

SRS-RN: Track 2: Reimagining the Chemical Heartland:

Closing the loop on the oil-plastics-recycling nexus to forge a resilient circular economy

Vision: to address the unique challenges faced by the “chemical heartland” and reimagine how the massive petrochemical infrastructure can be redeployed to foster a resilient, sustainable, and circular economy, as we progress through the energy transition



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DMR-2212962

December 1, 2021 to
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(NCE to November 30, 2023)

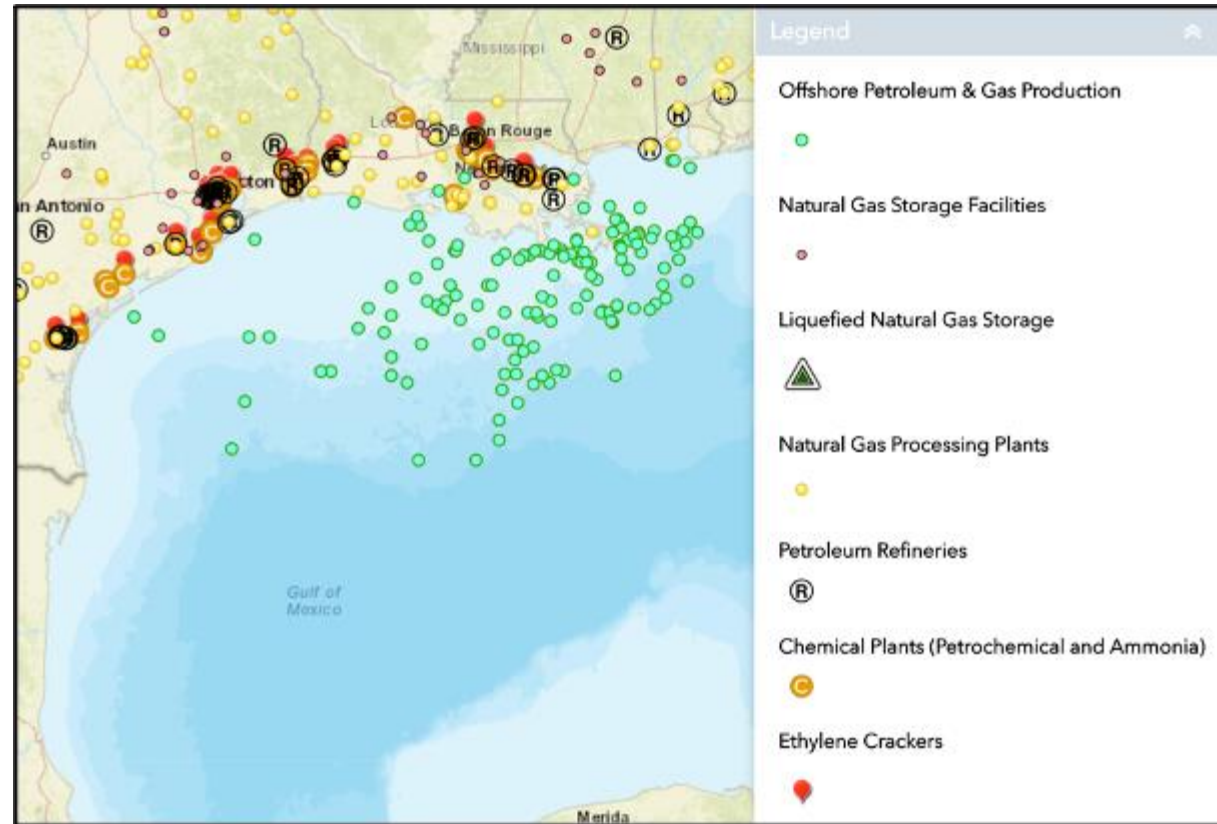
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Co-PIs: *Sarbajit Banerjee (TAMU Chemistry); Bjorn Birgisson (UGA Environmental, Civil, Agricultural and Mechanical Engineering); Michael de Miranda (TAMU Education and Human Development); Arnold Vedlitz (TAMU Bush School of Government and Public Service)*

Senior Personnel: *Ankur Dayal (TAMU Innovation Partners); Mark Holtzapple (TAMU Chemical Engineering); Benjamin Kalscheur (TAMU Office of Sustainability); Sivaranjani Kumarsrinivasan (TAMU Chemistry); Kayla Rollins (TAMU Education and Human Development); Chavis Stackhouse (TAMU Chemistry); Jacqueline Stillisano (TAMU Education and Human Development); Jeffery Tomberlin (TAMU Entomology)*

Gulf of Mexico U.S. Oil & Gas Resources:

- Technical and financial center of the U.S.
- Concentration of company headquarters
- 20% total U.S. crude oil production
- 45% U.S. petroleum refining capacity
- 51% U.S. natural gas processing plant capacity
- >50% U.S. downstream chemical production
- >50 major chemical plants



Fractracker Alliance, "National Energy and Petrochemical Map."

