The following proposals listed below and available full-length on the following pages were submitted on April 13, 2020 in response to a call from the U.S. House of Representatives Committee on Science, Space, and Technology for input "on ideas to be included in any future near-term response and longer term economic stimulus package(s) developed by the House to address and mitigate the impacts of the current COVID-19 crisis."

These proposals are ideas developed by Gulf Coast Carbon Center researchers in concert with collaborators, for consideration for funding and additional partnerships with other organizations.

<table>
<thead>
<tr>
<th>Proposal Name</th>
<th>Target Agency (Addition to Existing Grant #, If Applicable)</th>
<th>Budget</th>
<th>Researcher Submitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combining produced water and CO2 subsurface injection: an opportunity to optimize available pore space</td>
<td>US DOE-NETL or HQ/Fossil Energy Office</td>
<td>$6 million</td>
<td>J.-P. Niece</td>
</tr>
<tr>
<td>Long-term Surveillance of P&amp;A Wells to Reduce Environmental Damage and Liability</td>
<td>US DOE-NETL (#DE-FE-0031830)</td>
<td>$4 million</td>
<td>Susan Hovorka</td>
</tr>
<tr>
<td>New CO2 storage capacity estimation tool to facilitate industry investment in CCS industry</td>
<td>US DOE-NETL</td>
<td>$4 million</td>
<td>Seyyed Hosseini</td>
</tr>
<tr>
<td>Carbon Capture, Utilization and Storage (CCUS) Readiness Assessments</td>
<td>US DOE-NETL</td>
<td>$3 million</td>
<td>Vanessa Nuñez-Lopez</td>
</tr>
<tr>
<td>CO2 Storage Risk Management through Brine Extraction at the Devine Test Site (DTS) in Texas</td>
<td>US DOE-NETL</td>
<td>$20 million</td>
<td>Seyyed Hosseini</td>
</tr>
<tr>
<td>CarbonSAFE 2020: Paving the way for Commercial CO2 Sequestration</td>
<td>US DOE-NETL or General Land Office</td>
<td>$20 million</td>
<td>Alex Bump</td>
</tr>
<tr>
<td>Optimizing Geologic Sequestration of CO2: Machine Learning and Human Insight</td>
<td>US DOE-NETL (#DE-FE0031558)</td>
<td>$2.5 million</td>
<td>Alex Bump</td>
</tr>
<tr>
<td>Alternative shale production for greater energy, water, and climate security</td>
<td>US DOE-NETL</td>
<td>$2 million</td>
<td>Sahar Bakhshian</td>
</tr>
<tr>
<td>Leveraging Hydrocarbon Infrastructure to Breakthrough Barriers to Carbon Mitigation via CCS</td>
<td>US DOE-NETL</td>
<td>$12-14 million</td>
<td>Susan Hovorka</td>
</tr>
<tr>
<td>State of Carbon Capture and Storage Research Report for Journalists</td>
<td>US DOE-NETL (#DE-FE0031558)</td>
<td>$30,000</td>
<td>Emily Moskal</td>
</tr>
<tr>
<td>Creation of an interdisciplinary center for deepwater geohazard assessment to sustain the economy and environment</td>
<td>BSEE/BOEM, DOE-FE, NSF MG&amp;G (Geohazards), or ARPA-E</td>
<td>$30 million</td>
<td>Jake Covault</td>
</tr>
<tr>
<td>Re-purposing aging offshore infrastructure for the clean energy transition</td>
<td>DOE-NETL BSEE/BOEM</td>
<td>$10 million</td>
<td>Tip Meckel</td>
</tr>
<tr>
<td>New National Marine Seismic Imaging Facility</td>
<td>NSF-GEO</td>
<td>$40 million</td>
<td>Tip Meckel</td>
</tr>
</tbody>
</table>
Below were the solicited proposal categories:

1. **Opportunities for Additional R&D and Related Activities Specific to COVID-19 Response and Recovery**
   a. R&D Funding
   b. Infrastructure to enable R&D, including computing, databases, testbeds, etc.
   c. Manufacturing, including Manufacturing USA, MEP, and other programs/activities that may help address supply chain, rapid drug/vaccine/PPE manufacturing, and other domestic manufacturing for near-term response and recovery

2. **Near-Term Response to COVID Impacts on the larger Research Enterprise**
   a. Supplements to Existing Grants
   b. Needs for currently operating facilities and facilities currently under construction
   c. Scholarships/Fellowships to keep STEM students in the pipeline through the economic crisis

3. **“Shovel-Ready” Research Infrastructure**
   a. Federal Facilities Maintenance and Construction (e.g. modernizing NIST, DOE labs, and NASA Center facilities)
   b. Mid-scale projects (in NSF speak that's instrumentation and facilities in the approx. $10m-$100m range)
   c. Large new construction projects (telescopes, supercomputers, research ships, light and neutron sources, spacecraft, etc) – including significant upgrades
   d. University research labs modernization

4. **Long-term Economic Stimulus/Recovery**
   a. Funding for new grants and cooperative agreements (do we constrain or prioritize topics in any way, e.g. economically critical areas?)
      1. If you propose in this category, please make an effort to address the sustainability challenges and lessons learned from ARRA
   b. STEM Workforce Development
Combining produced water and CO₂ subsurface injection:
an opportunity to optimize available pore space

- **Suggested Agency:** US DOE: NETL or HQ/Fossil Energy Office
- This project would require 3 years to complete with a budget of $6 million.
- **Contact:** J.-P. Nicot, jp.nicot@beg.utexas.edu

**Introduction:** We will examine competition and synergy between subsurface disposal of produced water from oil and gas operations and sequestration of CO₂ from industrial installations for subsurface pore space. This study will investigate approaches benefiting goals of both industries: deep well injection of produced water and potential sequestration of captured CO₂ in the same geological units. The purpose of the study is to assess the various operational ways to achieve mutually beneficial goals. Injected CO₂ can be co-disposed with produced water into the subsurface or CO₂ and produced water can be injected in separate reservoirs, one helping managing the other (hydraulic control). The study will leverage and combine extensive analyses previously conducted by the Bureau of Economic Geology at The University of Texas at Austin (UT-BEG) on both produced water injection and carbon capture, utilization, and storage (CCUS). The analysis will also benefit from extensive research into induced seismicity risks linked to subsurface fluid injection performed at UT-BEG.

