RESTORE Act Texas Centers of Excellence (COE): Program Overview

COEs: Texas OneGulf for coastal environmental monitoring, Subsea Systems Institute for safer offshore energy systems.

RESTORE THE TEXAS COAST

TEXAS ONEGULF Center Of Excellence

Subsea SYSTEMS INSTITUTE

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

April 20, 2010

Deepwater Horizon Oil Spill

The spill began with the explosion of the Macondo exploratory well off the coast of Louisiana, killing 11 workers. The resulting blowout caused the largest oil spill in American history. Oil flowed into the Gulf for almost three months before containment. The well discharged millions of barrels of oil, and cleanup of oil is still ongoing in some areas.

July 6, 2012

RESTORE Act signed into law

The Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) was signed into law by the President, establishing a trust fund for programs, projects and activities that restore and protect the environment and economy of the Gulf Coast region.

July 2, 2015

Establishment of the Centers of Excellence

BP and Gulf states announced an $18.7b settlement, $5.5b of which would be used for Clean Water Act penalties.
A portion of these funds would establish the Centers of Excellence to fund resilience science.

2015

TCEQ announces the selection of Texas OneGulf and Subsea Systems Institute as the two Centers of Excellence in Texas as part of ongoing implementation of the RESTORE Act.

Trust Fund amounts are available to establish one or more one or more **Centers of Excellence** through competitive subawards to nongovernmental entities and consortia in the Gulf Coast Region, including institutions of higher education.

Funds may be used by those Centers of Excellence for science, technology, and monitoring in one or more of the following disciplines:

- Coastal and deltaic sustainability, restoration, and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast Region
- Coastal fisheries and wildlife ecosystem research and monitoring in the Gulf Coast Region
- Offshore energy development, including research and technology to improve the sustainable and safe development of energy resources in the Gulf
- Sustainable and resilient growth, economic and commercial development in the Gulf Coast Region
- Comprehensive observation, monitoring, and mapping of the Gulf

www.RestoreTheTexasCoast.org

Contact Us!

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Kelsea.Rushton@tceq.texas.gov

RESTORE Council Representative

Greg Abbott, Governor of Texas

Alternate to the Gulf Coast Ecosystem Restoration Council (RESTORE Council) & Member of RESTORE Steering Committee

Steven Schar, TCEQ Deputy Executive Director

RESTORE Staff

Melissa Porter, Program Manager

Carla Click, Grant Specialist Treasury Work Lead

Kelsea Rushton, Centers of Excellence Grant Specialist

TCEQ RESTORE Staff

Making Energy Development Safer in the Gulf

Managing the next wave "Revitalization" of Offshore shallow and deepwater energy

Ramanan Krishnamoorti
Director, Subsea Systems Institute
Professor, University of Houston

John Allen
Advisor Offshore Energy

www.subseasystems.institute

Subsea Systems Institute (SSI)

A Texas Center of Excellence (RESTORE Act)

Overview:

A collaboration between the University of Houston, Rice University and NASA-JSC, SSI pursues applied science and engineering technology development for offshore energy development, including improving sustainable/safe development, with a focus on the Gulf.

Mission:

To positively impact safety and efficiency of offshore energy development by 1) facilitating engineering, science and policy research and through third party unbiased validation of technology and practices and 2) increasing skill sets across the workforce aligned with the development and deployment of new technologies.

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Marie Contou-Carrere
Research Advisor for Industry Partners

Interim Executive Director, Carbon Hub Management Team

Kamlesh Lulla
Director, University Collaboration and Partnership, NASA-JSC

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Scope of SSI Activities

SSI Research Grants are designed to develop innovative research that can positively impact safe and reliable exploration and energy production from the Gulf.

Successful applications lead to technology advancement consistent with the mission objectives of the SSI.

1. Automation & Robotics
2. Asset – Integrity Monitoring
3. Power – Management
4. Energy Transition in the Gulf

$28 MM
in Research Funds Received

50
Faculty Members in SSI

20
Companies Participate

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SSI - Advisory Board Members

Tom Feutrill

Anish Simon

Nikunj Patel

Donald Craig

Dave Burns

Pat Toomey

Sudhir Pai

Brian Skeels

Diana Grauer

Jared Ciferno

Cheng Tai

Paul Hughes

Holger Stibbe

Aaron Culver

Francesco Tripodi

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Research Projects (2022 - 2024)

1. Offshore Robotics and Automation/AI for Safer Offshore Energy Systems
   A. Robotic Fish Enabled Sensing and Inspection
   B. Autonomous underwater vehicle navigation through steel scaffolding
   C. Integrity Monitoring subsea connections using percussion and machine learning
2. Offshore Asset Integrity Monitoring: Environmental Monitoring
   A. Development of self-powered distributed sensors/reporters for integrated offshore asset and local environment monitoring
   B. Practical implementation of organic electrochemical transistors (OECTs) for subsea chemical /hydrocarbon detection
3. Design and Development of Offshore Power Systems-efficiency safety integration of multiple energy sources and storage
   A. Multi-port Energy Router using Intelligent Transformers (MERIT): Energy Management and Supervisory Control
   B. Optimal Sizing of Onsite Generation Resources for Self-Sustainable Offshore Loads

