

Center for Energy Studies



ANNUAL REPORT | 2012



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COVER

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Center for Energy Studies

ALLAN G. PULSIPHER, EXECUTIVE DIRECTOR
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Natural Gas, Wind Energy Information in Demand in 2012

Serving as a resource for energy-related information and analysis for industry, lawmakers, and public agencies is a central mandate of the Center for Energy Studies. In 2012, our researchers responded to numerous and varied requests for information on timely energy topics, including the impact of the boom in natural gas development on the state's manufacturing sector, the economics of offshore wind development, and the most efficient sources for new power generation. Faculty presented their findings to industry, the media and the general public through forums, seminars, articles, books and interviews.

Boom Leads to "Manufacturing Renaissance"

In a study completed in December, David Dismukes, professor and associate executive director, examines the potential economic impacts of recent capital investments leveraged by the boom in unconventional natural gas production in the state. The study, titled "Unconventional Resources and Louisiana's Manufacturing Development Renaissance," was sponsored by America's Natural Gas Alliance and the Louisiana Oil & Gas Association. It provides an economic overview of the Louisiana manufacturing sector, examines the importance of natural gas to this sector, and shows how the emergence of unconventional resources has resulted in a virtual manufacturing investment renaissance in Louisiana.

Following the official release of the report in January 2013, the Washington, D.C., publication *The Hill* invited Dismukes to write an op-ed piece detailing the findings of the study. The piece was subsequently reprinted by several online news outlets. Dismukes also presented the study at the Baton Rouge Press Club, and his commentary on the topic was featured in a video by the Louisiana Oil & Gas Association.

Unconventional Resources and Louisiana's Manufacturing Development Renaissance

by David Dismukes

[Impacts of new capital investments](#)

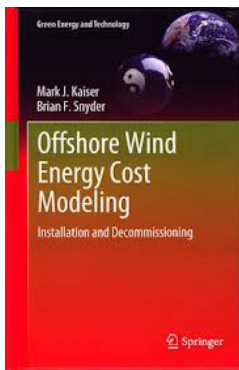
To date, some \$62.3 billion in new capital investments have been announced in Louisiana and are likely to be developed between the next five to eight years.

Statewide: Potential for in-state capital investment in Louisiana to total \$20.2 billion (out of the total of **\$62.3 billion**) over the next nine years.

- More than **\$29.7 billion** in economic output over a nine-year period (2011-2019),
- a cumulative increase of some **214,670** job-years,
- **\$9.3 billion** increase in wages over a nine-year construction period.

Regional: Most of the manufacturing project announcements are anticipated to be located in South Louisiana, so the impacts to the southern part of the state were estimated using three different regions: South East, South Central, and South West.

- Over **\$22.5 billion** in output,
- **160,000** in job-years,
- **\$7.4 billion** in wages



Kaiser, Snyder Publish Volume on Offshore Wind Cost Modeling

Mark Kaiser, professor and director of Research and Development, and Brian Snyder, research associate, have co-authored the book *Offshore Wind Energy Cost Modeling: Installation and Decommissioning*. Part of Springer's *Green Energy and Technology* series, the book provides a methodological framework to determine installation and decommissioning costs, and reviews existing processes and systems used in the offshore wind industry. The book features a detailed treatment of key principles in offshore wind development, as well as helpful visual aids and data tables. *Offshore Wind Energy Cost Modeling* serves as a key resource for readers interested in the offshore wind industry, particularly the technical and economic aspects of installation and decommissioning.

Dismukes Participates in D.C. Forum on Federal Wind Production Tax Credit

In November, David Dismukes participated in a forum titled "The Fate of Energy Policy in the Lame Duck: Will the Wind PTC Fly?" in Washington, D.C. The forum was hosted by the American Energy Alliance and congressional daily publication *The Hill*. Also participating in the event were Senator Lamar Alexander (R-Tenn.), Rep. Mike Pompeo (R-Kansas), and former Texas Senator Phil Gramm. Attendees included Capitol Hill staff and media.

The event followed the release of Dismukes' study, "Removing Big Wind's 'Training Wheels': The Case for Ending the Federal Production Tax Credit," which finds that the federal wind PTC is "an inefficient, expensive, and unsustainable policy mechanism for promoting wind." The credit, which was enacted in 1992 to boost the wind industry and was subsequently extended seven times, has provided wind producers with a subsidy of \$22 per megawatt hour of electricity generated. On January 1, 2013, as part of the recent "fiscal cliff" deal, Congress again authorized a one-year extension for the credit.



Manhattan Institute Event Addresses Advanced Technologies of Coal, Nuclear

In March, David Dismukes participated in a Manhattan Institute panel discussion titled "Keeping the Lights On: What Role for Coal and Nuclear?" at the Princeton Club in New York City. Dismukes explained that, in the U.S., adding nuclear capacity would be much more expensive than coal or gas. Nuclear would cost several thousand dollars per kilowatt of installed capacity versus closer to \$1,000/KW for coal or gas. Dismukes said that natural gas is the "safest play" for building a new power plant but cautioned that overbuilding gas-fired infrastructure could trigger eventual gas price increases over the longer term.

The moderator for the discussion was Robert Bryce, senior fellow, Center for Energy Policy and the Environment. The two panelists joining Dismukes were David Mohler, senior vice president and chief technology officer for Duke Energy, and David Diamond, senior scientist for Brookhaven National Laboratory.



In March, David Dismukes participated in a Manhattan Institute panel discussion on new nuclear versus coal and gas for power generation.

CES in the News: 2012

In 2012, the Center attracted local, regional, and national media attention for several research endeavors. David Dismukes' work on the economic impacts of the natural gas boom on Louisiana's manufacturing sector was reported on widely by news media and industry outlets throughout the state. His reports on the impact of legacy lawsuits on conventional oil and gas drilling in Louisiana, the Federal Wind Production Tax Credit, and utilities rate increases were also highlighted in the media, as was his participation in public panels addressing the topics.

Media outlets reporting on CES works in 2012 included:



Catalyst



EconSouth



EQ Magazine



THE HILL

The Houma Courier



Coastal Communities Outlook Focus of \$1.5 Million NSF Research Project

A multi-disciplinary team from LSU has been awarded a \$1.5 million National Science Foundation grant to research the long-term prospects for coastal communities where land loss, subsidence, sea-level rise, flooding, hurricanes and oil spills have had a major impact for years. Research will focus on the Lower Mississippi River Basin in Louisiana. David Dismukes is one of the co-principal investigators on the project. He and other CES researchers will examine the impact of subsidence, land-loss, and sea-level rise on energy infrastructure, how those geo-physical changes increase infrastructure development and restoration costs, and how various incentive and financial structures can be modeled to reconcile and/or leverage potentially differing public and private environmental damage mitigation strategies.

Nina Lam, professor in the Department of Environmental Sciences, is the principal investigator. Co-principal investigators are Kam-biu Liu and Victor Rivera-Monroy, Department of Oceanography and Coastal Science; Margaret Reams, Department of Environmental Sciences; and Yi-Jun Xu, School of Renewable Natural Resources. David Dismukes will provide economic analyses for the project.

Research will focus on areas north of Lake Pontchartrain and compare them to areas south of the lake. The economy and population have grown in the northern part of the study area over the past decade, while the southern part surrounding New Orleans has faced population and economic decline. The findings from the study will be used to help policymakers determine the best way to preserve much of the coast and its communities.

Other 2012 Projects

Geographic Units for Socioeconomic Impact Analysis in the Gulf of Mexico Region.

Allan Pulsipher and Kathy Perry. Funded by the U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement. This study uses industrial cluster analysis, regional input/output analysis and modeling, and geographic information systems in an interdisciplinary effort to identify geographic areas where significant socioeconomic impacts, either negative or positive, are likely to occur.

Understanding Current and Projected Gulf OCS Labor and Port Infrastructure Needs.

David Dismukes and Allan Pulsipher. Funded by the U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement and the LSU Coastal Marine Institute. This project is composed of two parts: a labor needs analysis and ports infrastructure needs analysis. The primary component of analysis for both of these sub-projects is a workshop series to explore, scope, and seek input and conclusions on numerous important issues facing the offshore industry in both its labor and port infrastructure needs and requirements.

Structural Shifts and Concentration of Regional Economic Activity Supporting GOM Offshore Oil and Gas Activities.

David Dismukes and Allan Pulsipher. Funded by the U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement and the LSU Coastal Marine Institute. The effects of consolidation and their impacts on local communities is complicated. After a sustained period of consolidation and contraction in the industry, higher prices over the past six years have resulted in a resurgence of oil and gas related activity. The purpose of this research is to conduct a comprehensive examination of the concentration and industry-related changes in oil and gas related employment in Louisiana with a special emphasis in the relative regional changes between various Louisiana municipal areas.