**Problem Statement:** The high cost to dispose of large volumes of produced water generated from oil and gas operations can challenge the economic viability of the play. Approaches to offset disposal costs would be beneficial to the entire industry. Combining CO₂ with produced water, either at the surface or downhole could be one solution. We would answer the questions: what are the technical and economic hurdles—and benefits—for co-disposing CO₂ and produced water into the same injection stream? Or is it more beneficial to dispose the two streams in separate reservoirs?

**Objectives:** The objectives of this study are to assess and optimize scenarios for potential co-disposal of produced water and CO₂ from industrial facilities relying on actual locations where the need is the greatest, such as the Permian Basin.

**Methods:** This study will address these questions and objectives in three specific phases. First, we will conduct laboratory studies of the geochemistry of mixed produced water and CO₂ solutions. Second, we will conduct regional and local numerical models under multiple subsurface scenarios. The main advantage of surface dissolution before injection is much lower leakage risks. UT-BEG will leverage its strong ties with industry operators across Texas to ensure that the scenarios are realistic and in sync with stakeholder expectations. Third, we will conduct economic studies to assess the cost-benefit of co-disposal, especially in light of the 45Q tax credit program, and the need for additional infrastructure.

**Conclusions:** The cost of disposing of produced water is a strong barrier to oil and gas development that needs to be reduced even more so during current low energy prices. The study will explore scenarios in which some of the cost can be offset by combining excess CO₂ from other operators or other industries. The potential for success is high because it leverages a decade of research on related topics. The workflow from lab studies, to modeling studies to economics will provide a stronger technical foundation for the creation of this potentially new industry, leading to the leveraging of decades of experience in both the oil and gas sector, and the CO₂ injection sector.
Long-term Surveillance of P&A Wells to Reduce Environmental Damage and Liability

- Target Agency: US DOE: NETL
- Contacts: Susan Hovorka, susan.hovorka@beg.utexas.edu; David Chapman, david.chapman@beg.texas.edu; Sahar Bakhshian sahar.bakhshian@beg.utexas.edu
- Projected project costs: $4 million for a project duration of 3 years
- Project link: DE-FE-0031830

What are we proposing? To develop and deploy an effective, low-cost system for long-term surveillance of wells that have been plugged and abandoned (P&A) but remain an environmental, financial, and liability risk. Such risk is problematic during development of new projects that use the subsurface such as Carbon Capture and Storage (CCS), fluid disposal, unconventional resource development, and geothermal energy projects. Our system is designed to “stand sentinel” -- be sensitive to early warning signals of initial well failure. Our proposal is composed of three novel elements: 1) array of multi-physics sensors with near-real time report-out, 2) fit-to-purpose data analysis system using machine learning to separate well-failure signal from high ambient environmental variability, and 3) field test program to optimize the system.

Why is this needed? By regulation, deep wells must be constructed and maintained to isolate hydrocarbon-bearing and saline zones from overlying freshwater resources. During construction, isolation is engineered in; when a well is properly P&A the casing is blocked by cement plugs. Many P&A wells in injection projects perform well in zonal isolation; nevertheless, screening based on well records is not fool-proof, resulting in environmental damages and liability if failure occurs. Where records for past well management are poor, the regulator may currently have no choice but to require that many wells be re-entered, which is difficult, time-consuming, and expensive. These failures can be avoided.

What does the new system look like? Sentinel surveillance of numerous P&A wells is accomplished with a multi-instrument tool instrument package sensitive to fluid migration installed in a shallow (<2-m-deep) over each P&A well stub. Target is cost less than $5k per well using an array of autonomous (battery connected) wired and or wireless sensors deployed to conduct long-term (decadal) surveillance. The sensors, attached to fiberglass rods, installed in an engineered trench fill and connected to a solar powered cellular package for real-time power and communications, will detect early warning signals of incipient leakage. Previously, data management from such shallow installations has been a weak point because of high noise. We will use powerful data analytics (e.g. Artificial Intelligence) which are ideally suited to separate normal systematic variability (seasons weather and soil processes) from leakage signal. Data analytics will assess both the temporal and spatial trends to flag anomalies that require emergency attention to avoid damages.

What is the method of testing and assessment? We will construct a well test bed composed of an array of shallow “proxy wells” on laboratory property to probe the response of various instrument packages, constructions and surface settings to leakage. This built array requires construction of only the upper few meters of typical wells so that controlled release of proxy fluids can be used to optimize instrument sensitivity and develop data analytics. We then migrate the optimized installation design and advanced data analytics to operating fields for on-site testing.

Sustainability: The proven technology will be commercially viable in many types of subsurface applications where well performance introduces risk and purchased by operators. This is proposed as a potential add-on to SECARB-USA (DE-FE-0031830).
Robust field tested autonomous (rechargeable battery) microsystems have been clamped onto smart rod pushed into the wellbore.

Field installation in shallow trench
Project Title: New CO\textsubscript{2} storage capacity estimation tool to facilitate industry investment in CCS industry (3 years, $4M)

Agency target: US DOE National Energy Technology Laboratory

Collaborators: The University of Texas at Austin, BP, USGS

Contact: Seyyed Hosseini, Research Scientist, 512-471-2360, Seyyed.hosseini@beg.utexas.edu

Summary
In 2013, with funding provided by Department of Energy (DOE) (DE-FE0009301, ~1M, 2013) Bureau of Economic Geology (BEG) developed an enhanced CO\textsubscript{2} storage capacity estimation tool that has been extensively used by industry over past several years but because of the lack of funding, further development of this tool has been stopped (https://www.beg.utexas.edu/gccc/research/easitool). Since then, we have had many requests from major stakeholders in Carbon Capture and Storage (CCS) projects to make improvements to this tool including but not limited to improving tool capability to deal with heterogeneous geological formations at various scale, impact of various physical forces on CO\textsubscript{2} storage capacity estimation, capacity estimation for dipped geological formations where geological trap and fetch can be used for CO\textsubscript{2} storage and impact of boundaries of the geological formations on overall CO\textsubscript{2} storage capacity. We are proposing a 36 months’ project to generate the next generation of this tool to respond to the interest from CCS industrial stakeholders. In the short term, this work will preserve the continuity of STEM research and education in CCS. In the medium term, it will help to accurately identify and assess USA’s storage resources, optimize storage projects and boost new clean energy technologies to mitigate the growing impacts of climate change. In the long term, it paves the way for the deployment of commercial CCS and the repurposing of oil and gas skills and infrastructure for a new, growing industry to create and sustain American leadership in the transition to a global clean energy economy.