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Projects (2022 - 2025) Part 2

Research Activities (Continued):

4. Offshore Energy Transition: Repurposing Gulf of America (Mexico) Assets

Focus on utilizing/leveraging depleting reservoir assets
as storage for CCUS (Carbon CO_2 Capture and Use) and H2
and economically leveraging existing infrastructure ('pipes and platforms')

A. Characterization of deep-water Gulf salt domes and proximal sediments for storage of hydrogen and sequestration of CO2
B. Developing methods of producing and processing marine algae to biocrude
C. Extending the life of offshore oil and gas infrastructure in the Gulf for profitable new uses in power and hydrogen generation in support of existing and preparation for energy transition.

Utilizing existing infrastructure to Store Hydrogen from Local/Renewable Power for Load-balancing and Carbon Elimination-Showcase

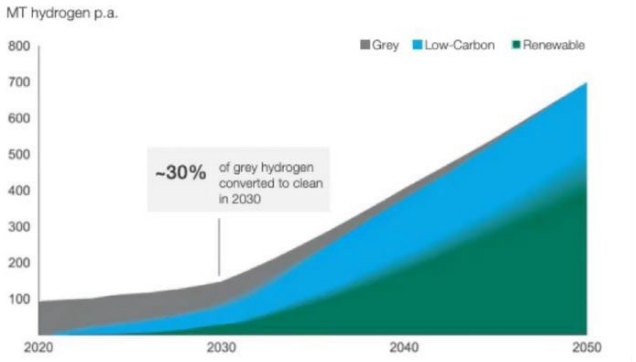
Multiple studies predicting key role for hydrogen in low-CI energy mix – 6 to 8 x increase in demand by 2050

Demand drivers: process industry fuel switching, power gen, long haul mobility

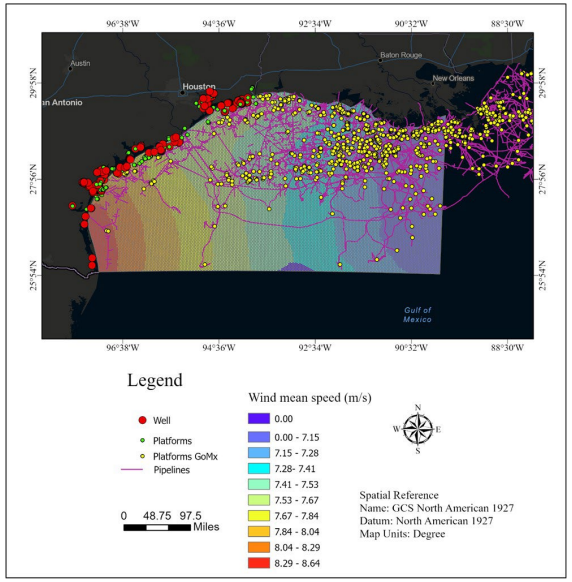
~2000 platforms and >10,000 miles of pipelines potentially available for repurposing when they reach the end of their oil & gas life

Wind speeds in the Gulf, sufficient to anchor wind energy projects

Many challenges: structural integrity, remaining life, regulatory requirements, cost of repurposing, low wind speeds in the Gulf etc.



Source: Hydrogen Council 2021



Mean Wind Speed (m/s)

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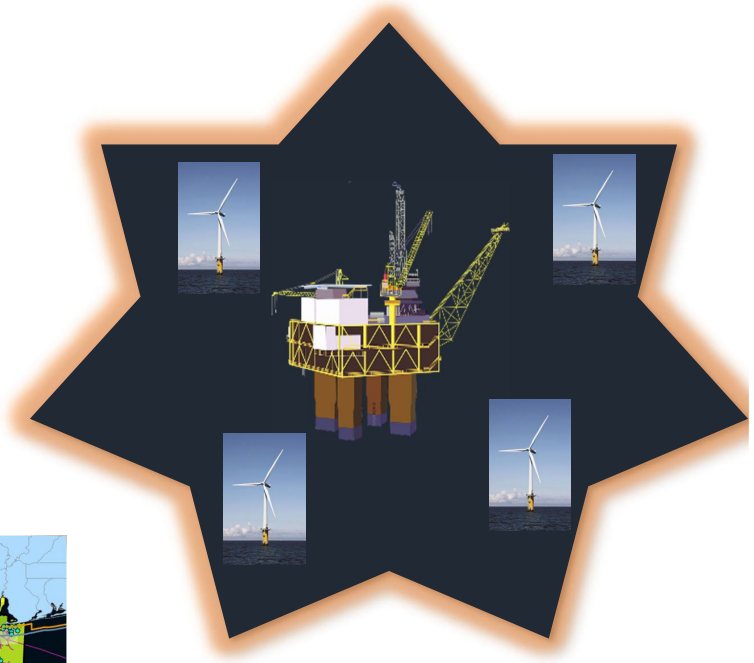
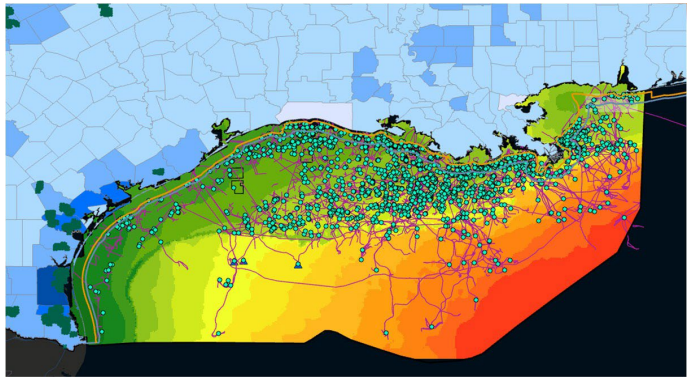
SHOWPLACE/ROICE : Techno-Economic Feasibility Studies

