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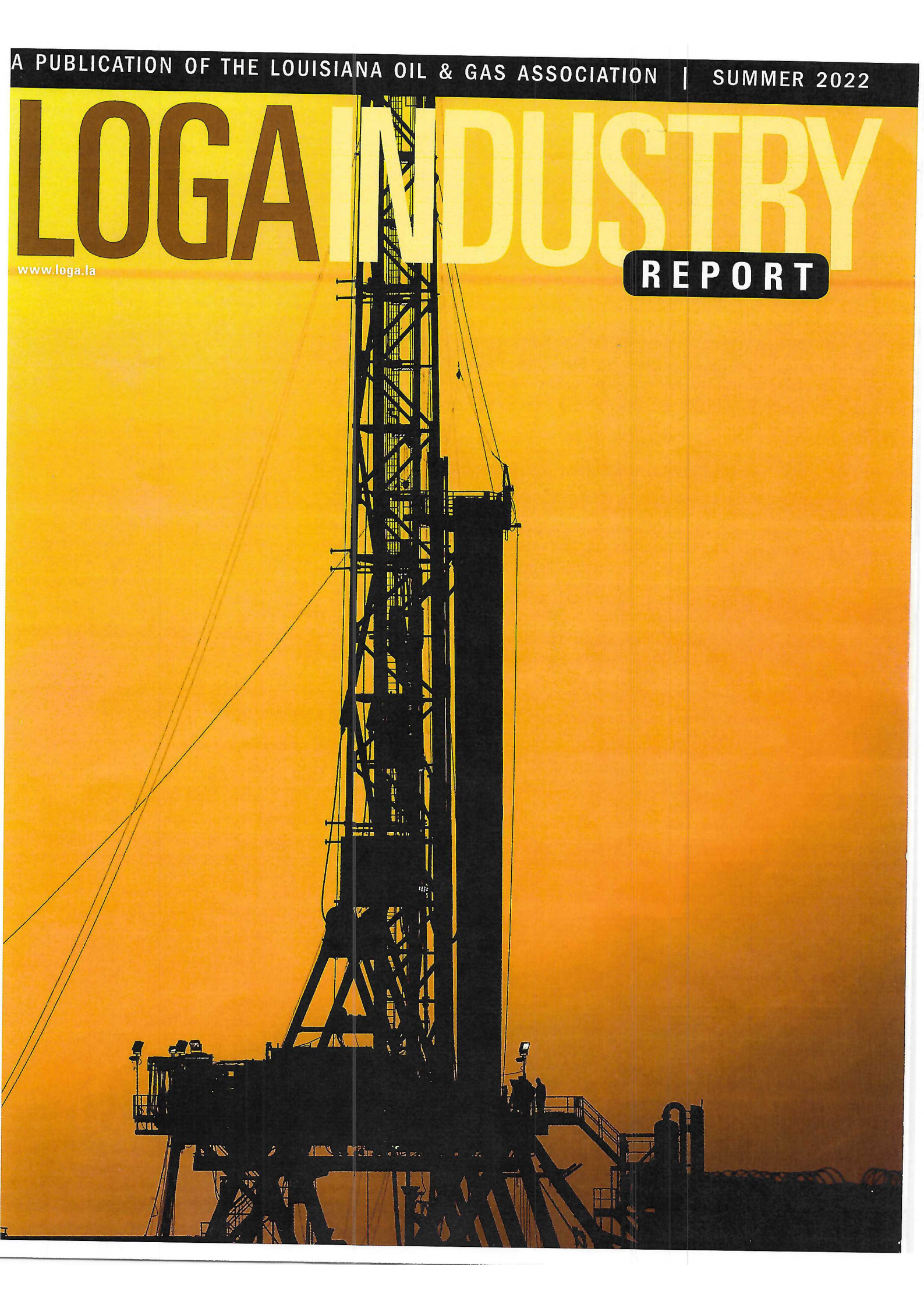

Working Toward Keeping Louisiana the Energy State

An introduction to the Energy Institute of Louisiana

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(photo not available)

The Energy Institute of Louisiana (EIL) is deeply focused on the technical aspects of keeping Louisiana at the forefront of the global energy industry. The mission of the EIL is to serve as an internationally recognized center of expertise for energy technology development and the impacts of these activities on the human and ecological systems.