Problem Statement
One of the first questions to be answered in developing a Carbon Capture and Storage (CCS) project is if enough storage capacity exists in the geological formations, preferably located not too far from the CO\textsubscript{2} emission source. In many occasions this information could play a critical role on a go or no-go decision in initiation of a commercial project. Many complex tools exist that could be used for this capacity estimation but industry needs a quick assessment tool that would provide fast and reliable CO\textsubscript{2} storage capacity estimates.

Objectives
The main objective of this study is to develop new tool in a direct response to the requests from CCS stakeholders in past decade to enable fast CO\textsubscript{2} storage site screening. Our objective is to develop this science based tool based on our current improved understanding of the geological CO\textsubscript{2} storage systems.

Methods
The main advantage of our proposed tool is to be science based, fast and reliable. To achieve these goals, we will use
- Cutting-edge analytical models to improve accuracy and speed
- Use of data analytics in the tool to deal with geological uncertainty
- Advanced laboratory experiments to investigate important physical processes in subsurface
- Use of high performance computing (HPC) resources to interrogate large data sets
Proposal to Science, Space, and Technology Committee
3.d “Shovel-Ready” Research Infrastructure-Labs Modernization
4.b Long-term Economic Stimulus/Recovery-Workforce Development
Proposal to Science, Space, and Technology Committee
Future near-term response and longer-term economic stimulus package
Category:
4.b Long-term Economic Stimulus/Recovery-Workforce Development

Austin, April 13th, 2020

Project Title: Carbon Capture, Utilization and Storage (CCUS) Readiness Assessments (3 years, $3M)
Target Agency: US DOE - National Energy Technology Laboratory

Objective: The overarching objective of the study is to assess the state of readiness of high-value geologic carbon storage sites in the U.S., both onshore and offshore, to determine the cost of advancing them toward commercial CCUS deployment. Specific objectives are (1) identify high-value carbon storage sites within diverse geologic settings, including depleted oil fields and deep saline aquifers, (2) assess prospective storage sites in terms of their readiness for CCUS commercialization, and (3) assist project developers in deploying CCUS projects. This study will complement the goal of DOE’s Regional Carbon Sequestration Partnership (RCSP) Initiative to advance the critical knowledge needed to accelerate CCUS deployment.

Background: Carbon capture and storage/sequestration (CCS), a technology where carbon emissions are captured, transported, and safely injected deep underground for long term storage, is acknowledged by the Intergovernmental Panel on Climate Change (IPCC) as an essential technology in the portfolio of large-scale emission reduction options needed to hold the increase of global average temperature to below 2°C above pre-industrial levels. However, the current pace and scale of CCUS deployment is not meeting the climate goals.

Methods: The scope of work of the project is focused on examining the readiness of storage complexes (enhanced oil recovery + saline + stacked) by assessing essential data requirements and capabilities necessary to advance knowledge and reduce uncertainties in CO₂ storage and containment in a defined portfolio of storage sites. To assess storage readiness, we will conduct a pre-feasibility analysis in selected sites to determine the level of available CCUS relevant data and estimate the cost of collecting missing information needed for project developers to make important site investment decisions.

A Phase 1 will include the identification and analysis of stakeholder needs, the development of a Storage Assessment Methodology, and the creation of stakeholder working groups (industry, government, NGO’s) that will provide feedback on key technical areas.

A Phase 2 will include the application of the Storage Assessment Methodology for the identification of a high-value portfolio of storage complexes. On identified complexes, research activities will include assessment of data availability and quality, risk assessment including induced seismicity, and storage cost assessment.

In a Phase 3 learnings from this study, as well as from the Regional Carbon Sequestration Partnerships (RCSP), will be integrated into a CCUS techno/economic assessment performed on a small (two to three) number of storage sites to estimate the integrated cost of the CCUS supply chain and demonstrate the business case to project developers.

Contact: Vanessa Nuñez-Lopez, Research Scientist Associate, The University of Texas at Austin
512-471-5825, vanessa.nunez@beg.utexas.edu
Project Title: CO₂ Storage Risk Management through Brine Extraction at the Devine Test Site (DTS) in Texas (3 years, $20 M)
Agency target: US DOE National Energy Technology Laboratory
Collaborators: The University of Texas at Austin, General Electric Company (GE), and Sandia Technologies
Contact: Seyyed Hosseini, Research Scientist, 512-471-2360, Seyyed.hosseini@beg.utexas.edu

Summary
We propose to construct deep brine extraction wells to control pressure buildup in CO₂ storage formations to mitigate related risks due to lack of storage capacity and induced seismicity. This project extends results from DOE (DE-FE0026137, completed in 2016). In parallel, extracted brine will be used as a test-bed for novel brine treatment and desalination technologies developed by GE’s. Desalination technologies will be selected for piloting based on a selection criteria matrix, which includes Cap-Ex, Op-Ex, and energy requirements. This project supports the global competitiveness of the U.S. as well as our nation’s ability to mitigate impacts of climate change by storing CO₂ emissions in deep geological formations and treating saline brine for reuse.

Problem Statement
A major concern in CCS projects is excessive pressure build-up that could lead to either well leakage, unintended excursions of fluids into overlying aquifers, or fracturing of seals; any of these impacts could potentially halt a project. Similar issues have been previously observed across the U.S. where large volumes of salt water have been disposed. In this research, we seek to answer the following question: how can we effectively manage pressure build-up in disposal formations, improving long-term safety and efficiency of CCS projects?

Objectives
The objective of this study is to design and operate a field project for brine extraction as a means to manage formation pressure and control subsurface CO₂ plume movement. Lessons learned will help manage risks in future large-scale CO₂ storage projects. The objective of GE’s brine treatment research is to demonstrate treatment of representative produced water with a pilot (10 gal/min) pretreatment and desalination test bed. Brine treatment goals include demonstration of the technical and economic feasibility of desalination technologies, which may be required for large scale CO₂ injection projects.

Methods
Our proposed research site is owned and operated by UT Austin. It is located ~50 miles southwest of San Antonio in Medina County, Texas.
• Drill and operate three wells at depth of 5000 ft in Medina County, Texas.
• Construct and operate desalination test bed using GE’s technology.
• Deploy MVA plans for monitoring, including use of smart tracers, pressure and temperature gauges, surface seismometers, and downhole geophones to record seismic events.
• Conduct rigorous evaluations to document improved safety and efficiency.