SHOWPLACE & ROICE developed engineering and economic models to evaluate the potential for Repurposing Offshore Infrastructure for Cleaner Energy (ROICE) projects in the Gulf of America

- Multiple clean energy projects and use cases evaluated, such as
- Power Project Case:
  - Install floating wind turbines with existing platforms as hub
  - Transport power to onshore electric grid
- Hydrogen Project Case:
  - Utilize wind power to generate freshwater via desalination
  - Generate hydrogen from freshwater via electrolysis
  - Transport hydrogen to shore using existing pipelines
- In consultation with 30-company Advisory Board





Results: “Heat Map” of Levelized Cost for a Hydrogen Project

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Optimizing Offshore Energy Generation Resources for efficiency/Environmental Impact

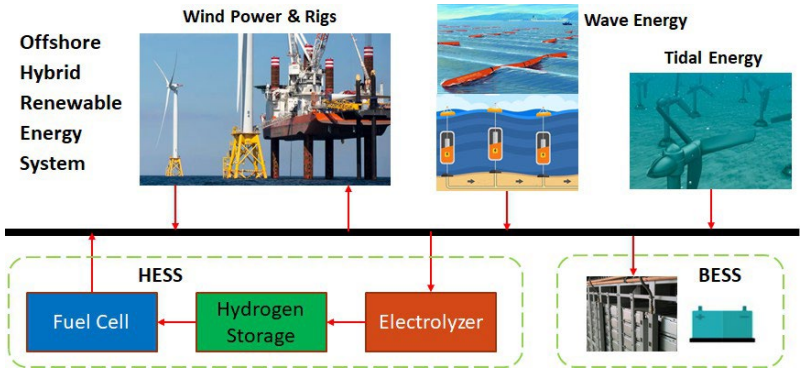
Most existing power systems for offshore rig platforms rely on diesel and gas generators

- Offshore rigs consume ~16 TWh energy a year to power their operations
- Substantial GHG emissions

Create a hybrid power energy system, using

- Renewables: offshore wind power, tidal power and wave power and others
- Energy Storage: battery and hydrogen storage

Goal: Design a local sustainable power system to ensure continuous power supply to offshore loads in an economic and reliable manner



- Modeling and parametrization of offshore renewable resources.
- Modeling and parametrization of energy storage resources.
- Battery (Li-ion) degradation modeling.

- Long-term planning for OHRES (investment decision-making step)
  - Formulate it as an optimization model.
  - Develop advanced algorithms to solve this planning problem.
  - Obtain the optimal size of each candidate energy resource.

- Evaluation and Validation
  - Power flow and stability analysis of the designed system.

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Developing Bio-inspired Buoyancy Control for Subsea Service AUVs

Project Goals:

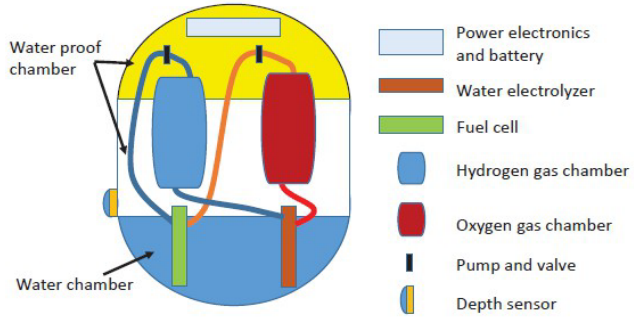
Develop an efficient buoyancy control for subsea service robots to achieve neutral buoyancy state when delivering tools and moving loads and for long endurance activities (autonomous operation)

Approach:

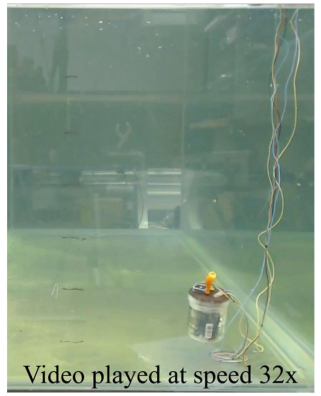
Using IPMC water electrolyzer and fuel cell to transform water to gas (reversibly) thus changing the buoyancy of the AUVs. Developing a nonlinear control of simultaneous hard and soft actuation to achieve fine buoyancy and depth control.