Forecasting Service Vessel and Helicopter Trips Related to OCS Development. Mark Kaiser, David Dismukes, and Allan Pulsipher. Funded by the U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement and the LSU Coastal Marine Institute. The purpose of this proposal is to expand and update the current BOEM descriptions related to service vessel and helicopter trips and to develop methodologies (and usable equations) to forecast the trips required to support a given level of oil and gas activity as represented by BOEM exploration and development (E&D) scenarios.

State and Local-Level Fiscal Effects of the Offshore Petroleum Industry. David Dismukes. Funded by the U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement. The fiscal consequences of the OCS program are the most direct and significant way in which the program affects states and communities.

These effects are largely shaped by the interaction of federal law and each state's revenue and allocation mechanisms. Currently, the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEM) lacks a systematic understanding and analysis of the direct and indirect fiscal effects at state and local levels. This study is designed to strengthen Agency assessments by addressing this oversight, support our continued improvements to the projections of the indirect effects of the program, and provide information to the State of Louisiana, local communities, and other stakeholders concerning the cumulative effects of the program.

OCS Studies Review: (1) Geographical Units for Observing and Modeling Socioeconomic Impact of Offshore Activity; (2) Louisiana and Texas Oil and Gas Activity Review and Production Forecast; (3) Pipeline Paper. Mark Kaiser, David Dismukes, and Allan Pulsipher. Funded by the U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement. Louisiana and Texas are the highest energy consuming and producing states in the nation and historically have played a major role in supplying the U.S. with oil and gas, either through conventional production, imported oil, or imported LNG. The OCS of Louisiana and Texas remains a major supplier of domestic oil and gas, and it holds the potential for new supplies of energy, through imported LNG, wind and ocean energy, and natural gas hydrates. The purpose of this proposal is to research three topics of interest to the BOEM in a timely and comprehensive manner. The study provides a review of the historical development of oil and gas activity in Louisiana and Texas, and the regulations, incentives, drilling activity, production statistics, pipeline infrastructure, planning boundaries, and other activities related to the exploration, development, production and transportation of oil and gas.

The Offshore Drilling Industry and Rig Construction Market in the Gulf of Mexico. Mark Kaiser, David Dismukes, and Allan Pulsipher. Funded by the U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement. This study provides an examination of the offshore drilling industry and rig construction markets and investigates targeted issues relevant to the Gulf of Mexico (GOM). It includes empirical models over specific segments of the industry, aggregated statistics for rig construction by class and geographic region, quantified labor and materials requirements for rig construction in the GOM, and a discussion of trends that are currently playing out and expected to impact the industry in the future. The economics of rig supply and demand in the GOM, and the factors that influence the competitiveness of the domestic rig construction industry, is of particular interest.

Energy Policy Research Assistance. David Dismukes. Funded by the Louisiana Department of Natural Resources. The LSU Center for Energy Studies provides general consulting, advisory, and policy research to the Louisiana Department of Natural Resources on renewable and alternative energy issues in the state.

Economic Impacts Associated with Shell's Potential Gas-to-Liquids Project. David Dismukes. Funded by Shell Exploration & Production Co. The purpose of this study is to provide an economic impact analysis associated with the potential development of a Gas-to-Liquids (GTL) plant in Louisiana. The analysis is not limited to simply traditional economic impact measures but highlights the broader economic contributions made by the project that includes leveraging existing in-state and regional natural gas production and supporting energy infrastructure. The study examines and highlights the contribution the potential project makes to U.S. energy production (refined product) and technological development. The study also examines the strategic benefits to local communities in terms of employment and local/state tax revenues.

For a complete list of 2012 CES projects,
visit www.enrg.lsu.edu/projects

At the Lectern

The following presentations by David Dismukes are available online in pdf format at www.enrg.lsu.edu/presentations.

“What’s Going on With Energy? How Unconventional Oil & Gas Development is Impacting Renewables, Efficiency, Power Markets and All That Other Stuff”

Atlanta Economics Club Monthly Meeting

“Trends, Issues and Market Changes for Crude Oil and Natural Gas”

East Iberville Community Advisory Panel Meeting
Syngenta

“Game Changers in Crude and Natural Gas Markets”

Chevron Community Advisory Panel Meeting

“The Outlook for Renewables in a Changing Power and Natural Gas Market”

Louisiana Biofuels and Bioprocessing Summit

“The Changing Dynamics of Crude and Natural Gas Markets”

Chalmette Refining Community Advisory Panel Meeting

“The Really Big Game Changer: Crude Oil Production from Shale Resources and the Tuscaloosa Marine Shale”

Baton Rouge Chamber of Commerce

“The Impact of Changing Natural Gas Prices on Renewables and Energy Efficiency”

NASUCA Gas Committee Conference Call/Webinar

“Issues in Gas-Renewables Coordination: How Changes in Natural Gas Markets Potentially Impact Renewable Development”
Energy Bar Association Meeting

“Issues in Natural Gas End-Uses: Are We Really Focusing on the Real Opportunities?”
Energy Bar Association Meeting

“Louisiana’s Unconventional Plays: Economic Opportunities, Policy Challenges”
LMOGA 2012 Annual Meeting

Outreach & Education

CMI Anniversary Event

The LSU Coastal Marine Institute 20th Anniversary Symposium was held Monday, April 23, in the Dalton J. Woods Auditorium. The event was hosted by the LSU Center for Energy Studies, the LSU School of the Coast & Environment, and the U.S. Bureau of Ocean Energy Management. Principal investigators provided retrospectives on 20 years of valuable research, discussions on current offshore energy trends and ideas for solving energy issues facing Louisiana, and perspectives on the future of the offshore energy industry, specifically Louisiana’s oil, gas and marine minerals resources.

Through CMI, more than \$26 million in research contracts have been awarded to researchers at LSU, the Louisiana Universities Marine Consortium, UNO and ULL, producing pivotal and foundational research as well as positively affecting the scholarly development of more than 100 graduate and undergraduate students.

Fracking, Environmental Issues Focus of Gulf States Energy Retreat

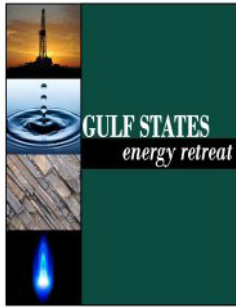
Technological advances in drilling and related environmental issues were the topics of the Gulf States Energy Retreat, presented by the Center for Energy Studies and Jones Walker law firm, June 20 and 21, at the Dalton J. Woods Auditorium. Experts in mineral law, drilling technology, and water and environmental issues related to horizontal drilling discussed the controversial topic of how hydraulic fracturing impacts the environment and how those impacts might be measured and reported.



View or download CES
presentations at www.enrg.lsu.edu/presentations

Speakers included Patrick Martin, former Campanile Professor of Mineral Law at the LSU Law Center and director of the Louisiana Mineral Law Institute; Charles G. "Chip" Groat, founding president and CEO of the Water Institute of the Gulf, director of the Center for International Energy and Environmental Policy, and associate director of the Energy Institute at The University of Texas at Austin; and Chuck Duginski, Chesapeake Energy Corp., district manager -- Haynesville Shale.

Presentations from the Gulf States Energy Retreat, are available at <http://www.enrg.lsu.edu/Conferences/gser2012/presentations.html>



Rector for the University of Haifa Visits Center

On February 14, CES hosted David Faraggi, Rector of the University of Haifa at Mt. Carmel in Israel, at a meeting to discuss the recent natural gas discoveries in Israel's Mediterranean Exclusive Economic Zone (EEZ), the mission of the University of Haifa, and the Leon H. Charney School of Marine Sciences and its efforts to establish a multi-disciplinary research center dedicated to the sustainable development of Israel's hydrocarbon industry. Faraggi explained that the center would comprise experts in marine geosciences, law, economics, policy, planning, marine biology, and archeology. To learn about LSU's efforts in multi-disciplinary research in energy, Faraggi spoke with faculty and staff representing CES, Louisiana Geological Survey, the School of the Coast and Environment, the LSU Law Center, the Cain Department of Chemical Engineering, and the Ourso College of Business. Topics included plans for funding of the center, potential training and qualification programs to support the industry, and the potential for "bi-national" research agreements and collaboration.

Under the Rotunda

The conference area of the Energy, Coast & Environment Building, including the Dalton J. Woods Auditorium, a large conference room, and lobby, provides a venue for commencement exercises, convocations, cultural events, workshops, seminars, and receptions. In 2012, the space served as a venue for 204 events, including 21 public outreach events hosted by the Center for Energy Studies, Louisiana Geological Survey, the School of the Coast and Environment and other units. The conference facilities and calendar are managed by CES librarian Versa Stickle.

Personnel

Faculty

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

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

Omowumi (Wumi) Iledare, Ph.D., director of the Energy Information and Data Division, professor of petroleum economics and policy research, adjunct professor of petroleum economics at the Craft & Hawkins Department of Petroleum Engineering at LSU and the University of Ibadan

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

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

Ralph W. Pike, Ph.D., director of the Minerals Processing Research Division and Paul M. Horton Professor of Chemical Engineering

Research Associates

Elizabeth Dieterich

Siddhartha Narra, Ph.D.