Impact
Our solution to extract brine from the CO₂ storage formation is similar in concept to enhanced-oil recovery, but it has not been tested or evaluated in CCS conditions. If successful, the approach could lead to increased storage capacity for CO₂, reduced stress on geological formations, reduced risk of brine
and CO₂ plume movement into unwanted formations, and reduced area of review (AoR). All of these benefits will add Op-Ex efficiency, reduce costs, and encourage broader use of CCS.
Proposal to Science, Space, and Technology Committee:

**CarbonSafe 2020: Paving the Way for Commercial CO\textsubscript{2} Sequestration**

- **Topic 3:** “Shovel-ready” Research Infrastructure; Suggested agency: DOE-NETL
- **Submitted by the Gulf Coast Carbon Center at the University of Texas at Austin**
- **Contact:** Alex Bump ([alex.bump@beg.utexas.edu](mailto:alex.bump@beg.utexas.edu))
- **Cost will be $25M and require 3 years to complete**

**Vision:** There is no industrial-scale carbon capture and geologic storage (CCS) system in the USA. CarbonSafe 2020 will convert a depleted offshore gas field into the nation’s first large-scale system for safely disposing of industrial CO\textsubscript{2} in saline reservoirs, creating a CO\textsubscript{2} transport network and disposal hub. The project will **pave the way for private investment and build American leadership** in the transition to a profitable carbon-neutral economy. Our first step will be permitting, drilling and testing an EPA Class VI (CO\textsubscript{2}) injection well, using highly skilled professionals idled by the COVID-19 crisis and oil price collapse. These professionals include engineers, geoscientists, environmental consultants, rig crews, construction workers and regulatory experts.

**Background:** CCS is a key means of mitigating climate change and is the only option currently available to decarbonize industries such as LNG terminals, cement, steel refineries, and chemical plants. **Texas & Louisiana have a global leadership role** in this area, with one of the densest clusters of industrial CO\textsubscript{2} emissions in the U.S., an under-employed energy industry workforce skilled in exploration, drilling and transporting fluids, and **20 years’ experience in R&D on CCS technology** in the region’s universities & partner companies.

Interest in CCS is high across the political spectrum. **Private investment in this growth industry has been hampered by business concerns around untested or unresolved regulation, permitting, and liability.** With other countries (Norway, The Netherlands, Australia) already planning integrated storage hubs, the U.S. will fall behind in this new industry without concerted federal support and partnerships. We will leverage decades of work by the Gulf Coast Carbon Center (GCCC), deep relationships with industry, regulators and legislators, and the existing skills of oil and gas professionals to **create a first-of-its-kind example of a high-volume, low-risk and low-cost storage model that can propagate throughout the Gulf Coast, other U.S. waters, and even globally.**

**Objectives:** We will partner with energy operators, regulators, service companies, and consultants to access and recommission an existing depleted offshore gas field, design, permit and drill the **first offshore Class VI well**, and perform test injection and monitoring. This work will build on existing DOE-funded work on the DOE-NETL CarbonSAFE and GoMCRB initiatives and detailed characterization of the High Island 24L and 10L depleted gas fields. This project will address the nation’s ability to mitigate the rapidly growing impacts of climate change. The vision is to ultimately turn the facilities over to a suitable long-term private operator who would build pipelines, aggregate sources, and turn it into a commercial enterprise with R&D monitoring by the GCCC.

**Partners:** The proposed activity builds on 20 years’ experience in R&D of pilot projects at the Gulf Coast Carbon Center (UT Austin). The Carbon Center has deep relationships with partner energy companies, national labs, regulators and Gulf Coast industry, many of whom have expressed support for this project. Consultants for writing a Class VI injection permit are identified, and the GCCC has experience drilling wells for CO\textsubscript{2} injection and managing large budgets. Subcontracting companies are eager to become involved in the project. Existing contractual relationships with engineering firms such as Trimeric and Aker Solutions to work on offshore carbon storage topics can be augmented to cover the required engineering design and construction. The GCCC has presented the proposed concept to OGCI Climate Investments for consideration in their evaluation of potential industrial CCS hub projects in the Gulf Coast region.

**Conclusion:** This project **retains jobs** and critical energy industry expertise in the short term, creates the **first offshore CO\textsubscript{2} storage hub** in the U.S. and **paves the way for private investment** in a growth industry. **American innovation can lead in the global transition to a clean energy economy.**
Map showing industrial CO₂ emissions in east Texas and southwest Louisiana, the location of the proposed storage complex and potential pipelines to aggregate and transport CO₂ for storage. 196 point sources of CO₂ are shown, the largest of which produces over 10 million metric tons of CO₂ per year (NATCARB database, 2019). Red lines show potential pipeline routes to transport separated CO₂ to the proposed storage complex. Note that the project is entirely within state waters and that the storage complex could be drilled with deviated wells from an onshore pad if that proved advantageous.

More background information can be accessed here: [http://beg.utexas.edu/gccc/research/carbonsafe-II](http://beg.utexas.edu/gccc/research/carbonsafe-II)
Proposal to Science, Space, and Technology Committee

Optimizing Geologic Sequestration of CO₂: Machine Learning and Human Insight

- **Topic 2a: Near-Term Response to COVID Impacts on the larger Research Enterprise**
- **Supplement to existing US DOE NETL grant #DE-FE0031558, "Partnership for Offshore Carbon Storage Resources and Technology Development in the Gulf of Mexico"**
- **Submitted by The Gulf Coast Carbon Center at the University of Texas at Austin**
- **Contact: Alex Bump (alex.bump@beg.utexas.edu)**
- **Cost: $2.5 million, 2 years**

**Vision:** Reducing current barriers to private investment in commercial Carbon Capture and Storage (CCS) by enhancing predictions of subsurface reservoir and seal performance using newly developed, UT-proprietary algorithms. In the short-term, this work will preserve STEM employment by redirecting work from oil-related research into CCS. Longer-term, the resulting insight will help de-risk private investment and shape appropriate regulation in a growth industry, building American leadership in low-carbon business.

**Background:** CCS is the capture and permanent geologic storage of industrial CO₂ emissions. It is widely recognized as a key to reducing industrial greenhouse gas emissions and is the only way to decarbonize industries like cement, steel and refining. While the technology is promising, regulatory and technical uncertainties have hindered commercial development. The types of reservoirs and seals that work for oil and gas on geologic timescales are not necessarily optimal for sequestering CO₂ on commercial timescales. Ultralow-viscosity CO₂ tends to spread in thin plumes that fail to fully saturate the reservoir. Heterogenous reservoirs may spread the flow, leading to more efficient storage but the effect is poorly quantified and not yet predictable. Recent oil industry-sponsored work at UT has developed machine-learning algorithms for analyzing large volumes of well data—algorithms and expertise that are ideally suited to addressing this problem and that are at risk as oil-industry funding dries up.