Anticipated Impact:

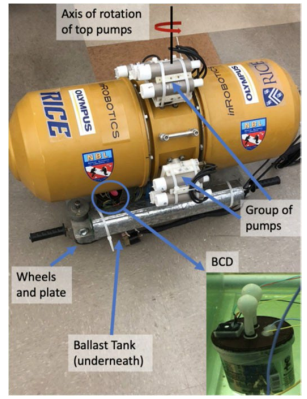
Service robot with efficient buoyancy control will enable AUVs to deliver tools move object and perform long term/residency operations to support subsea infrastructures.



Buoyancy control device (BCD) enabled by IPMC and fuel cell



Preliminary results: depth control using BCD enabled by reversible fuel cells



System integration: AUV with BCD for automatic buoyancy and depth control

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Mechanical Engineering
Dept. University of Houston

Fathi Ghorbel
Professor
Mechanical Engineering
Dept. Rice University

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Robotic Fish Enabled Subsea Inspection

Project Focus:

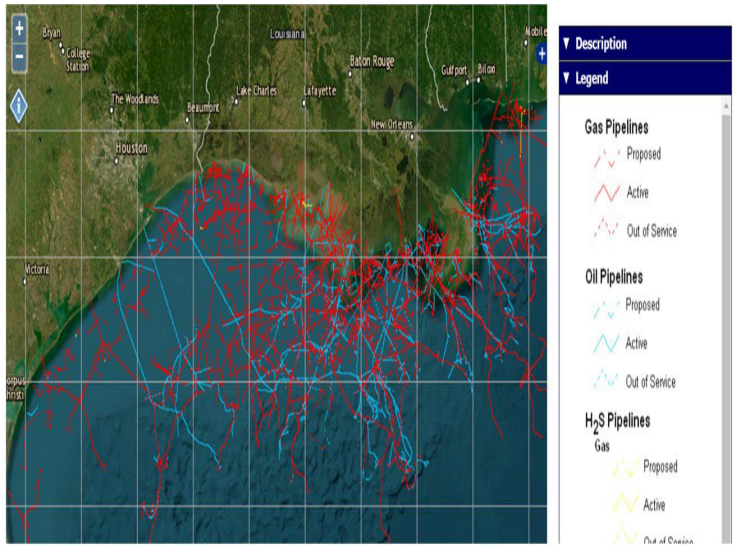
- Developing robot ('fish') and swarms for subsea inspection (leveraging miniaturization)
- Bio inspired Electromagnetic viewing/swarm synchronization and Buoyancy
  - ML for infrastructure/pipeline detection and integrity
  - Edge computing for limited bandwidth transmission.

Need/Significance:

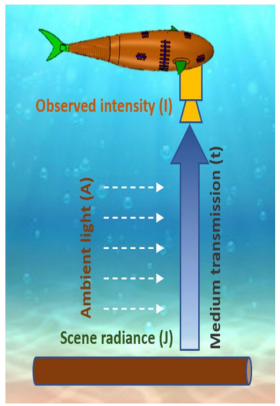
- Subsea and connected environments especial during/after storms need timely and cost-effective inspections.
- UAVs autonomously detect the underwater integrity including ruptures of pipeline, interpret results through unsupervised ML and edge computing, and communicate with a nearby station through underwater EM communication
- Anomalies due to major storms seismic activity, offshore drilling, turbulence, and ship anchoring may be detected at early stages allowing operators to make informed decisions on damage mitigation.

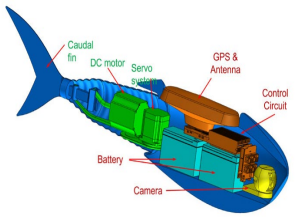
Relevance to SSI Mission:

- Mitigate potential for environmental impact from infrastructure integrity compromise



Pipeline damage caused 25,000 gallons oil spill in O.C. in 2021.