Kathryn Perry

Christopher Peters

Ric Pincomb

Brian Snyder, Ph.D.

Lauren Lee Stuart

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Diana Reynolds, assistant to the executive director

Versa Stickle, librarian

Michael Surman, computer analyst

MPRD Staff

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F. Carl Knopf, associate director, Anding Professor of Chemical Engineering

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Thomas A. Hertwig, process engineer, Mosaic Corporation (retired)

Mohammed Shafi Syed, Ph.D. Student

Abhijith Kondapally, MS Student

Tate Stumper, undergraduate student, major chemical engineering

Arpan Seth, undergraduate student, major chemical engineering

Minerals Processing Research Division

RALPH PIKE, DIRECTOR
www.mpri.lsu.edu

The Minerals Processing Research Division (MPRD) was established in 1979 by Federal legislation as one of 31 State Mineral Institutes associated with the U.S. Department of the Interior. The mission includes facilitating research and public service programs in process research and technology transfer, sustainable development, energy management, energy sustainability, and inherently safer design. This minerals processing research and public service complements and benefits from the energy research and geological research performed by other groups in the Center for Energy Studies and the Louisiana Geological Survey.

MPRD's current research focus is on energy optimization of oil and gas operations and on using biomass feedstocks that supply the same products as current plants in the chemical production complex in the lower Mississippi river corridor. Cooperative research agreements are in place with Monsanto, Motiva Enterprises and Mosaic. This research and technology transfer involves collaboration with process and plant engineers at these and other companies.

Chemical Production Complexes – Sustainable Development

The chemical production complex in the lower Mississippi River corridor is uniquely positioned to take advantage of bio-derived feedstocks. There is strong agricultural industry in the region, and the Mississippi River provides deep-water ports to ensure continuous supply of bio-feedstock throughout the year. The vision is to aid in the transition of industries based on non-renewable resources to ones based on renewable resources.

In this chemical production complex there are about 150 chemical plants producing a wide range of petrochemical that are used in housing, automobiles, fertilizer and numerous other consumer products, consuming about 1.0 quad (10^{15} BTUs per year) of energy. This complex is one of about 20 world-class multi-plant giants.

A new methodology has been developed for identifying new bioprocesses and demonstrating integration of these bioprocesses into the chemical production complex in the lower Mississippi River corridor. This methodology shows that there can be a transition from nonrenewable resources to renewable resources as feedstocks for chemicals. Based on these results, the methodology could be applied to other chemical complexes in the world for reduced emissions and energy savings such as the one in Camaçari-Bahia, Brazil. Collaborative research has begun with the Federal University of Rio de Janeiro (UFRJ), using the Brazilian Science without Borders program, and support has been requested from USAID to expand this methodology.

The methodology uses a quantitative description (material and energy balances) of this chemical production complex that was developed for the plants in the agricultural chemical chain and the methanol and benzene chains with the assistance of industrial collaborators and published sources. This description is representative of current operations and practices in the chemical industry and is called the base case of the existing plants. It includes plants that produce and use carbon dioxide in the complex.

Then the methodology had potential bioprocesses evaluated based on selection criteria, and simulations of these bioprocesses were performed in Aspen HYSYS® and ICARUS®. Then the bioprocesses were combined with processes in the existing complex to form a superstructure of plants that was optimized to obtain the optimal configuration of existing and new plants (chemical complex optimization) based on an economic, environmental and sustainable costs/credits objective function (triple bottom line).

The triple bottom line from the optimal solution increased 93% from the base case of existing plants. The increase was from the sale of new products from the bioprocesses. The utility costs increased due to the addition of new plants. The sustainable costs to the society decreased from the base case as credits were given for pure carbon dioxide consumption. The total pure carbon dioxide emission in the optimal structure was reduced to zero from the base case where 84% of the pure carbon dioxide was consumed by algae and used for the production of algae oil. Impure carbon dioxide emissions from the power plant increased by 75% from the base case and contributed to sustainable costs to society.

Detailed results from the optimal solution, the Pareto optimal solutions from multi-criteria optimization and the sensitivity of the optimal solution evaluated using Monte Carlo simulations are reported in the MPRI web site, <http://www.mpri.lsu.edu/thesisindex.html>.

Energy Optimization of Oil and Gas Operations

In energy optimization of oil and gas operations, Process Energy Analysis and Optimization (PEAO) is guided by fairly well defined paths/procedures. What makes this area rewarding is that unexpected results and discoveries often occur. In general PEAO can be at applied two levels in an operational plant:

- A. Optimization based on Improved System Understanding.
- B. Optimization based on Equipment Placement.

A. Improved System Understanding

A specific example makes the logic behind the PEAO procedures easier to follow. Our most recent efforts have focused on improving the cost of operation of the 20MW cogeneration facility supplying electricity and steam at Louisiana State University. This is a natural gas fired turbine with heat recovery.

1 A first step was to evaluate material and energy balances using data from both the distributed control system and the data historian. Here data reconciliation was used to both validate data and determine the presence of any gross errors. Using reconciled data, process parameters including heat rate (fuel energy/kW electricity produced), turbine component efficiencies and heat recovery efficiency were determined. Several of these parameters, including the heat rate, compressor efficiency and heat recovery unit efficiency now serve as key performance indicators (KPI). Changes in these KPI indicate when cleaning or other maintenance operations should be performed.

2 Based on the economic success of the data evaluation and KPI in Step 1, a more detailed modeling approach was utilized to address other cost issues. A major cost consideration for the turbine system is fuel injector performance. Injectors are inspected (system off-line) on a regular basis but injector problems are difficult to detect and they have led to several combustion chamber failures, each costing approximately \$200,000 for chamber replacement. It is not possible to directly monitor the injector/flame zone of the combustor. As an alternative we installed a NOx monitoring system in the exhaust stack. A detailed model of the combustor flame zone allowed accurate prediction of NOx emissions. When predicted NOx emissions are not in agreement with measured NOx, the

model can be used to identify whether problems exist with the injectors. Injector/nozzle replacement is relatively inexpensive at approximately \$1,000/nozzle.

3 Finally, based on the economic success of the data evaluation and KPI (Step 1) and detailed modeling (Step 2), a more systems-level energy optimization strategy was investigated. The cogeneration system supplies electricity and steam to campus (like an industrial complex), but an alternative exists in which the local utility can supply electricity and steam can be produced on-site by stand-alone boilers. A real-time economic model was developed to best position Louisiana State University. Options included: full cogeneration with no externally purchased electricity; or any combination of cogeneration and some purchased electricity; or even complete external electricity purchase with all campus steam from a stand-alone boiler. Depending on the time of day (campus demand varies with time) and the cost of purchased electricity there was continuous movement in the best operating and lowest cost strategy. This would be analogous in an industrial setting to monitoring major feedstock costs if various sources were available, and local utility pricing if cogeneration were available.

Every energy optimization project is “different,” but a generic approach to *improved system understanding* includes (but is not limited to): process analysis → data validation and parameter determination including KPI → modeling (empirical or detailed) → individual unit optimization → system optimization. What is important is that this outline can be applied to a single unit operation or an entire complex. The approach can also be extended to include advanced process monitoring concepts including for example, statistical process control.

B. Equipment Placement

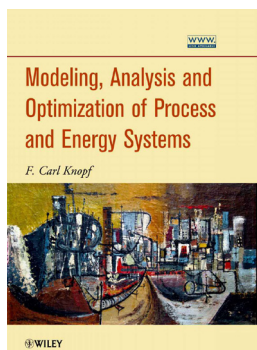
Here the addition of new equipment or the revamping of existing equipment and perhaps even changes to the plant layout are considered. *Equipment Placement* is generally more expensive and takes longer to implement when compared to *Improved System Understanding*.

Equipment Placement includes process analysis, data validation and parameter determination including KPI. Next, specific energy targets for individual unit operations or part of the complex or even the entire complex are determined using

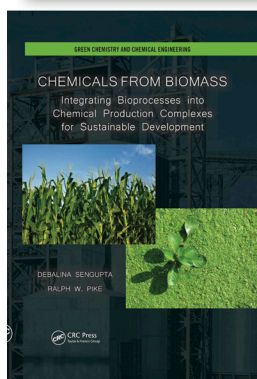
established pinch technology techniques. With the energy targets in hand, a detailed economic evaluation is used to determine how to best meet or approach these targets, or if energy cost savings do not justify additional investment.