**Objectives:** Our aim is continuity of STEM research by redirecting oil-related work to 1) quantify observed reservoir and seal heterogeneity; 2) turn it into actionable predictions of CO₂ reservoir performance and seal capacity on the Texas and Louisiana Gulf Coast; and 3) develop a method that can be applied globally. Specifically, we will apply machine learning and human interpretation to the description and quantification of reservoir and seal heterogeneity, using large datasets of well logs and industry seismic. We will use oil migration and reservoir modelling software to correlate heterogeneity with CO₂ reservoir and seal performance and we will calibrate the resulting predictions against observation from outcrop and existing CCS field trials. Ultimately, our goal is actionable insight and we will work with regulators and industry to apply the results.

**Partners:** The partnership assembled for this work is uniquely positioned for delivery, with a long track record of work in both CCS and oil and gas reservoirs. GCCC brings experience in modeling and monitoring, deep expertise in geosciences and has conducted eight successful DOE-funded field projects. We are also well networked with both regulators and private industry and frequently advise on both policy and projects. We will partner with the UT Quantitative Clastics Laboratory, a leading research group in reservoir geology with proprietary technology and long experience in prediction and performance of oil and gas reservoirs.

**Summary:** In the short term, this work will preserve jobs and continuity of STEM research. In the longer term, it will help to accurately identify and assess storage resources, optimize storage projects, inform regulation and de-risk private investment. In short, this is about preserving jobs and repurposing research expertise to create American leadership in the global transition to a clean energy economy.
Project Title: Alternative shale production for greater energy, water, and climate security (3 years, $2 million)
Target Agency: US DOE - National Energy Technology Laboratory

Introduction: We propose to conduct a fundamental study to assess the potential effectiveness of using CO₂ as a fracturing fluid in unconventional resources, while providing environmental benefits including CO₂ sequestration and mitigating the risks associated with produced water management. Through integrated technical and socio-economic assessment, we provide a step forward to better understand the environmental and cost benefits of using CO₂ as a non-aqueous fluid in hydraulic fracturing. Through CO₂-based fracking, shale producers can deliver not just the energy that economies rely on, but also the carbon (CO₂) storage to help tackle our climate challenge.

Problem statement: As the COVID-19 pandemic spreads around the world, global oil and gas demand is expected to decline due to a deep contraction in energy consumption and major disruptions to global travel and trade. This global decline in demand has led to oil price plummeting and production cuts for most oil and gas companies, particularly U.S. shale producers. On the bright side, the demand is expected to increase shortly after the pandemic, giving the oil and gas industry a boost to compensate for the lost demand. American shale oil and gas suppliers play an important role in satisfying the domestic demand and securing U.S. oil/gas exports. Hydraulic fracturing is a critical component of shale resource production. Use of the traditional hydraulic fracturing fluid, water, has raised concerns in recent years as access to local water resources and disposal of wastewater become challenging. Increased shale oil/gas production as a result of the increased demand after the COVID-19 pandemic could compound water and wastewater issues associated with hydraulic fracking. Thus, considering a non-aqueous alternative e.g., CO₂, as the fracking fluid can be a viable solution to address these issues.

Objectives: Our main objective is to gain insight into CO₂ storage and enhanced oil and gas recovery in shale resources from both technical and socio-economic standpoints. We propose to develop experimental and modeling frameworks to assess the potential for CO₂ to be used as a fracturing fluid by characterizing fluid flow and transport in shale formations across different spatial scales (nano-, micro-, core- and reservoir-scale). Finally, integration of an economic assessment (with considering the benefit of the 45Q tax credit program) into the technical outcome will provide insight into the economic benefits of CO₂-enhanced recovery in shale reservoirs.

Methods:
• Conduct multi-scale numerical simulation techniques to identify physics-based mechanisms that control the hydrocarbon production rate in shale reservoirs as well as their CO₂ storage potential.
• Apply novel experimental approaches (e.g. engineered and geo-material micromodel experiments under reservoir conditions) to validate the modeling and simulation results.
• Integrate experimental and numerical simulation outcomes with an economic assessment (dynamic Life Cycle Analysis) to provide a robust foundation for commercialization of the process.

Conclusion: This research can help us to better optimize oil and gas production along with CO₂ storage in unconventional reservoirs. It also provides valuable guidance toward the design and execution of technically and economically viable field-scale operation in future. The outcome of this study can support the workforce development by
Proposal to U.S. House of Reps. Science, Space, and Technology Committee
Topic 4b: Long-term Economic Stimulus/Recovery - STEM Workforce Development

providing a new opportunity for shale producers to shift to CO₂’s fracturing capabilities and offset their cost associated with produced water disposal.

Contact: Sahar Bakhshian, Research Associate, The University of Texas at Austin
Sahar.bakhshian@beg.utexas.edu
Shayan Tavassoli, Research Associate, The University of Texas at Austin, shayan.tavassoli@beg.utexas.edu
Proposal to Science, Space, and Technology Committee
Near-Term Response and Longer-Term Economic Stimulus Package

- Topic 3: Immediately Available Research Infrastructure
- Agency target: US DOE National Energy Technology Laboratory

Title: Leveraging Hydrocarbon Infrastructure to Breakthrough Barriers to Carbon Mitigation via CCS

The COVID-19 crisis highlights the need to define and implement an independent market for CO₂ sequestration projects that does not depend on commodity pricing. We propose to define that market using skills and infrastructure already in place for the advancement of safe, long-term subsurface storage of industrial carbon dioxide (CO₂) emissions, and to reduce barriers to widespread commercialization of the nascent Carbon Capture and Storage (CCS) industry. CCS is essential to decarbonizing industries like cement, steel and refining as well as power generation. The highly favorable geology of the Louisiana and Texas Gulf Coast offers numerous opportunities to store large volumes of CO₂. A systematic evaluation of the storage opportunities in the region coupled with the economic and industrial incentives to store is the foundation in a framework to move towards the acceleration executable CCS projects in the Gulf Coast.

We propose to address these issues through the combination of a thorough technical definition of CO₂ storage reservoirs across the region and immediate testing of the critical uncertainties using available land resources. The University of Texas at Austin Bureau of Economic Geology will work with Louisiana State University to identify suitable geological strata throughout the region that may be suitable for testing to determine efficacy for safe, long-term CO₂ storage. They will define the storage capacity of these reservoirs as well as potential locations of safest accessibility. The project will design modeling of the key uncertainties and verify it with monitoring to improve information about how CO₂ occupies the subsurface and requirements to ensure safe, long-term storage. Louisiana State University will provide Louisiana-relevant policy and modeling expertise. The resulting policy relevant recommendations will be both published in the peer reviewed literature and supplied to lawmakers in Texas and Louisiana.