The institute is housed within the University of Louisiana at Lafayette (UL), which is one of only two public institutions in Louisiana that has a Research-1 Carnegie Classification. It is noteworthy to mention that only 3% of the nation's universities fall within this classification. The institute's philosophy is that Louisiana sits on the forefront of the major global energy transition. The rate of this transition will be strongly based on technology development and associated costs. Assets, such as the EIL, will be key catalysts for moving this transition along.

Many often-cited future energy systems are actually in the development stage, making current energy systems still of great value — thus petroleum will play a major part of the global energy resources for many years to come. Yes, petroleum is a transitional energy source that will indeed likely one day be replaced with developing options, such as hydrogen, wind, biomass, solar and geothermal. It is this reality that has guided the university to tailor the current compositional design of the institute. It is also this reality that encourages the EIL to place a high value on improving and expanding petroleum, particularly natural gas as it is greener than many other currently used energy sources. And still, it is this reality that also compels the EIL to strongly pursue the development and acceleration of alternative green energy options.

Finally, it is important to note that petroleum is a critical feedstock for both chemical and pharmaceutical production, which further entrenches our current need for this resource. There are some emerging alternative feedstocks, such as microbial sources, that may also one day replace petroleum, but that day is not in the near future.

And Louisiana? Well, our state has a very bright future. We are a state with world-class capabilities — both in facilities and people — to design and manufacture complex-engineering reactors and supporting equipment. We are also home to consulting firms that have unique knowledge on energy resource management,

Above: The Cleco Alternative Energy Center in Crowley, Louisiana. Note the large parabolic mirrors of the concentrating solar-thermal testbed and the technology-assessment building, which houses a complete analytical laboratory, as well as the technology-assessment pilot area, which houses the gasifier and torrefaction units. **Right:** Growing microalgae culturing in the laboratory for both CO_2 capture and conversion into value-added chemicals.

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transformation of chemicals, responsible integration with sensitive ecosystems and the safe handling of these systems. On top of that, Louisiana is extremely blessed with its geographical positioning and climate to be a major producer of traditional and alternative energy. The institute believes that Louisiana must and will retain its role as a global-energy region due to its terrestrial and climate assets along with its wealth of great transportation vectors. It is the people of Louisiana, however, who are and will be our greatest asset — we can think it, we can build it, we can move it and we can operate it. The institute is proud to have been, and plans to continue to be, a major component to the we-can ecosystem within Louisiana.

The workforce of the EIL is composed primarily of 30-plus participating faculty, hailing mainly from three colleges at UL — engineering, science and business — along with a highly skilled permanent staff of six. At any given time, over 30 students at both the graduate and undergraduate levels are working as part of the institute's team. In addition, numerous visiting scientists and affiliated experts from other world-class entities collaborate with the EIL to maximize knowledge gained and exchanged.

In fact, collaboration is a key cornerstone for the institute as it works with other like-minded research entities within Louisiana, such as LSU and Tulane University. The institute is currently working with numerous other universities from across the globe, such as universities in Canada, Mexico, Brazil, Chile, Saudi Arabia and Israel. The bulk of these collaborative activities are oriented toward technology research and development (R&D), which entails scientific and engineering discovery and optimization coupled with strong economic performance assessments with an eye on commercialization. The institute is composed of five research centers, an advanced analytics laboratory, two field-demonstration facilities and one information-extension service.

The Center for Optimization of Petroleum Systems (COPS), led by Dr. Boyun Guo, of UL Petroleum Engineering, performs R&D on novel technologies to expand our access to petroleum resources in an environmentally friendly way while reducing the costs — from petroleum exploration to the delivery of energy — to the downstream industry. Examples of current key COPS activities include energy extraction from unconventional oil and gas resources, CO_2-related processes, and geothermal-enhanced oil and gas recovery methods.

The Southern Unconventional Resources Center of Excellence (SOURCE), led by Dr. Mehdi Mokhtari, of UL Petroleum Engineering, directs its R&D efforts toward the economic extraction of product from tight, unconventional subsurface resources. Example projects ongoing within the SOURCE are developing methods to reduce the cost of extracting petroleum from the Tuscaloosa Marine Shale, the study of the mechanics of fracking to optimize performance and the evaluation of CO_2 sequestration within subsurface systems.

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The Chemicals and Fuels Development Center (CFDC), led by Dr. Rafael Hernandez, of UL Chemical Engineering, is charged with the development of economic conversion methods of feedstocks into energetic (fuels) and chemical products, which involves both traditional and green refining methods. Some example projects being worked on within the CFDC include production of green diesels using biomass inputs, removal of CO_2 using microalgae, production of green hydrogen from biomass, the formulation of green corrosion control products from use in the petroleum industry, and production of commercial glues from sewage sludge and microalgae.