Both *Improved System Understanding* and *Equipment Placement* rely on experience and common sense. There are many additional techniques and literature studies that can be incorporated into any process energy analysis. The material provided here is intended as an overview. As noted earlier we have found process energy analysis and optimization to be extremely rewarding as unexpected results and discoveries often occur. Our past efforts have generally developed site/problem specific software as well as detailed economic evaluations of cost/energy savings. Please contact Professor Ralph W. Pike, Director, at pike@lsu.edu or Professor F. Carl Knopf, Associate Director of MPRD, at knopf@lsu.edu for more details

Publications on Energy Optimization and Sustainable Development



Knopf, F. Carl, *Modeling Analysis, and Optimization of Process and Energy Systems*, Wiley, New York, 2012



Sengupta, Debalina and Ralph W. Pike, *Chemicals from Biomass: Integrating Bioprocesses into Chemical Production Complexes for Sustainable Development*, CRC Press, Boca Raton, FL, 2012

Continuing Education for Professional Engineers

The Division maintains an extensive website that provides continuing professional development self-study courses for professional engineers' PDH requirements. Also available on the website www.mpri.lsu.edu are research results including journal articles, conference proceeding, technical reports, theses, dissertations and computer programs. The programs have installation files that can be downloaded and used on an individual's computer. Included with the programs are users' manuals and tutorials. These programs have been developed using actual plants, and the process models can be applied to comparable plants.



Technology Transfer

Two technologies that have immediate and substantial energy savings on 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, and two short courses on these topics are available on request by contacting the Division at www.mpri.lsu.edu.



Louisiana Geological Survey Personnel

Administrative Personnel

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John Johnston., assistant director

Patrick O'Neill, LGS Publications Sales and Resource Center

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Brian Harder, research associate

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Reed Bourgeois, computer analyst

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Richard McCulloh, research associate

Paul Heinrich, research associate

Water & Environmental Section

Douglas Carlson, assistant professor-research

Riley Milner, research associate

Cartographic Section

John Snead, cartographic manager

Lisa Pond, research associate

Robert Paulsell, research associate

R. Hampton Peele, research associate

Staff

Melissa Esnault, administrative coordinator

Jeanne Johnson, accounting technician

Louisiana Geological Survey

CHACKO J. JOHN, DIRECTOR & STATE GEOLOGIST
PROFESSOR—RESEARCH

JOHN JOHNSTON
ASSISTANT DIRECTOR

www.lgs.lsu.edu

Geological surveys in every state and around the world conduct geological research on natural resources, hazards, and the environment and provide critical data and technical support to other state and federal agencies, municipalities, industry, academia and the general public. In Louisiana, the Louisiana Geological Survey (LGS) performs these functions. The LGS was first organized in 1869 and was permanently established in 1934 by Act 131 of the Louisiana State Legislature and has, since inception, been located on the campus of Louisiana State University (LSU). LGS was transferred to LSU in July 1997 by an Act of the Louisiana Legislature during its regular 1997 session (HB 2353). LGS reports to the LSU Vice Chancellor for Research and Economic Development through the Executive Director of the Center for Energy Studies. The LGS currently functions as a research unit on geoscience projects to accomplish its mission of providing unbiased geological and environmental information to promote environmentally sound economic development of the energy, mineral and water resources of the state of Louisiana.

The Basin Research Energy Section

The current Basin Research section projects are designed to address industry interest for geological information on oil and gas fields in the state and the potential development of unconventional energy resources.



Tuscaloosa Marine Shale Research Cited in AAPG Explorer

An article in the October 2012 issue of the American Association of Petroleum Geologists (or AAPG) *Explorer* publication cites the Louisiana Geological Survey's 1997 study of the Tuscaloosa Marine Shale (or TMS) as having originated interest in the play. Describing the TMS play as a "long-tantalizing yet elusive" drilling zone for oil, the article describes how ongoing high oil prices make the TMS a "sleeping giant" in this era of horizontal drilling and multi-stage hydraulic fracturing. The article provides an update on production in the shale play: 13 completions reported, well costs in the range of \$13 to \$15 million, and average total vertical depth of about 12,500 feet. Successful development of the TMS play is expected to greatly increase revenues to the state and substantially increase the number of jobs in the area.

The LGS study, "An Unproven Unconventional Seven Billion Barrel Oil Resource - the Tuscaloosa Marine Shale," can be viewed online at <http://www.lgs.lsu.edu/depoy/uploads/Tuscaloosa%20Marine%20Shale.pdf>.

Louisiana Geological Survey Completes It's Second Year Contributing to the National Geothermal Data System

The focus of this three-year project is to identify, catalog, and create geothermal databases and maps for inclusion in the National Geothermal System which will facilitate the potential development of geothermal (geopressured-geothermal) resources in the United States. All of the 50 state Surveys in the country are participants in this \$21 million project represented by the Association of American State Geologists, funded by the U.S. Department of Energy and managed by the Arizona Geological Survey. All required project deliverables for the second year have been completed and submitted to AZGS. This includes over 6,000 well temperature profiles and a georeferenced map showing the depths to the South Louisiana Geopressured Tertiary Sandstone. When completed in 2013, the U.S. Department of Energy Geothermal Data System (NGDS) will have geothermal data from all states. It will help mitigate much of the upfront risks associated with exploring for, confirming and characterizing the potential of available geothermal resources in the country.

***All of the 50 state Surveys
in the country are participants in this
\$21 million project.***

Geologic Data Creation for Three Louisiana Parishes (Iberville, Pointe Coupee, and West Baton Rouge) for Use in the USGS National Geologic Carbon Dioxide Sequestration Assessment

The main objective of this one-year project funded by the USGS was to identify and describe suitable sites for carbon dioxide (CO₂) sequestration in a three parish area and to present relevant information on these sites in the format desired by the USGS. Because of time and funding limitations, the LGS focused attention on a three-parish area in south-eastern Louisiana consisting of Iberville, Pointe Coupee and West Baton Rouge Parishes and covering the Bayou Bleu, Bayou Choctaw, Bayou Sorrel, Fordoche, and Livonia fields. These fields are typical of the geologic settings of oil and gas accumulation

in Louisiana and are representative of settings where CO₂ sequestration might be accomplished in Louisiana. The fields selected for study were active and depleted oil and gas fields and saline aquifers which met the USGS assessment criteria (depth 3,000ft – 13,000ft; 500,000 BOE) to determine their suitability as CO₂ sinks. LGS compiled a database of relevant information for those fields which included publically available cross sections, maps, formation tops, lithographic data, permeability, porosity and calculated appropriate estimates of potential CO₂ storage volume in the reservoirs. All information generated was provided to the USGS in the final project report.

Louisiana Tank Geothermal Demonstration Project

LGS partnered with Louisiana Tank Inc. in a joint proposal to the U.S. Department of Energy which was funded by DOE to Louisiana Tank for \$5 million for 3 years from 1/29/10 to 3/31/13 to field demonstrate energy production from a well in Cameron Parish. LGS completed the first-year deliverables which included the appropriate maps, cross sections, and the first-year final reports of the geopressured and geothermal reservoir to be tapped and provided them to Louisiana Tank Inc.

However, unfortunately, Louisiana Tank Inc. could not find financial investors for drilling of the well and they terminated the contract with the Department of Energy and the sub-award with LGS in July 2011.

LSU Petroleum Engineering Geothermal Project

LGS researchers are partnering with faculty from LSU Petroleum Engineering and other LSU departments on a three-year Petroleum Engineering Department project funded by the U.S. Department of Energy for \$997,000, titled “Zero Mass Withdrawal, Engineered Convection, and Wellbore Energy Conversion.” The project will evaluate the technological and economic feasibility of technologies that circulate reservoir fluids to increase heat extraction. The project focuses on geopressured geothermal brines which are a huge potential energy resource in the U.S., especially in the Gulf of Mexico region. The project work is split up in different tasks to be performed by the investigators located in the various LSU departments. The LGS task is to determine the resource scope and characterization and involves collecting requisite data on brine composition, reservoir geometry and rock properties for input into the modeling applications.

Geologic Review

The Geological Review program is a project created by the Louisiana Geological Survey in 1982 to provide regulatory technical assistance to the Coastal Management Division (CMD) of the Louisiana Department of Natural Resources and to three districts of the U.S. Army Corps of Engineers (USACE) and is renewed every year. The purpose of Geologic Review of drilling permit applications is to ensure that the least damaging feasible alternative is permitted for oil and gas drilling in the environmentally sensitive coastal zone of Louisiana while still allowing the operation to proceed. Alternatives involved such concepts as reducing the size of ring levees and slips, reducing the length of board roads and canals, the use of directional drilling, and the use of alternate and less damaging access routes, but still allowed the well to be drilled while avoiding or minimizing any environmental damage involved. The long-term effect of Geological Review has been a significant reduction (up to 75%) in the average length of canals and board roads built in the Louisiana Coastal Zone.