The project will drill a CO₂ injection well and 2 observation wells equipped with state-of-the art downhole monitoring and conduct a baseline 3-D and two 4-D seismic surveys to assess the rate and extent of CO₂ migration in the subsurface. Geoscientists, engineers, builders and rig crews will be put back to work pioneering the experiment, addressing the challenges of subsurface geologic uncertainty and clarifying requirements for initial well remediation and potential longer-term monitoring. Experience shows that this project could begin quickly by using existing leases, infrastructure and the team’s existing deep experience in CO₂ handling. The definition of suitable CO₂ storage targets combined with recommendations to prepare sites for appropriate use will be a significant push to advance anthropogenic CO₂ capture projects.

The project team expects the support from the region’s existing commercial CO₂ injection and transportation industry who are aligned with the goal of identification of suitable underground geological sites for long-term CO₂ storage.

The project will draw from the experience derived from three successful DOE-NETL CO₂ storage projects under the recently completed Regional Carbon Sequestration Partnerships (RCSP) program. These are
Cranfield, MS (SECARB, early test); Citronelle, AL (SECARB Anthropogenic test) and Bell Creek, MT (PCOR). We expect that this saline-focused project will extend the learnings from those projects to fill gaps in reliable modeling and pragmatic handling of the CO₂ plume extent in the thick and high-quality saline formations of the Gulf Coast.

GCCC brings experience in modeling and monitoring, deep expertise in geosciences and has conducted eight successful DOE-funded field projects, starting in 2004 with the first US test Frio Pilot in TX. LSU brings experience in modeling, reservoir management, and this project will build from their productive CarbonSAFE DOE-funded project which identified sources of CO₂ and potential sinks in the Louisiana Chemical Corridor.

Our study is linked to and augments and extends the learnings from other projects globally, such as the Ketzin project in Germany, the Nagaoka and Tomakomai projects in Japan, and the ongoing Sleipner and Snøhvit projects in Norway.

Project costs are in the range of $12-14 million USD, which include about $8 million USD for field work, costs of permitting, modeling, required well monitoring and high-end monitoring to validate models, publication and workshops.

Submitted by:

Gulf Coast Carbon Center, Bureau of Economic Geology, Jackson School of Geosciences, The University of Texas at Austin: Susan Hovorka: susan.hovorka@beg.utexas.edu

Center for Energy Studies, Louisiana State University: David E Dismukes <dismukes@lsu.edu>
Economic Recovery & Sustainability: Repurposing O&G Jobs & Infrastructure for Carbon Management

- **Target Agency:** USDOE, NETL, related to existing contact DE-FE-0031830
- **Contact:** Susan Hovorka, susan.hovorka@beg.utexas.edu; Peter Hennings, peter.hennings@beg.utexas.edu
- **Budget and Timeline:** $12 million for a project lasting 5 years

The combination of a depressed market for oil and depressed demand for transportation fuels because of travel limitations imposed by COVID-19 are a threat to jobs and companies directly involved in hydrocarbon production and the network of businesses that directly and indirectly support them. However, hydrocarbon production companies and workers have resources, skills and infrastructure urgently needed to reduce carbon emissions from stationary sources like power plants, refineries and chemical plants, cement plants using the well-known process of Carbon Capture and Storage (CCS). Government investment in CCS now will prepare the U.S. for sustained recovery with energy de-carbonization and climate change mitigation benefits.

The subsurface below and laterally adjacent to hydrocarbon reservoirs, known as the “water leg” of the reservoir, can be highly suitable for storage of CO₂ captured from emission sources or directly from the air. In many oil producing regions of the U.S., pipeline infrastructure already exists that can be used to increase the share of captured CO₂ shipped to selected and qualified storage locations. In this proposed project, a team composed of experts drawn from academia and industry will qualify storage sites and prepare them for injection. The sites will be within a few miles of existing CO₂ pipelines. Key issues to be addressed include:

1) Quality of reservoir on the flanks and below structures that trap hydrocarbons
2) Quality of confining system “top seal” that isolates the injected CO₂ from escape
3) Risk of induced seismicity as a result of increasing pressure from injecting CO₂
4) Competition of subsurface space between produced water and CO₂
5) Managing well penetrations to avoid losses

This project differs from past R&D and completed projects in CCS led by the US DOE in the past two decades. Here we will advance to commercial scale explicitly by leveraging oil company expertise and workforce, infrastructure, leases, and pipelines in a way that has not been possible before – to focus on storage rather than CO₂ Enhanced oil Recovery (EOR). New EOR project development, which has previously been much more profitable, is not viable during this period of low oil price. Instead, large volume storage value is obtained by use of tax credits under the newly expanded 45Q program. Tax Credits are higher for saline storage than for EOR, and payout is quicker, making this a preferred approach at this time. However, overall forward progress is slowed because 1) it is novel, and therefore carries an elevated-risk business model, and 2) low oil price and perceived future price volatility limit investment potential.

We will identify and qualify a selection of areas adjacent to reservoirs and with suitable infrastructure to advance selection, permitting, and piloting injection to store CO₂. The proposing team has deep experience with all aspects of this process and is qualified to bring the project to successful operation. The value of the project will be maintained at project end by qualifying the injected CO₂ for Tax Credits under the 45Q program.

Deploying O&G workers in the near to term to prepare and develop storage sites in areas where hydrocarbon is produced is sustainable in two ways: 1) it would preserve jobs, infrastructure, and
businesses for the future when demand for fuel increases and assure adequate domestic production, and 2) continue and increase the volume of CO$_2$ captured and injected to reduce atmospheric emissions. To be viable, the project must be linked to other funding that incentivizes capture and carbon-emissions reduction across a broad portfolio of projects.

Phase 1: Site selection and qualification: $3.6 million USD for reservoir and seal assessment, seismic risk assessment, modeling and scenario consideration.