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SPIN FORWARD INITIATIVES

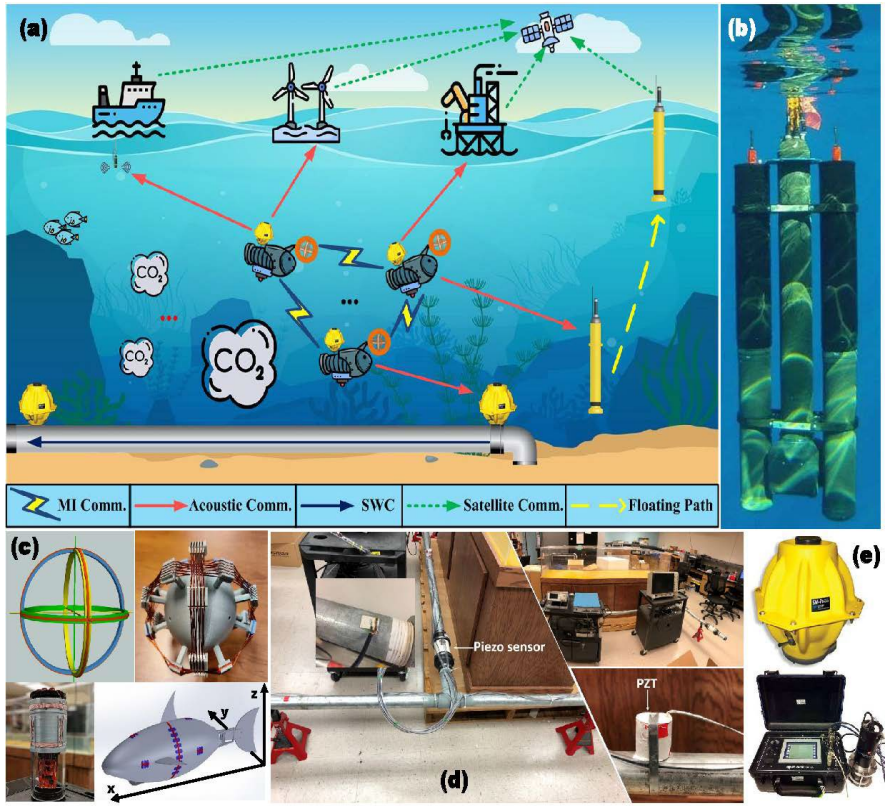
Further developing the broad initiatives focusing on

- Asset integrity, Robotics, Power and Alternate offshore energies
- Underwater Swarm Center

Extending the robot fish development to a national swarm initiative. Creating a center for Offshore and Underwater integrity surveillance. This extends to post catastrophe capability including flooded land/coastal areas, flood drainage infrastructure and overflows into (and then including) the ocean.

Intercalibration Initiatives

- Working Closely with One Gulf and the other Gulf States to create initiatives greater than the sum of the parts
- Collaboration with Industry on focus areas to capitalize and leverage impact of the program (BSEE Integrity program)



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Questions?

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ONEGULF
Center Of Excellence

Texas OneGulf Center of Excellence

SCIENCE DRIVING SOLUTIONS TO GULF PROBLEMS

PAUL MONTAGNA & JULIE CANTWELL
HARTE RESEARCH INSTITUTE
TEXAS A&M UNIVERSITY-CORPUS CHRISTI

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Centers of Excellence

May Focus on One or More of Five Disciplines

- Coastal and deltaic sustainability, restoration and protection
- Sustainable and resilient growth. Economic and commercial development
- Coastal fisheries, and wildlife ecosystem research and monitoring
- Observation, monitoring and mapping of Gulf of America (Mexico)
- Offshore energy development…improving sustainability and safe development

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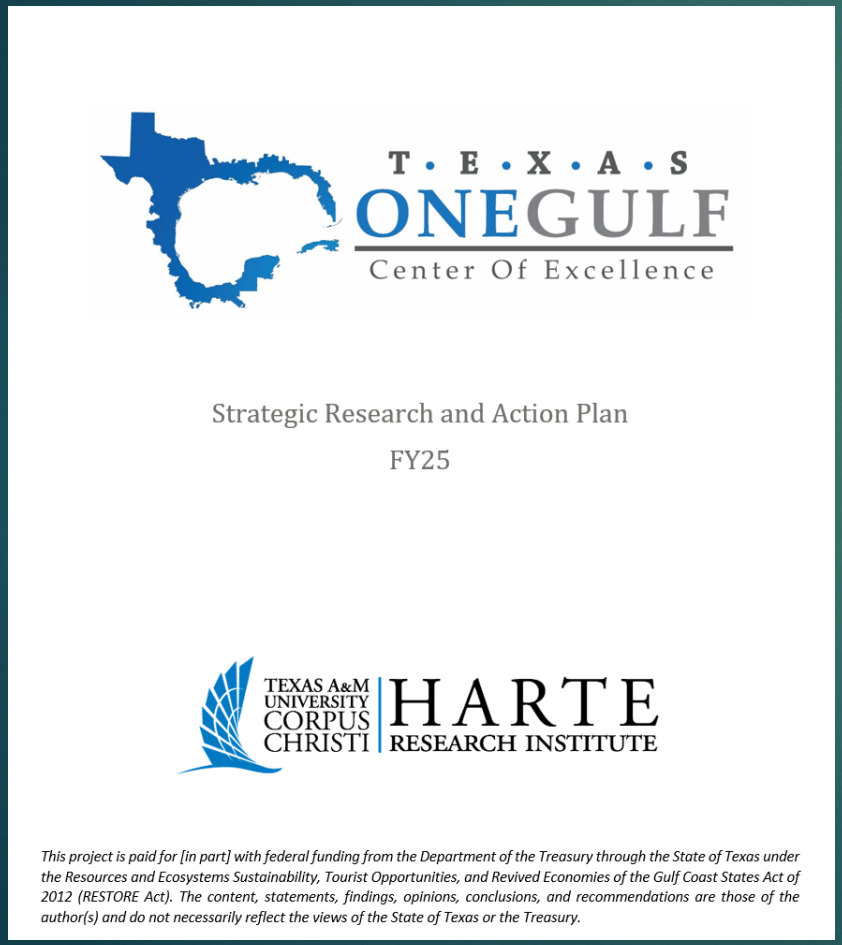
Strategic Research & Action Plan