Geologic Mapping and Mineral Resources Section

The Geologic Mapping and Mineral Resources Section conducts investigations of surface geology primarily involved with the creation of geologic maps, which depict the distribution of rock types, strata and geologic features, such as faults, according to their particular characteristics and geologic ages. While geologic maps have value in themselves for understanding the geology of the area, they also are major sources of derivative applications, such as the delineation of areas with engineering properties of interest (e.g. location of landfills, siting of industry, etc.).

Interpreting the geology in coastal-plain settings like in Louisiana presents problems that are subtler and less dramatic than those in other settings (e.g. in areas of active or geologically recent mountain building or volcanism and areas of high relief and topography). Still, the mapping of coastal-plain geology presents its own unique problems.

Geologic Mapping in Louisiana

LGS surface geologic mapping activity, supported by cooperative agreements with the U.S. Geological Survey under the National Cooperative Geologic Mapping Program, STATEMAP component, continued in 2012 with the Natchitoches 30 × 60 minute quadrangle in western north Louisiana. Three 30 × 60 minute geologic quadrangles covering a substantial portion of north Louisiana were delivered to the U.S. Geological Survey in 2012 at the conclusion of the fiscal-year 2011 project: Leesville (west-central Louisiana), Winnfield (south-central north Louisiana), and Natchez (southeastern north Louisiana). A highlight of the field excursions in the Winnfield quadrangle was a tour guided by local hunting club and timber company representatives of the Zenoria–Little Creek structure in northwestern La Salle Parish, which is arguably the most enigmatic geologic structure in the state.

Production of lithographs of 30 × 60 minute geologic quadrangles previously compiled with STATEMAP support continued in 2012 with two quadrangles in the western delta plain (Morgan City and Atchafalaya Bay) and one in north-central Louisiana (Monroe North). The Morgan City quadrangle is noteworthy for containing all five salt domes of the Five Islands trend (Jefferson, Avery, Weeks, Cote Blanche, and

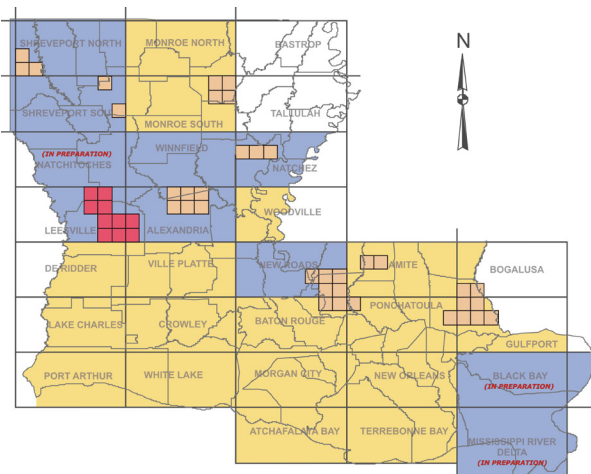
Belle Isle) within its extent. Review of additional 30 × 60 minute geologic quadrangles for possible cartographic production and release as lithographs in the spring of 2013 yielded three potential titles: Shreveport North, in northwestern Louisiana, and Black Bay and Mississippi River Delta, in the eastern Mississippi River delta plain. Production of one or more of these

quadrangle sheets will be determined by a more thorough assessment of their technical content and by availability of funds to support their preparation as lithographs.

Other activities included finalization of a paper entitled, “Surface Faults of the South Louisiana Growth-Fault Province” by R. P. McCulloh and P. V. Heinrich, submitted to a 2012 Geological Society of America special volume developed as an outgrowth of a 2010 annual convention conference session. This paper chronicles the notable increase in the number of surface faults interpreted in south Louisiana over the past 20 years, which primarily reflects the results of STATEMAP-supported LGS surface geologic mapping projects since 1993 and the availability of LIDAR imagery that began ca. 2000.

Project Examines Responses of Late Quaternary Stream and Estuarine Systems to Holocene Sea Level Rise

In the fall of 2012, the Louisiana Geological Survey entered into a cooperative agreement with the Bureau of Ocean Energy Management (BOEM), Bureau of Safety and Environmental Enforcement (BSEE) to investigate possible sand resources and archeological sites in the Outer Continental Shelf. This cooperative agreement, titled “The Late Quaternary Stream and Estuarine Systems to Holocene Sea Level Rise on the OCS Louisiana and Mississippi: Preservation Potential of Prehistoric Cultural Resources and Sand Resources,” is a two-year \$450,669 (obligated amount \$225,000.00 for year 1) project with Paul Heinrich as principal investigator. This project examines responses of late quaternary stream and estuarine systems to Holocene sea level rise. The objectives of the study are to develop a geophysical and geologic database for the study area, to develop geologic/stratigraphic models, develop a predictive model for paleo-landscape preservation potential, and to evaluate sand resources of the fills of Late Quaternary paleovalleys within the study area. An understanding of these processes will eventually be used in the evaluation and refinement of models used to predict cultural and non-fuel mineral resources within deltaic environments. A fully functional Geographic Information System (GIS) will be developed from all collected geospatial data. These data will be archived with the National Oceanographic Data Center (NODC) and the National Environmental Satellite, Data, and Information Service (NESDIS). The project is expected to be complete by September 30, 2014.



1:24,000-Scale Compilations (GIS)

- STATEMAP
- NonSTATEMAP

1:100,000-Scale Compilations



GIS Compilation



Printed Lithograph

Status of geologic mapping of 30 × 60 minute quadrangles (scale 1:100,000) and 7.5-minute quadrangles (scale 1:24,000) by the Louisiana Geological Survey, current through December 2012.

Water and Environmental Section

The water and environmental section of LGS performs research on the hydrologic systems of Louisiana, specifically on how the state's aquifers interact with each other and with the rivers, lakes, and wetlands. Hydrologic projects done by LGS provide technical assistance and support to state agencies and the various stakeholders interested in Louisiana's water resources, thus aiding in Louisiana's management of this critical and valuable resource.

Waterfalls in the Sicily Island Hills Wildlife Management Area

The area in northern Catahoula Parish encompassing Sicily Island and the Chalk Hills to its west is underlain by sediment comprising mudstone of the Oligocene Vicksburg Group and sandstone of the Catahoula Formation (Miocene–Oligocene), the latter of which is overlain by the Pleistocene graveliferous Bentley alloformation of the Upland allogroup, capped by two Pleistocene loess units (Miller et al., 1985, their figures 2 and 3). On Sicily Island, the Sicily Island Hills Wildlife Management Area (SIHWMA) owned and administered by the Louisiana Department of Wildlife and Fisheries (LDWF) contains mature forest communities with associated floral and faunal assemblages of unique ecologic significance, including some notably rare species (LDWF, 2012). According to the LDWF's Louisiana Natural Heritage Program (LNHP, 2000), these communities originally were noteworthy, but became rare through heavy logging and its initiation of successional changes. In addition to its ecological sensitivity, the SIHWMA area is highly susceptible to erosion following physical disturbance, because of its high relief and steep slopes maintained by the loess-capped Bentley sediments overlying Catahoula sandstone.

The SIHWMA area has considerable scenic value and appeal for tourism of the kind permitted within the framework of wildlife management areas. The forest itself is unlike any with which Louisianians are familiar elsewhere in the state, resembling more something perhaps characteristic of the Appalachians (LNHP, 2000); but the area contains as well a number of waterfalls, localized in places along the base of the Bentley at its contact with the Catahoula. Both the Bentley and Catahoula are aquifers in this area (Van Biersel and Milner, 2010)—the Bentley corresponding to all or a substantial portion of the "Upland Terrace" aquifer—and the permeability contrast between unconsolidated Bentley sand and gravel and the underlying hard Catahoula sandstone creates preferential pathways for the flow of water to the surface. One of these waterfalls is the state's tallest (LNHP, 2000), and was written up in a popular guide to out-of-the-way places of interest to tourists in Louisiana (Odom, 1994). Many of the waterfalls may be visited via hiking trails, and it is reported that the unique character of the SIHWMA makes it a popular destination for hiking clubs from inside and outside the state.



*Dr. Wrenn, Department of Geology and Geophysics, LSU (left)
and Rick McCulloch, LGS (right)*

One of these waterfalls is the state's tallest and was written in a popular guide to out-of-the-way places of interest to tourists in Louisiana.

