and enforcement inspections conducted by the LDEQ’s Radiation Surveillance & Enforcement Section in 2017. In February, an inspector visited the RSO and carried out an inspection of the physical protection program at LSU. He reviewed the verification records of Category 1 and Category 2 quantities of radioactive material, training for individuals granted unescorted access and local law enforcement agency (LLEA), and security plans with LLEA for an armed response to an actual or attempted unauthorized entry. He also inquired about the background investigations and access control programs, requirements of physical and sensitive information protection, operation, testing and communication of the monitoring and intrusion alarm systems and record retention. In addition, he walked through the

security zones to observe the function of the security control measures. After the walk-through, an exit interview was held and no areas of concern were listed on the LDEQ’s Field Interview Form.

In October, an inspector visited CAMD and carried out an inspection of the radiation-producing equipment safety program for an X-ray photoelectron spectroscopy device at CAMD. The inspector walked through the facility to check the registration, verify proper postings, perform a physical inspection of the X-ray unit and review the records of training, personnel radiation monitoring, surveys and annual X-ray inspection conducted by the RSO. He also inquired about copies of the Louisiana Administrative Code Title 33, Part XV. Radiation Protection, over-exposure incidents (none), and training material for operators. In addition, the inspector interviewed



RSO Technical Assistant Kyle Huber checks in a White-I radioactive package containing tin-117m for metastatic bone disease treatment.



RSO Technical Assistant Blaine Irle performs a radioactive contamination survey on gas chromatography equipment.

the authorized radiation principal investigator of the X-ray unit, with questions including purpose and typical use of the X-ray unit, interlock mechanisms, use frequency, calibration techniques, operating procedures, and operator training. During the inspection, the inspector requested a tour of the synchrotron at CAMD. After the walk-through, an exit interview was held at CAMD and no areas of concern were listed on the LDEQ's Field Interview Form.

Noteworthy

Robinson, Wang Participate in Waterford 3 Steam Electric Station Ingestion Pathway & Recovery Evaluation Exercise

The Louisiana Peacetime Radiological Response Plan prepared by LDEQ provides the basis for offsite response for all state and local government agencies, as well as volunteers and/or other authorized individuals or agencies who would be called upon in the event of a radiological incident at one of the fixed nuclear facilities having the potential for affecting the population and/or the environment of the State of Louisiana. According to this plan, an ingestion pathway exercise with full participation will be conducted at least once every eight years to provide plan improvements for emergency responses. This exercise will also be evaluated by the Federal Emergency Management Agency. The RSO was requested by LDEQ to participate in this exercise for the Waterford 3 Steam Electric Station at Killona. RSO's Jabari Robinson, operations manager, and Wei-Hsung Wang, director, also attended the Radiological Emergency Preparedness Meeting, Radiological Plan Workshop and Ingestion Pathway Dress Rehearsal in preparation for this exercise.

RSO Staff Appointed Technical Advisers to La. Department of Health

To offer guidance and assistance to the Louisiana Department of Health (LDH) as well as to serve the best interest to the State of Louisiana in response to an actual radiological event, members of the RSO - Amin M. Hamideh, radiation specialist; Jabari Robinson, operations manager; Wei-Hsung Wang, director; and Charles A. Wilson, IV, CAMD radiation safety officer - have been appointed as Technical Advisers to the LDH. They attended the Radiological Response Workshop to assess the role and responsibilities of the LDH in response to a nuclear incident. This two-year participation is voluntary, and LSU has no legal involvement with this arrangement.

Wilson Earns Laser Safety Officer Certification

Charles A. Wilson, IV, CAMD radiation safety officer of the RSO, completed all requirements for certification as a Certified Laser Safety Officer (CLSO). Administered by the Board of Laser Safety (BLS), this certification is awarded to individuals who meet educational standards, satisfy professional laser safety

experience requirements and have passed a written examination. This written examination covers nine areas of practice: lasers and optics fundamentals, laser /optical radiation biological effects, non-beam hazards associated with lasers, laser control measures, regulations and standards, hazard evaluation and classification, maximum permissible exposures, laser safety program administration and laser measurements.

BLS certification is one of the highest credentials a laser safety professional can achieve. It recognizes the individual who has achieved a credible level of knowledge and expertise as well as possesses a higher level of commitment to evaluate laser-associated hazards and implement appropriate control



RSO Technical Assistant Caroline Babin performs a routine survey of a radioanalytical laboratory using a Geiger Müller meter.

measures. This certification, CLSO, demonstrates to the public, colleagues and employers one's qualifications to manage advanced laser safety issues.

Robinson Completes CHP Certification

Jabari Robinson, operations manager at the RSO, completed all requirements for certification as a Certified Health Physicist (CHP) and became the sixth CHP in the State of Louisiana. Administered by the American Board of Health Physics, which was established in 1958, this certification, accredited by the Council of Engineering and Scientific Specialty Boards, is the highest credential a health physics professional can achieve and is awarded to individuals who meet

academic standards, satisfy responsible professional health physics experience requirements and have passed two parts of a written examination. Part I of the examination tests the knowledge of the applicant in fundamental aspects of health physics. Part II of the examination determines the applicant's competence in applied health physics topics which include: personnel dosimetry, shielding and activation, measurements and instrumentation, biological effects of radiation, accelerators, environmental, fuel cycle, medical, research and power reactors, university, general and non-ionizing radiation.