Strategic Goal 1: Improve understanding of the Gulf as a large marine ecosystem

- Habitats, Living Marine Resources, Environmental Flows, Estuarine and Coastal Environments, Offshore and Deep Gulf, Socio-Ecological Systems, Pressures and Stressors

Strategic Goal 2: Improve understanding of the connections between environmental and human health to benefit both

- Human and Environmental Health, Environmental Stressors and Individual Health, Environmental Stressors and Public Health, Mental Health, Community Resilience

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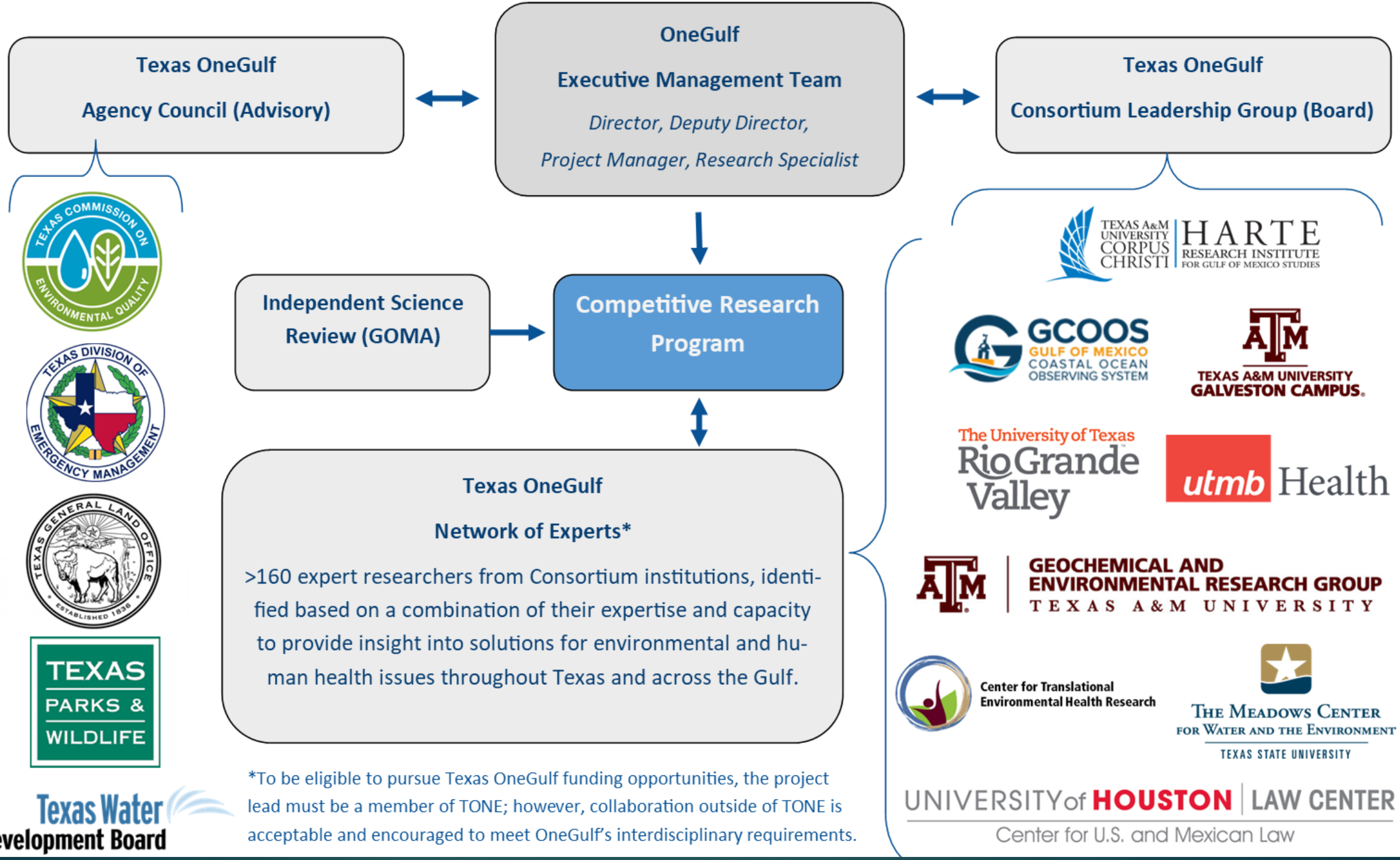
Strategic Research & Action Plan