The Energy Efficiency and Sustainable Energy (EESE) Center, led by Dr. Terrence Chambers, PE, of UL Mechanical Engineering, works on developing and optimizing electrical power generation, distribution and storage systems. R&D efforts being undertaken by the EESEC include commercialization of new photovoltaic solar technology, development of advanced microgrid systems, development of power sources for green hydrogen production via electrolyzer units, optimization of wind energy production and the expansion of commercial uses of concentrating solar thermal-energy units.

The Center for Environmental Protection (CEP), led by Dr. Mark E. Zappi, PE, of UL Chemical Engineering, directs its resources toward protecting ecological systems through the development of advanced treatment technologies. Example technologies being advanced by the CEP are high-performing mesoporous polymers for adsorption of water-based pollutants, chemical oxidation of pollutants, development of a wastewater treatment for the human space camp on Mars for NASA and the absorption of CO_2 from gas sources using microalgae and/or chemical absorption.

The Advanced Biochemical Analytics laboratories, led by William Holmes, has tremendous analytical capabilities, which are heavily focused on tracking chemical transformational fate throughout reactor systems. Unique system analytics are often coupled with actual running reactor systems to provide real-time evaluation of chemical reactions and fate. Example analytics under development include liquid chromatography with mass spectrophotometry (MS) for characterizing microbial lipids (fats and oils) as well as the QUATRA-C, which is a bench-top catalytic-cracking system with real-time MS capacity. Example current projects are tracking the removal of sulfur compounds in gas matrices and assessing protein-structure conversion during adhesive processing.

The institute is also home to two large-scale research testbeds. The Cleco Alternative Energy Center (CAEC), located in Crowley, Louisiana, and led by Dr. Kary Ritter, of UL Mechanical Engineering, supports the demonstration of various energy systems at large scales. This unique facility represents one of the finest testbeds for green energy within the United States. It receives its base support via funds from Cleco, of Pineville, Louisiana, in collaboration with the Louisiana Public Service Commission. Cleco's interests include the provision

of clean energy to its customers at competitive costs. Significant R&D funds are spent at the CAEC via support from both companies and government agencies alike. Over 20 companies and four government entities have utilized the facilities at the CAEC for advancing the commercialization of their products. Additionally, UL utilizes the CAEC facilities for performing R&D using industrially real designs. Key facilities within the CAEC are:

- Two 400-foot-long thermal solar testbeds with 40-foot-wide parabolic trough concentrators coupled to an organic rankine-cycle power block.
- A 3-ton-per-day biomass-fed fluidized-bed gasification unit equipped with novel gas-management systems and a high level of process monitoring.
- A quarter-ton-per-day biomass-fed rotary-torrefaction unit for production of biocoal and biochar from wood and other combustible inputs.
- A mobile 200-gallon anaerobic-digestion testbed for evaluating waste inputs for the production of biomethane and/or biohydrogen at industrial and municipal sites.

The other testbed facility within the institute is the Louisiana Solar Energy Lab (LaSEL), which is under the leadership of Dr. Terrence Chambers, of UL Mechanical Engineering. This 5-acre facility, located in the UL Research Park, houses various research-grade photovoltaic (PV) panels for the evaluation of PV panels at various commercialization states of development as well as the coupling of both energy storage and microgrid technologies. LaSEL produces enough electrical power (>1.1 megawatts) to fully energize the entire athletic complex at UL. In fact, UL is the first U.S. university where a sunny day of athletic games can be entirely powered by solar energy.

The institute is also home to the first C1 Extension Service in the country. C1 stands for carbon dioxide (CO_2) and methane (CH4), which represent over 95% of the greenhouse gas emissions in Louisiana — and the U.S., for that matter. The Louisiana C1 Extension Service (LC1ES) is not an R&D unit but an outreach entity staffed by skilled technical communicators. Its mission is to provide the state with much-needed tech-transfer expertise and a repository of information on the management of C1 emissions — both prevention and CCSU technologies.

It is often stated that these are exciting times in the energy industry, and this statement is as true today as it ever has been. The institute stands ready to ensure that these are indeed exciting and good times for the energy industry in Louisiana. ●

For more information on the Energy Institute of Louisiana, contact *Mark E. Zappi, who can be reached by email at mark.zappi@louisiana.edu or by phone 337-322-1683.*