Preliminary Observations of a Fracture with Strike-Slip Displacement Near the Baton Rouge Fault in Southern East Baton Rouge Parish

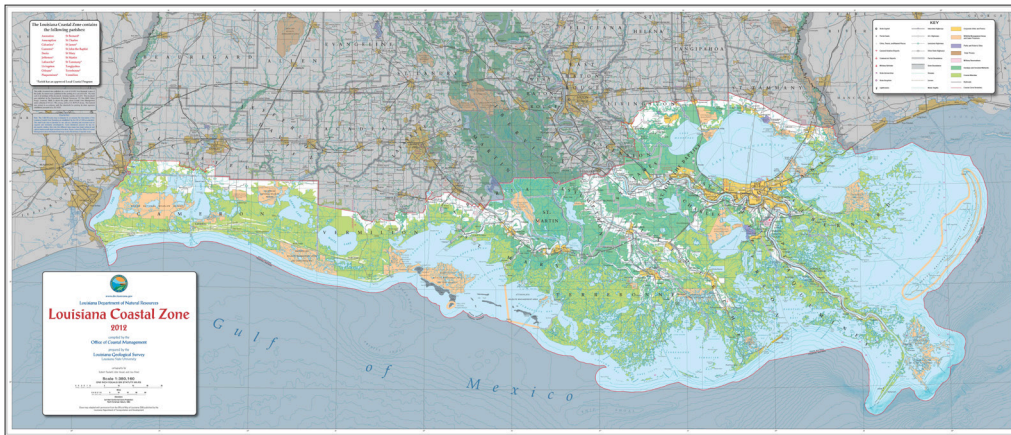


A sidewalk fracture in a residential neighborhood not far north of the Baton Rouge fault in southern East Baton Rouge Parish exhibits transcurrent or strike-slip displacement of approximately 10 cm (3.9 in), with a left-lateral sense of separation. The fracture, which strikes approximately $N 72^{\circ} E$, is subparallel to the sidewalk and transects portions of 6 sidewalk panels. The average strike of the Baton Rouge fault in the area to the south is approximately $N 79^{\circ} W$, making the angle between the fracture and the fault approximately 29° .

The magnitude of displacement of the fracture is not large, but is yet significant. Although the fault plane of the Baton Rouge fault is understood as grossly shovel-shaped and flattening out increasingly with depth, it is characterized primarily by dip-slip movement at the surface and in the shallow subsurface. Thus, considering the proximity of this fracture to the Baton Rouge fault, its strike-slip character is perhaps unexpected. Its presence could suggest that though the onshore U.S. Gulf Coast is understood as a dominantly extensional province, within it there may be potential for at least brief and/or localized compression. Alternatively, a minor reconfiguration of the northeastern extent of one of the regional-scale sediment-and-salt masses hypothesized by Peel and others (1995) to have been mobilized Gulfward could bring its boundary through the observed location in a manner that would account for left-lateral strike-slip displacement along a fracture striking $N 72^{\circ} E$.

Surface Water Gaging Improvements

LGS faculty and staff are working on a three-year Louisiana Department of Natural Resources (DNR) funded project to provide additional assistance and data to better inform efforts to monitor and manage surface water resources of the state. LGS will establish four to five new surface water gaging stations in consultation with DNR especially in parishes where such stations are insufficient or lacking. Further LGS will select 50 existing gaging stations spread all over the state for seasonal (quarter-annual) discharge measurements. This data combined with data available from other monitoring agencies will be used to develop new or revised existing rating curves and profiles for the gaging sites which would be made available for use by interested parties. The project also includes compiling a catalog of hydrologic and geologic data for publicly owned lakes and reservoirs.



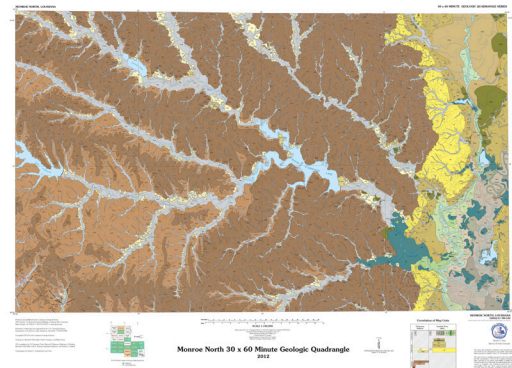
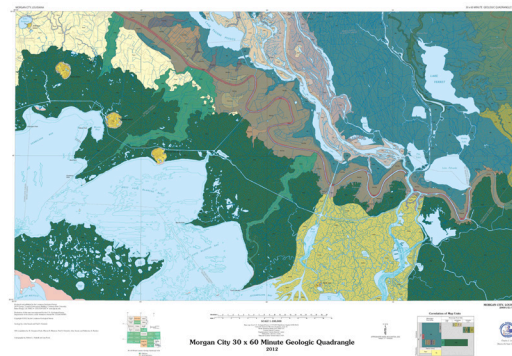
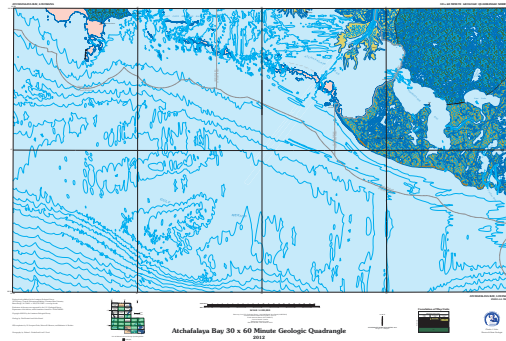
Louisiana Coastal Zone Map

The Louisiana Geological Survey Cartographic Section was awarded a contract with the Louisiana Department of Natural Resources, Office of Coastal Management, to update the Louisiana Coastal Zone Map. Act No. 588 of House Bill No. 656 Regular Session 2012, enacts R.S. 49:214.34(C). "... to redraw the coastal zone boundary; to provide relative to determination of fastlands within the coastal zone; to provide relative to required coastal use permits within the coastal zone; and to provide for related matters." The map was carefully prepared by LGS cartographers. 4,000 copies have been produced. Maps can be ordered through the LaDNR, Office of Coastal Management <http://dnr.louisiana.gov>.

Geologic Quadrangle Maps (1:100,000)

The LGS geologic quadrangle maps describe and illustrate the surface geology of the Atchafalaya Bay, Morgan City and Monroe North quadrangles. The colorful 28"x 46" maps, identify the various surface geologic formations and their composition, and the locations of fault lines and waterways. In addition to rendering the geologic framework of the surface of these areas, the maps can serve as a potential guide to derivative engineering properties of surface materials, such as in connection with the design and construction of flood-protection structures. The 30 x 60 minute geologic quadrangle maps are at 1:100,000 scale.

The Atchafalaya Bay Geologic Quadrangle, by Heinrich, P. V. and John Snead, 2012, 28 X 48 in. Scale = 1:100,000. Multicolored. Describes and illustrates the surficial geology of the Atchafalaya Bay quadrangle.

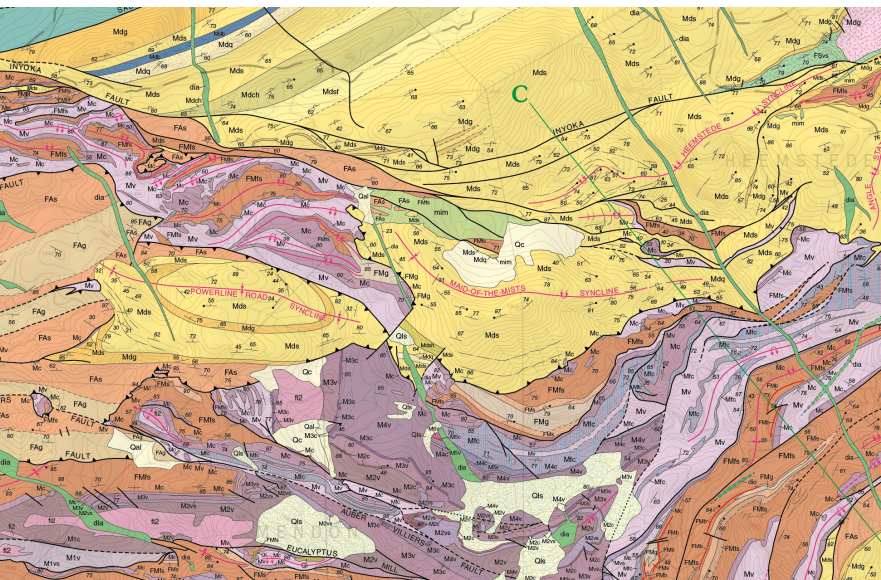


The Morgan City Geologic Quadrangle, by Snead, John and P. V. Heinrich, 2012, 28 X 48 in. Scale = 1:100,000. Multicolored. Describes and illustrates the surficial geology of the Morgan City quadrangle.

The Monroe North Geologic Quadrangle, by McCulloh, R. P., P. V. Heinrich and Marty Horn, 2012, 28 X 48 in. Scale = 1:100,000. Multicolored. Describes and illustrates the surficial geology of the Monroe North quadrangle.

Geologic Map of the Barberton Greenstone Belt, South Africa

The LGS Cartographic Section provided technical and cartographic expertise in the production of an oversized (55x70 in) lithographic wall map of some of the oldest sedimentary rocks in the world (the Barberton Greenstone Belt, South Africa). This project is funded by the Stanford University Department of Geological and Environmental Sciences and the LSU Department of Geology and Geophysics. The map culminates a 30-year investigation by Gary Byerly and Don Lowe and was published by the Geological Society of America in late 2012.