- Purpose: Texas OneGulf recognizes that humans are part of the environment and that a healthy environment, a healthy economy, and healthy citizens define a Gulf that Texas wants now and for the future
- Mission: To gather and improve knowledge about the Gulf to inform decision making around the challenges of environmental and economic sustainability of the Gulf and its impact on the health and well-being of Texans and the nation
- Science Driven Solutions: A consortium that facilitates and encourages research programs supporting the best science available from Texas institutions to focus on Gulf issues, integrating multidisciplinary strengths
- Outcome: Restoration and maintenance of Gulf health for the humans and organisms that inhabit its shore and waters, and providing a platform for development of informed policy to assist the state, region, and nation in making critical decisions related to the Gulf

Texas OneGulf Consortium

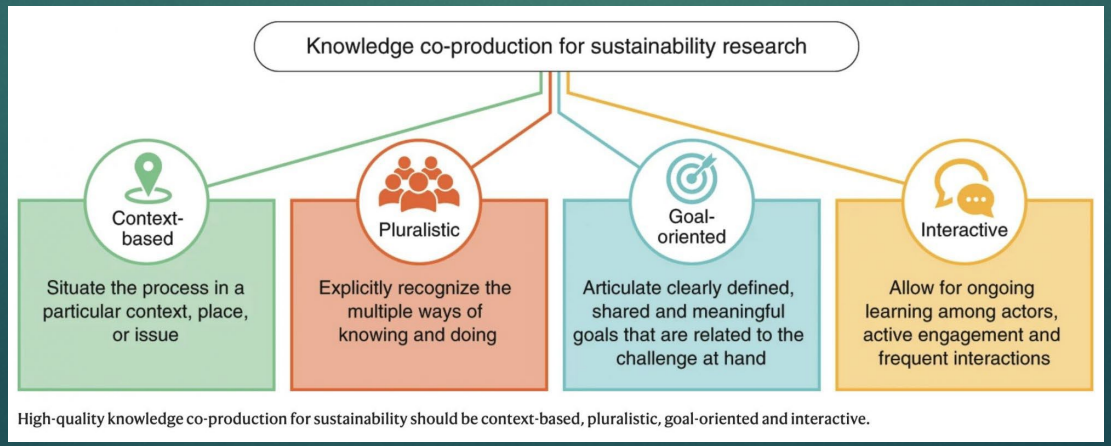
Nine Institutions

OneGulf is a partnership of nine institutions, who serve as our Consortium Leadership group, dedicated to the long-term environmental and economic health of the state of Texas and the Gulf


Texas OneGulf
Agency Council (Advisory)
OneGulf
Executive Management Team
Director, Deputy Director,
Project Manager, Research Specialist
Texas OneGulf
Consortium Leadership Group (Board)
Independent Science Review (GOMA)
Competitive Research Program
Texas OneGulf
Network of Experts*
>160 expert researchers from Consortium institutions, identified based on a combination of their expertise and capacity to provide insight into solutions for environmental and human health issues throughout Texas and across the Gulf.
*To be eligible to pursue Texas OneGulf funding opportunities, the project lead must be a member of TONE; however, collaboration outside of TONE is acceptable and encouraged to meet OneGulf's interdisciplinary requirements.
Texas Commission on Environmental Quality
Texas Division of Emergency Management
Texas General Land Office
Texas Parks & Wildlife
Texas Water Development Board
Texas A&M University Corpus Christi
HARTE Research Institute for Gulf of Mexico Studies
GCOOS Gulf of Mexico Coastal Ocean Observing System
Texas A&M University Galveston Campus
The University of Texas Rio Grande Valley
utmb Health
Geochemical and Environmental Research Group
Texas A&M University
Center for Translational Environmental Health Research
The Meadows Center for Water and the Environment
Texas State University
University of Houston Law Center
Center for U.S. and Mexican Law

Actionable Science

- Research produced with needs of a specific end-user in mind
  - Provides input that meets the needs of decision-makers
  - Decision-relevant outputs and products
- Co-Produced science is collaboration
  - Involves end-users in the planning and implementation phases of research
  - Brings in different perspectives
  - Creates buy-in of decision-makers, thus they're more likely to be useful and used
    - More likely to produce outcomes



High-quality knowledge co-production for sustainability should be context-based, pluralistic, goal-oriented and interactive.