Phase 2: Acquire injection rights, permitting, drill wells, shoot seismic, short segment pipeline construction: $8.4 Million USD

Phase 3: Injection start up. This stage becomes profitable and sustainable for CO$_2$ source and injection operator who receive revenue under 45Q.
State of Carbon Capture and Storage
Research Report for Journalists (3 months, $30,000)

- **Supplement to existing DOE NETL grant #DE-FE0031558**: Partnership for Offshore Carbon Storage Resources and Technology Development in the Gulf of Mexico (GoMCarb), Task 6
- **Contact**: Emily Moskal, Bureau of Economic Geology, University of Texas at Austin, emily.moskal@beg.utexas.edu, 281-796-9834

**Background**: In order to support the transition of oil and gas jobs to carbon capture and storage (CCS) as result of dropping oil prices, a variety of stakeholders need to be engaged to develop the energy transition workforce. A large portion of the public, policymakers, and industry partners need an introduction in order to garner support. Media have a strong influence on decision-making and information access in each arena.

**Problem**: The DOE's Regional Carbon Sequestration Partnerships initiative has spent $400 million over 14 years to conduct research on CCS. However, press coverage has been limited. In 2019, a media analysis (unpublished) by the Gulf Coast Carbon Center (GCCC), University of Texas at Austin, found that coverage of CCS peaked between 2008 and 2009, vastly dropped afterwards, and remains low today despite climate coverage peaking in March 2019, according to research by the University of Colorado. Comprehensive coverage on CCS—beyond stories on doubt of feasibility and safety—appear to begin and end a decade ago. The media have a strong influence on the public perception of science and technology and its worthiness for investment in job growth. What are the factors that limit media interest? What would make outcomes more worthy of coverage? Many insights were gained after the preliminary qualitative survey of American journalists that spanned journalist coverage areas, types of outlets, and prior knowledge of CCS. Many interviewees had many misconceptions that stopped coverage when national interest waned after 2008. As one journalist put it, “I won’t write about it until you show me something has changed.”

**Solution**: The low coverage appears to be due to an informational feedback loop of journalists referring to old news articles rather than having access to targeted media briefings on research developments. All journalists surveyed said that a report detailing the recent advances and current state of the technology would make them more likely to cover the technology. There are several accessible reports published that target broader audiences such as policy makers or the general public. But to the knowledge of GCCC researchers, there is not one targeted solely to journalists. The proposed media-targeted report will outline the state of research (with particular focus on developments since 2008) to be distributed by media briefing channels such as SciLine with concurrent pitches to science-literate outlets such as *Scientific American*. The suggested “State of CCS” report sections will include: Here's where we are: a broad overview of the state of research and progress towards commercialization; Major gaps that need to be accomplished; Where we've come: major advances and leaps in technology; Types of CO\textsubscript{2} source industries and their applications to “locked-in emissions”; How storage sites are selected; Approaches to capacity estimation; Monitoring capabilities; Key regional hubs across the U.S.; The future of offshore CCS.

**Partners**: Leverage existing collaborations with University of Texas at Austin Moody College of Communication and Stan Richards School of Advertising and Public Relations, as well as carbon capture and storage experts across the country.
Proposal to Science, Space, and Technology Committee Economic Stimulus Package
• Topic 3b: “Shovel-ready” research infrastructure
• Submitted by the Quantitative Clastics Laboratory and the Gulf Coast Carbon Center at the University of Texas at Austin. Contact: jake.covault@beg.utexas.edu.
• Suggested agency: BSEE/BOEM, DOE-FE, NSF MG&G (Geohazards), or ARPA-E.
• Total funding requested: $30M over 4 yrs.

Creation of an interdisciplinary center for deepwater geohazard assessment to sustain the economy and environment of the Gulf Coast USA

The economy of the Gulf Coast is highly dependent on the exploration and production of oil and gas. However, extracting these resources is technically challenging and potentially hazardous; miscalculations can be costly and harmful to the environment. Moreover, the COVID-19 pandemic has exacerbated an employment crisis in the energy sector. **We propose to create a new center at UT-Austin to assess drilling hazards in the Gulf of Mexico.** We aim to mitigate 1) offshore drilling hazards, and 2) economic impact of struggling companies of the Gulf Coast.

In regions of complex geology, poor understanding of drilling hazards in the shallow subsurface can lead to economically and environmentally harmful accidents. A familiar example is the 2010 Deepwater Horizon disaster. The loss of life and environmental impact devastated economic productivity of the Gulf Coast. A **systematic and expansive subsurface hazard characterization effort has the potential to identify geohazard conditions that impact well stability.** Such an effort **will require the acquisition of large, 3D geophysical datasets to image and characterize subsurface hazards**, such as active faults, irregular topography, areas prone to landslides, shallow salt, gas hydrates, and over-pressured layers of rock.

The **objective of the center will be to test new high-resolution 3D seismic-reflection technology (P-cable) at deepwater sites in federal waters of the Gulf of Mexico.** Tests of this technology can be used to inform **BSEE permit requirements** for addressing drilling hazard. Furthermore, we will develop and test **new, automated technologies, including machine learning algorithms**, for seafloor and subsurface interpretation of drilling hazards.

Acquisition of novel geophysical datasets will provide **employment opportunities** in the Gulf Coast, including vessel providers, crews, geophysical equipment vendors, and technicians. The recent downturn in the energy sector has led to layoffs that will continue for the foreseeable future. Furthermore, the center will train a **next generation of STEM scientists** in areas of US workforce shortages, including geospatial analysis, remote sensing, data analytics, and machine learning to preserve future workforce competitiveness. In the short term, the work of this center will contribute to **job creation in the Gulf Coast.** In the long term, the work will provide 1) technology tests and data for informing regulatory requirements, and 2) expansive deepwater geohazard assessments.

We are uniquely positioned to acquire and interpret these new data in deepwater. Our integrated team has decades of experience as exploration and subsurface characterization subject matter experts in major oil and gas companies, academia, and state and federal governments. Furthermore, UT-Austin houses unique P-Cable seismic acquisition technology, and the Texas Advanced Computing Center (TACC) to apply automated technologies to geohazard assessment.

**Funding: $30M over 4 years.** 3D seismic-reflection data in the Gulf of Mexico ($10M). Computing time at TACC and computational hardware ($2M). Space renovations at UT-Austin ($4M). Non-UT-Austin expenses and salaries in geophysical data testing and acquisition (~$5M). UT-Austin faculty/staff support includes: six full-time scientists (4 yrs ~$5M), two post-doctoral researchers (4 yrs ~$1M), 10 graduate students (4 yrs ~$2.5M), and one administrator (4 yrs ~$0.5M).
Re-purposing aging offshore infrastructure for the clean energy transition

**Suggested Agencies:** DOE-NETL and BSSE/BOEM

**Proposal Contact:** Timothy Meckel, Bureau of Economic Geology, The University of Texas at Austin

tip.meckel@beg.utexas.edu

**Vision:** Targeted evaluation and recommissioning of offshore Gulf of Mexico pipelines, platforms, and wells for transition from hydrocarbon extraction to carbon dioxide injection for industrial atmospheric emissions mitigation. Focus is on existing infrastructure evaluation, formal recommissioning involving design and new engineering, and new subsurface geologic data acquisition.