La. Geological Survey's Publication Catalog Available Online

The collection features some of the Survey's earliest geological reports, including an overview of mineral resources and topography dating back to 1869, available for viewing only at the LSU Hill Memorial Library. Copies of "newer" reports, such as 1931's "Geology of Iberia Parish", are available for order. An index provides a list of geological, mineral, and water reports and pamphlets available for Louisiana parishes. Most maps, atlases, and geological reports are available for order.

Outreach & Education

2012 Conferences and Symposiums

GCAGS Convention

The 62nd Annual Gulf Coast Association of Geological Societies (GCAGS) conference was held at Austin, Texas and was hosted by the Austin Geological Society. LGS faculty and staff attended and participated in the meeting and abstracts of papers detailed below were printed in the GCAGS Transactions. LGS also had an exhibit booth displaying LGS publications which was staffed by Research Associate Riley Milner assisted by other LGS staff attending the conference.

Extended Abstracts

John, C. J., B. J. Harder, B. L. Jones, R. J. Bourgeois, and W. Schulingkamp, 2012, Potential for carbon dioxide sequestration in five fields along the Mississippi River industrial corridor in Louisiana: Gulf Coast Association of Geological Societies Transactions, v. 62, p.563-571.

Schulingkamp, W., C. J. John, B. J. Harder, and R. J. Bourgeois, 2012, A potential geopressured, geothermal area in Southwest Louisiana: Gulf Coast Association of Geological Societies Transactions, v. 62, p.609-614.

Abstracts

Carlson, D., and M. Horn, 2012, Evidence that old oil and gas fields influence chemistry of the overlying Wilcox Aquifer: Gulf Coast Association of Geological Societies Transactions, v. 62, p.675.

Carlson, D., and M. Horn, 2012, Impact of seasons, nutrient pulse, and Mississippi River flood of the spring-summer of 2011 on water quality in the Atchafalaya Basin, Louisiana: Gulf Coast Associates of Geological Societies Transactions, v. 62, p.677.

Carlson, D., M. Horn, G. Hanson, A. Lewis, and D. Soderstrom, 2012, Impact of the 2010-2011 drought on Wilcox Aquifer groundwater supply levels and water quality: Gulf Coast Association of Geological Societies Transactions, v. 62, p.679.

Hanson, G., D. Carlson, and A. Lewis, 2012, Drought of 2010-2011 causes water supply crises throughout northeastern Texas and northwestern Louisiana: Gulf Coast Association of Geological Societies Transactions, v. 62, p.723.

Johnston, J., 2012, The geologic review procedures: A regulatory intersection of energy, economics, and the environment: Gulf Coast Association of Geological Societies Transactions, v. 62, p.737.

LGS Staff Recognition

John Snead, LGS Cartographic Manager, retired September 28 after 33 years of service. He returned to work in a part-time capacity for the Survey.

Earth Science Week



Earth Science Week 2012 was celebrated from October 14-20, 2012. This year the focus was "Discovering Careers in the Earth Sciences". At the request of the Louisiana Geological Survey, Louisiana Governor Bobby Jindal issued a proclamation declaring October 14-20, 2012 as Earth Science week in the State of Louisiana. Earth Science week

is sponsored annually by the American Geosciences Institute (AGI) and all its member societies on behalf of the geoscience community. More information about AGI and Earth Science week can be found on their websites (www.agiweb.org and www.earthscienceweek.org).

LGS Resource Center

The LGS Resource Center consists of a core repository and log library. It is located behind the old Graphic Services building on River Road. The core and log collections are included as part of the LSU Museum of Natural History as defined by the Louisiana Legislature and is the only one of its kind in Louisiana. The core facility has more than 30,000 feet of core from wells mostly in Louisiana. The well log library contains more than 50,000 well logs from various parishes in the state. The LGS Resource Center is available for use by industry, academia and government agencies, and others who may be interested. There is a nominal daily charge for use of this facility. For more information, contact Patrick O'Neill at 225-578-8590 or by email at poneil2@lsu.edu.



Radiation Safety Office Personnel

Wei-Hsung Wang, Ph.D., CHP, CLSO, director

Mary J. Haik, M.S., operations manager & laser safety officer

Amin M. Hamideh, radiation specialist

Richard E. Teague, RRPT, senior technologist

Lorraine Day, Ph.D., CAMD liaison

Lorrie Gaschen, D.V.M., Ph.D., SVM liaison

Artis Pinkney Jr., PBRC liaison

Technical Assistants

Dylan Albers

Nicholas Desselles

Jamie Dismukes

Jeremy Dismukes

Marisa A Fanguy

Nicholas Kubiak

Isai Martinez

Gregory Martini

Jerrica Williams

Charles Wilson IV

Radiation Safety Office

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

LSU provides education and nationally competitive research that contribute to the economic development of the state and the nation. The Radiation Safety Office (RSO), a research compliance unit under the direction of the Radiation Safety Committee (RSC), provides research guidance and regulatory-mandated support of academic activities involving the use of sources of ionizing and non-ionizing radiation at LSU. The RSO is responsible for implementing radiation control policies and procedures as well as ensuring safe practice to not only comply with federal and state mandated regulations and licensing/registration conditions but to also assure proper protection of people, the environment, and the integrity of the University. The University's radiation protection program is authorized in the LSU System's Permanent Memorandum-30 (PM-30) and LSU Policy Statement-99 (PS-99), while the LSU System's Safety Procedures for Non-Ionizing Radiation governs the non-ionizing radiation safety program. The RSO directly supports LSU's research programs and thus reports to the Office of Research and Economic Development, with administrative supervision and assistance through the Center for Energy Studies. The RSO/RSC also reports to the LSU System's Radiation Safety Committee.

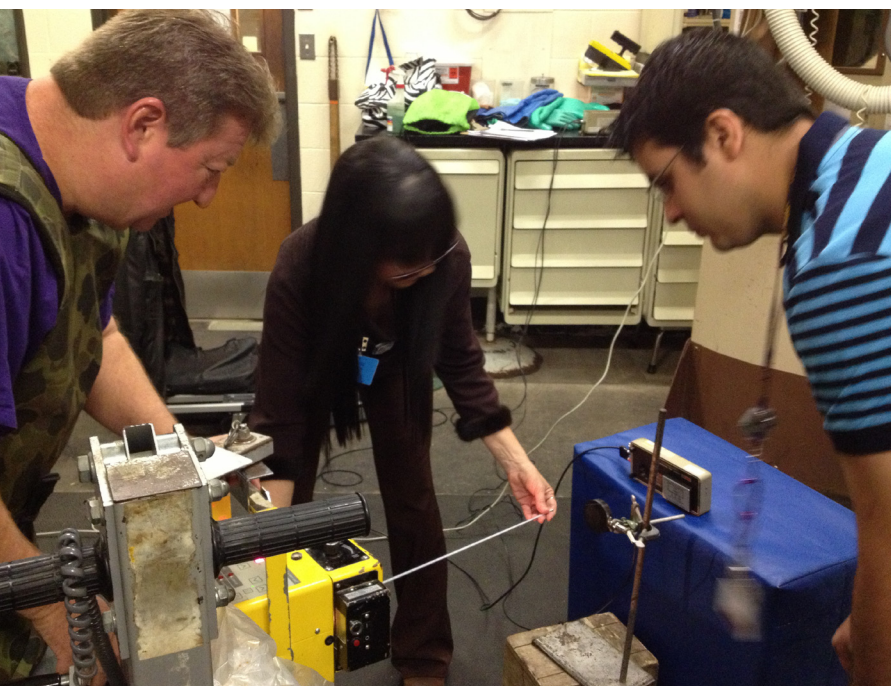
In fiscal year 2011-2012, LSU researchers brought in \$33,701,226 of grant funds that required the use of radioactive materials or radiation producing equipment. Currently, there are 850 approved radiation workers in 210 radiation laboratories on the LSU campus in Baton Rouge, including the LSU Agricultural Center, and associated facilities such as the Center for Advanced Microstructures and Devices, the Louisiana Emerging Technology Center (LETC), the National Center for Biomedical Research and Training, and the Pennington Biomedical Research Center; there are 104 approved laser users. The RSO provides training and monitoring for radiation workers, and performs surveys, inspections, calibrations, leak tests, and radioactive waste management to comply with regulatory requirements and licensing conditions. The RSO also evaluates and inspects inventoried Class 3B and Class 4 laser systems for laser intra beam hazards and provides user training.