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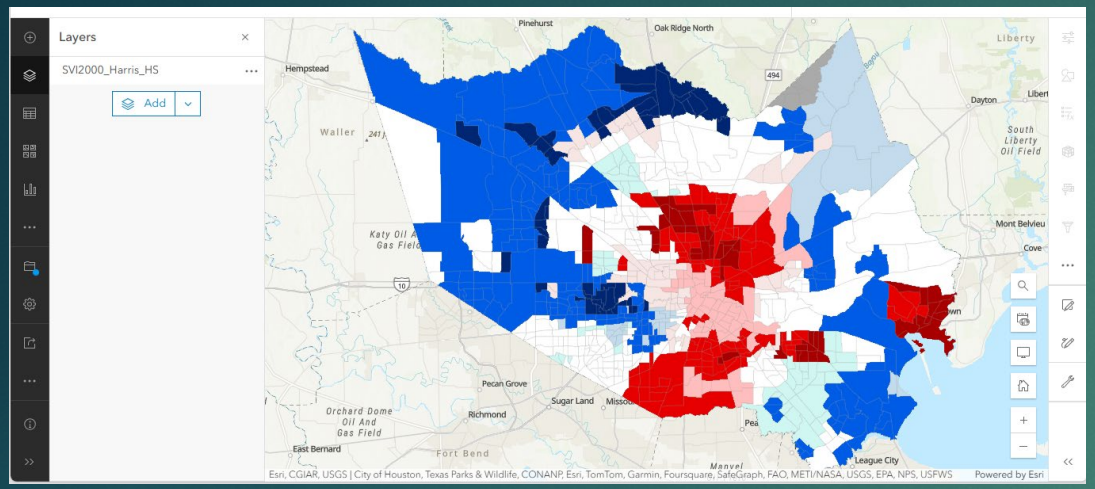
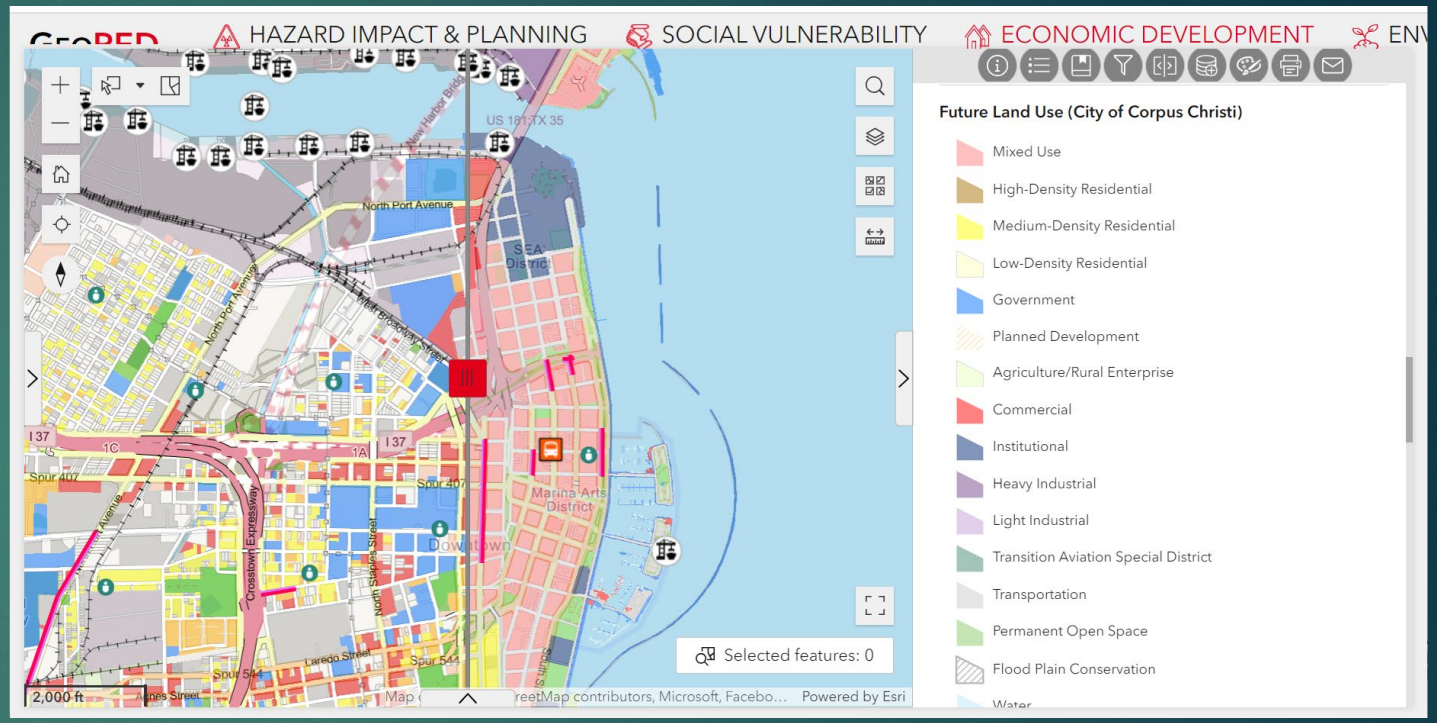
Some Current Projects



Evaluating the Fiscal and Social Implications of Property Buyouts in Flood-prone Communities

Observational Study of Ship Channel and Shallow Bay Interactions and their Influence on Sediment Transport, Mixing, and Water Quality in Corpus Christi Bay



Geospatial Resilient Economic Development (GeoRED): Tools & Data for Hazard, Economic, & Natural Resource Planning

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Projects to Date

Year	Projects	Amount
2015	12	$2,094,648
2016	8	$3,267,861
2020	7	$2,794,562
2025	*	$2,257,033
Total	27 +	$10,414,104

*Current funding competition

Contact TX OneGulf Management Team:

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- Julie.ParishCantwell@tamucc.edu, Program Manager

Thank you!

Questions?

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