**Cost:** This project would require 2 years to complete with a budget of $10 million. Job retention is expected in mid-size independent offshore operators, offshore energy service providers, engineering firms, and seismic data vendors and acquisition companies.

**Background:** The Gulf of Mexico is the largest market in the world for energy infrastructure abandonment and de-commissioning. Opportunities to re-commission infrastructure can save billions of dollars in abandonment and de-commissioning costs. Many of the mid-size operators on the inner-shelf have experienced production decline for years and were marginally profitable prior to the staggering decline in oil price. Without a rapid recovery in oil and gas prices, those enterprises are likely to be facing bankruptcy in 2020 and 2021. Bankruptcy could lead to abandonment of assets, resulting in decommissioning cost burdens being transferred to state and federal agencies who cannot afford it, creating additional financial stress. Bankruptcy could also cause assets to be inaccessible in the near future due to lengthy litigation, and may become condemned and unusable at any point in the future, wasting re-use cost savings.

**Objectives:** The proposed activity will work with energy operators and service providers to evaluate and rank infrastructure asset (pipeline, platform, well) suitability for re-commissioning for CO2 transport and injection. This requires updated data on pipeline materials and status, platform condition and age, and well status and material condition. These activities will require service companies and engineering firms to inspect a subset of targeted facilities that are most promising. In addition, the carbon dioxide storage enterprise needs to determine which parts of the Gulf of Mexico are most suitable geologically for large-scale storage development. Rather than re-processing vintage (>25 years) seismic data, operators need new broadband seismic data acquisition in key re-commissioned pipeline fairways to assess optimal adjacent large-scale storage opportunities. These fairway geometries are not conventional, so existing data do not best serve the aims. This activity will keep seismic crews active, retaining key expertise needed for energy resiliency post-recession, while creating and sustaining American leadership in the transition to a global clean energy economy and addressing the nation's ability to mitigate the rapidly growing impacts of climate change.

**Partners:** The proposed activity involves 15 years of research expertise at the Gulf Coast Carbon Center (UT-Austin), including information on geologic and infrastructure resources in the Gulf of Mexico. Fairfield Geotechnologies and Seismic Exchange, Inc. have contacts with the most active operators in the gulf (all under severe economic stress currently), and can facilitate engagement for evaluating facility recommissioning opportunities. Existing contractual relationships with engineering firms such as Trimeric and Aker Solutions to work on offshore carbon storage topics can be augmented to expand evaluation of aging infrastructure and proposed engineering modification needed for re-commissioning.

**Conclusions:** This project retains crucial jobs and energy-sector expertise, but also saves money by delaying costly abandonment and decommissioning by converting assets into activities that lead to sustained future use in clean energy development (carbon capture and offshore storage).
**SST Topic 3b: Mid-scale Projects** - New National Marine Seismic Imaging Facility

**Suggested Agency:** NSF-GEO; **Proposal Contact:** Timothy Meckel, Bureau of Economic Geology, Jackson School of Geosciences, University of Texas at Austin, email: tip.meckel@beg.utexas.edu

**Vision:** World-class, national multi-user facility for seismic technology, field acquisition, and data processing center based at The University of Texas at Austin to pursue diverse energy development and broader geoscience research priorities. Focus is on facility construction, advancing technological equipment design and manufacturing, and providing broader scientific community access, emphasizing STEM workforce retention and development.

**Cost:** Phase 1 of this project would require 3 years to complete with a budget of $40 million. 

**Job retention** is expected in marine seismic technology, IT and satellite sectors, and construction.

**Background:** The scientific platform centerpiece for NSF’s National marine geophysics program, the research vessel *Marcus Langseth*, has struggled to maintain financial sustainability and programmatic viability. This has negatively impacted the research community’s ability to conduct critical marine seismic subsurface imaging activities related to diverse National and global scientific initiatives. NSF previously asked the seismic community (‘Dear Colleague Letters’) to consider alternatives for providing cost-effective imaging capabilities, while diversifying the user-base and types of scientific investigations. This proposal extends the vision originally presented in an unfunded 2019 NSF Mid-scale Research Infrastructure Proposal with multi-institutional PIs, with renewed focus on maintaining jobs and establishing resiliency in multiple manufacturing and technology sectors.

**Objectives:** The proposed Center will reduce technology access barriers and place newly-developed technology into the hands of a larger and more diverse NSF user community seeking to conduct transformative research in marine and non-marine environments. MaSIC will focus on: 1) providing state-of-the-art high-resolution multi-channel seismic (HR-MCS) infrastructure, 2) advancing the technical capabilities of HR-MCS equipment while reducing cost, 3) providing high-quality HR-MCS acquisition and HR, 2D, and 3D seismic processing capability and turn-key data services to the scientific and education community, and 3) enabling career growth for the next generation of STEM experts through educational field initiatives allowing hands-on experience in all technical aspects. Goal of financially self-sustaining.

**Methods:** The multi-institutional effort envisions an industry-grade remote operations command center (modified existing space) for involving more entry-level and mid-career scientists in data acquisition. The command center envisions industry-grade visualization and communications similar to how remote real-time drilling is undertaken, but for seismic imaging. This center will communicate in real-time with global vessel operations via stationary-orbit satellites (e.g. SpaceX’s Starlink, CubeSat). Technological advances in marine seismic data acquisition include acquisition arrays using autonomous marine vehicles (surface and underwater), allowing new acquisition arrays designed for fit-to-purpose imaging. The center also intends to provide world-class seismic processing resources integrating high-performance computational resources (e.g. TACC at UT). Utilizing an established Marine Geology and Geophysics Field Course for students, the Center will train the next generation of STEM scientists to lead future competitiveness.

**Partners:** The proposed Center involves multiple academic institutions as well as the commercial technology and manufacturing sectors. Academic and US institutional partners include: Scripps Institute of Oceanography, LDEO of Columbia University, Texas A&M University, United States Geological Survey. Industrial partners include Geometrics (seismic technology manufacturer, California), Mechdyne Corporation (IT, Indiana), and vessel operations (TDI-Brooks, Texas).
Conclusions: The timing of this proposed study is extremely important as young scientists turn away from energy research and STEM careers due to the current economic recession.