Hamideh Passes Part I of Certified Health Physicist Written Exam

Amin M. Hamideh, radiation specialist of the RSO, fulfilled the academic requirements and applied professional experience in health physics to be admitted to take Part I of the Certified Health Physicist written examination. He passed the examination and demonstrated competence in fundamental aspects of health physics.

Scholarly Activities

Grant Awarded

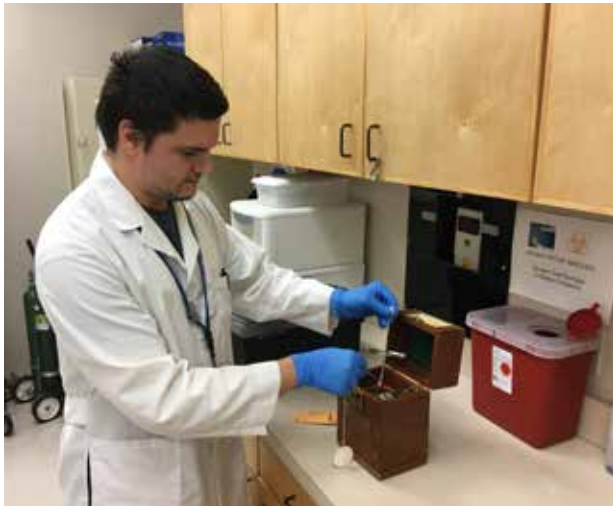
LSUHSC-NO Radiological Physics for Residents. Matthews II KL, Dey J, Wang W-H, LSU-Health Science Center, Contract # 46630-1.

Grant Pending

LSU Graduate Fellowship Program in Radiation Sciences. Newhauser WD, Matthews II KL, Wang W-H, U.S. Nuclear Regulatory Commission.



RSO Technical Assistants Joseph Lahaye (left) and Shelby Myers (right) carry out leak tests for potentially removable radioactive contamination on portable chemical detection systems.



LSU health physics graduate student from the Department of Physics and Astronomy Andrew D. Hastings conducts a swipe test to verify the integrity of a sealed strontium-90 source during his summer internship at the RSO. This source is used to treat superficial skin cancers.



LSU environmental health physics graduate student from the Department of Environmental Sciences Nicholas T. Desselles (left), supervised by CAMD Radiation Safety Officer Charles A. Wilson IV (right), uses different types of radiation detection equipment (i.e., a neutron survey meter and a pressurized ion chamber meter) to measure ambient radiation levels at CAMD for his master's research project.

Publications

Wilson IV, C.A., W-H Wang. Potential for active engagement in radiation protection training. Proc. of the 6th International Conference on Education and Training in Radiological Protection, paper A0048, ISBN 978-92-95064-30-0, May 30-June 2, Valencia, Spain, 2017.

Elfar E.I., B.B. Ellwood, W-H Wang, G.L. Bell. Sea level and climatic-induced facies variations in the Middle Cambrian House Range Embayment, western Laurentia. *Palaeogeography, Palaeoclimatology, Palaeoecology* 475:125-139; 2017.

Gegenheimer J.B., C.A. Wilson IV, W.N. Waggenspack, A. Steele. Utilizing a student-led program to make major leaps in persistence. Paper presented at the ASEE Annual Conference & Exposition, Columbus, Ohio. doi: 10.18260/p.19864, 2017.

---. Closing the gap: using supplemental instruction as a tool to assist minorities in engineering. Paper presented at ASEE Annual Conference & Exposition, Columbus, Ohio. doi: 10.18260/p.19870, 2017.

Personnel

Wei-Hsung Wang, Ph.D., CHP, CSP, CLSO, director
Jabari Robinson, M.S., operations manager & laser safety officer
Amin M. Hamideh, radiation specialist & laser safety officer
Richard E. Teague, RRPT, senior technologist
Charles A. Wilson, IV, MS, CLSO, CAMD Radiation Safety Officer
Lorrie Gaschen, D.V.M., Ph.D., SVM liaison
Christy White, D.V.M., PBRC Liaison

Technical Assistants

Caroline Babin
Jeremy Dismukes
Marie Garrett
Kyle Huber
Phoenix Hwaung
Blaine Irle
Jennifer Kenyon
Isai Martinez
Gregory Martini
Emaya Moss
Shelby Meyers

Staff News

In Memoriam

Richard E. Teague, RRPT, Senior Technologist of the RSO, passed away in his sleep in September. A native of Sarepta, Louisiana, Teague studied at LSU and was employed by the Nuclear Science Center while he was an undergraduate student at LSU. He was a kind soul with an incredible mind and a gentle spirit. He was always willing to help others even when he had his own personal business to attend to. Teague never met a person he didn't like or who didn't like him. His knowledge and passion for nuclear sciences and mentoring young professionals were without question. He will surely be missed, not only because of his exceptional expertise in almost every technical discipline, but also as someone we called a dear friend. Rest in peace, Richard.



Richard E. Teague (1960-2018)

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