Inspection by the Louisiana Department of Environmental Quality

Broad Scope Radioactive Material License (LA-0001-L01) and Increased Controls inspections of the LSU's radiation protection program were conducted by two inspectors from the Louisiana Department of Environmental Quality's (DEQ) Radiation Surveillance Section on February 13 and 14, 2012. They examined the standard operating practice for essential radiation safety operations and the policies and procedures for Increased Controls. They reviewed the records of individual and area radiation exposure monitoring, investigation for elevated personnel exposure, Radiation Safety Committee meetings, annual review of the radiation protection program, inventory and leak tests of sealed radioactive sources, radiation laboratory contamination surveys, radiation laboratory inspections, and survey meter calibration. They also inquired about the functions and applications of the Health Physics Assistant software, the procedures for receiving, monitoring, documenting, and disbursing radioactive material packages, and the current status of the National Source Tracking System. The inspectors walked through the survey meter calibration station, the radioactive waste storage facilities, the radioanalytical laboratory, the Increased Controls areas with enhanced security measures, and 16 randomly selected radiation laboratories to check the radiation levels, calibration of survey meters, posting requirements, and security in these places. After the walk-through, an exit interview was held and no areas of concern were listed on the DEQ's Field Interview Form.

Actions Taken in Response to a Bomb Threat on the LSU Campus

At approximately 11:30 a.m., Monday, September 17, 2012, LSU's emergency alert system notified faculty, staff, and students about a reported bomb threat on campus and instructed everyone to evacuate as calmly and quickly as possible. After receiving the message, the RSO staff immediately inspected the perimeter of the Nuclear Science Building (NSB) for suspicious items and walked through the Increased Control areas to verify the active alarm monitoring system. All entrances to the NSB were checked and secured. Professor Wei-Hsung Wang, director of the RSO, also reported the actions taken in response to the bomb threat to the Emergency & Radiological Services Division of DEQ (ERS/DEQ) via phone and e-mail before leaving the NSB at 12:45 p.m. At approximately 6:45 p.m. Wang returned to the NSB per direction of the LSU Emergency Operations Center to provide assistance in checking the NSB. At 7:33 p.m., the LSU Police Department instructed him to search all areas of the NSB. The perimeter of and areas inside the NSB were inspected. Again, no forced access to the NSB was indicated and no suspicious items were identified. The alarm monitoring system of the Increased Controls areas had not been triggered and appeared to have been working properly. The findings were reported to the LSU Police Department at 8:16 p.m. The NSB was declared clear at this time. At 8:33 p.m., Wang sent an e-mail to the ERS/DEQ to notify of the all-clear situation. He also called ERS/DEQ the next day to report the return to normal operation of the campus. A detailed inventory verification for the Increased Controls areas was conducted as a precautionary measure. All listed sources were located and identified.



Mark Hunter (left), associate clinic specialist at the LSU Veterinary Teaching Hospital, assists RSO manager Mary Haik (middle) and radiation specialist Amin Hamideh in conducting an inspection on a mobile diagnostic X-ray machine.

Self-Study of the Radiation Safety Office

Per direction of the Office of Research and Economic Development, the RSO conducted a five-year (2007-2012) cyclical review to identify its strengths, weaknesses, opportunities, and threats (SWOT). The results of the SWOT analysis are summarized below:

Strengths

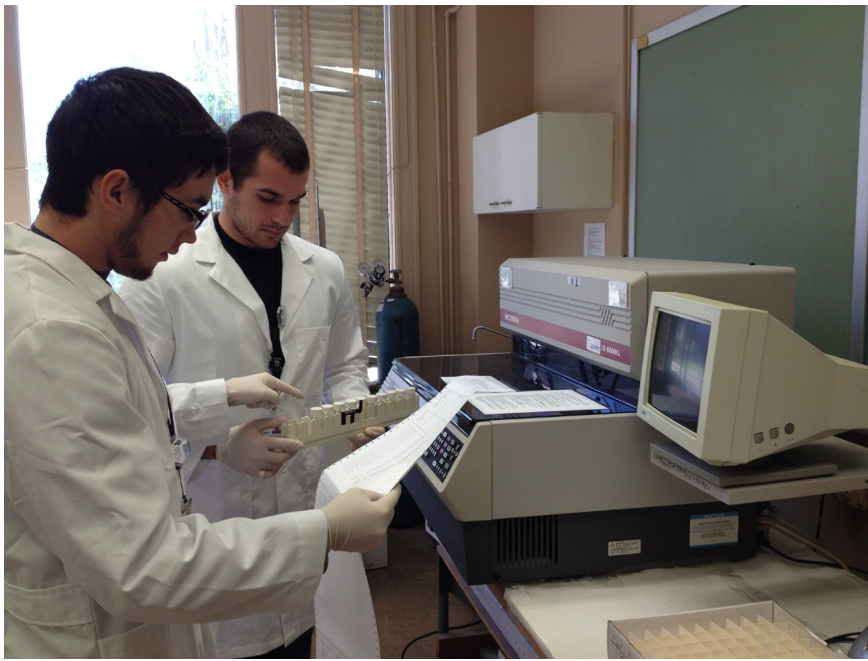
- **Long-running successful safety program.** The RSO has operated for many years with few compliance issues. The DEQ has carried out eight Radioactive Material License and Increased Controls inspections at LSU since 2007. No areas of concern were listed on DEQ's Field Interview Forms and no single violation was cited based on the inspector's observation.
- **Recognized expertise on radiological health and safety.** In the past several years, Wei-Hsung Wang has been appointed to multiple national committees for health physics practice and education, served as a panelist for two federal radiation protection workshops, and been interviewed by local media regarding the Fukushima nuclear incident.
- **Supports other LSU System campuses via System Radiation Safety Officer.** The RSO assists and advises the LSU System Radiation Safety Officer and other campuses with routine and emergency operations, such as x-ray inspections, waste handling, and investigations.
- **Practical work experience for student workers.** The RSO typically employs 5-6 LSU undergraduate students at any time. Working for the RSO provides these students with valuable general work experience as well as specific skills in radiation safety operations. A number of these students subsequently have pursued careers in radiological sciences.



RSO technical assistants Jerrica Williams (left) and Dylan Albers carry out a routine radiation laboratory contamination survey using a pancake Geiger-Mueller probe survey meter and smears.

Weaknesses

- **Available manpower.** Current available manpower is marginal to complete all required RSO duties. The RSO is understaffed, both in terms of essential FTEs to accomplish RSO functions and compared to other universities in our peer group. One additional professional staff member should be added to maintain an adequate radiation protection program and to successfully fulfill the mission of the RSO.
- **User fees.** The LSU-supplied budget for the RSO operations must be supplemented with fees assessed to the radiation principal investigators. These fees assist with required radiation laboratory surveys, personnel and environmental dosimetry, radiation survey meter calibrations, X-ray equipment inspections, radioactive waste disposal, leak tests of sealed radioactive sources, and annual licensing fee. Despite recent difficult economic times, user fees have not been increased since 2009.



RSO technical assistants Isai Martinez (left) and Gregory Martini perform swipe test analysis of removable radioactivity using a liquid scintillation counting system.

Opportunities

- **Academic/professional development.** Through the Research Experiences for Undergraduates and Health Physics Intern Programs, the RSO will strive to provide students with hands-on experiences in operational radiation safety through comprehensive applied health physics training. As a faculty member of the Center for Energy Studies, Wei-Hsung Wang has taught and developed regular graduate-level courses for the Medical & Health Physics program, supervised graduate thesis research, and engaged in research activities. In light of the recent progress of the nuclear renaissance, the RSO actively supports and pursues teaching and research collaborations with other academic units at LSU, professional societies, and energy industries who are interested in nuclear power and nuclear facility safety.
- **Education/outreach.** Use seminars, short courses, and meetings (e.g., Louisiana Nuclear Society and Deep South Chapter of the Health Physics Society) to educate the LSU community and the public about the benefits and concerns of radiation uses.

Threats

- **Increasing mandates.** Expansion of state and federal requirements on security of radiation sources imposes additional workload/expenses. An example is the implementation of Increased Controls and fingerprinting of individuals requiring unescorted access to certain radioactive materials in quantities of concern.
- **Increasing operating costs.** Costs of operational support (e.g., personal dosimeter badges, laboratory supplies, and maintenance of radioanalytical instruments) continue to rise.
- **Budget reductions.** Mandated by state and federal regulations, the RSO operations cannot be scaled back in response to budget reductions.

Thus, increased user fees may be required to offset budget reductions and meet regulatory requirements. Adequate staff size and budget to support the RSO duties are essential to ensure full compliance with the regulatory mandates; in the extreme case, an inability to meet regulatory compliance could result in loss of federal funding for LSU's researchers.

- **Support of other LSU System campuses and affiliates.** The support needs of the LSU System Radiation Safety Officer to assist with other campuses and affiliated units (e.g., LETC) require time commitments by RSO staff in addition to their regular assigned duties. No additional compensation results from providing this support.
- **Turnover rate.** Two professional staff members left the RSO during the last five years, in large part because the professional experience acquired with the RSO allowed them to successfully pursue other employment. Building a competent radiation protection program requires a commitment of time, effort, and resources. It is vital that the University provides adequate budgets for competitive compensation and incentives to promote, reward, and sustain staff productivity.

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