<https://www.whistleblowers.org/oil-and-gas-industry-in-the-gulf-of-mexico-and-the-u-s-gulf-coast/> (accessed June 8, 2023)

Complex Challenges Motivating Need for a Sustainable Regional Systems – Land, Sea, Space – Research Network

GULF-COAST REGIONS – TAMU is one of 17 LAND-, SEA- & SPACE-grant institutions



LAND

- Fossil fuel pumpjack
- Tractor in a field

ENERGY

- FOSSIL FUEL ↓
- RENEWABLE ↑

SPACE

• ?? CHEMICALS/PHARMACEUTICALS/PLASTICS

OTHER RESOURCES

SEA

- Solar panels
- Wind turbine
- Insect
- Shellfish
- Offshore oil rig
- Aquaculture net

WATER (“THE NEW OIL”)

- FRESH
- SALINE
- PRODUCED
- SEWER/WASTE

AGRICULTURE

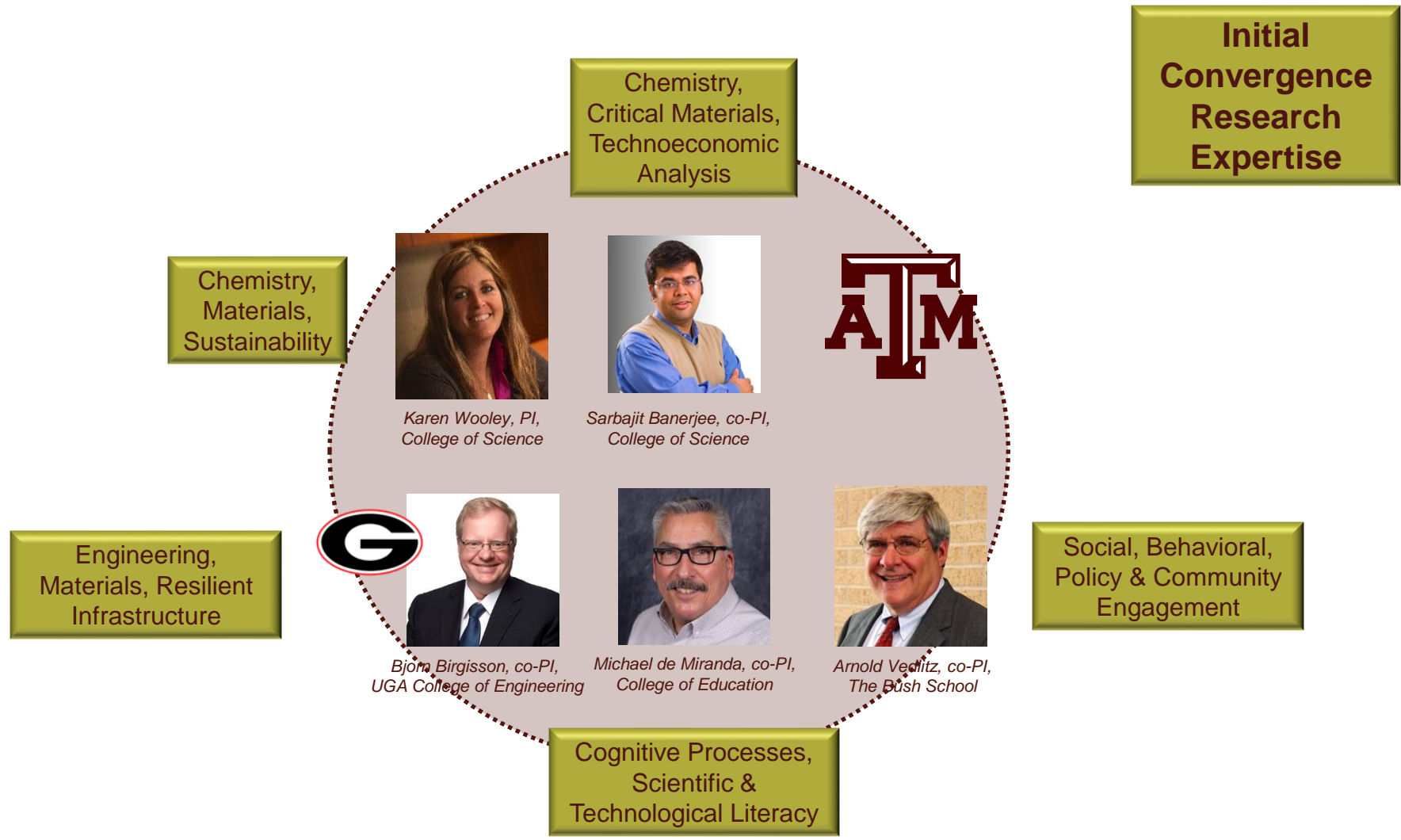
- LAND AND MARINE
- TRADITIONAL CROPS & LIVESTOCK
- EMERGING RESOURCES
- BIOMASS TO CHEMICALS & BIOPLASTICS

GENERATION STORAGE DISTRIBUTION CAPTURE/COLLECTION REUSE/RECYCLING

<https://www.nasa.gov/press-release/nasa-targets-coastal-ecosystems-with-new-space-sensor>

Images from canstockphoto.com, cosmeticsdesign.com, dreamstime.com, etsy.com, forbes.com, nasa.gov, oregon.gov, wayfair.com

Omnivergent Growth & Development of RESURGE Team, Research Targets & Network



Omnivergent Growth & Development of RESURGE Team, Research Targets & Network

Materials Chemistry Research, Teaching, Mentoring & Outreach for Training a Diverse Next-generation Workforce



Ami Patel, Graduate Research Assistant, College of Science



Karen Wooley, PI, College of Science



Chavis Stackhouse, Postdoctoral Research Associate, College of Science



Sarbajit Banerjee, co-PI, College of Science



Heish Waxman



Jacqueline Stillisano Education Research Center



Sivaranjani Kumarsrinivasan, Program Coordinator, College of Science



Kayla Rollins Education Research Center

Teaching, Learning, Culture – Informative and Evaluative Stakeholder Engagements



Kim Wright

Program Intensification, Oversight and Coordination



Bjorn Birgisson, co-PI, UGA College of Engineering



Arnold Vedlitz, co-PI, The Bush School



Michael de Miranda, co-PI, College of Education

Troy Medeiros, Sustainability Intern, The Bush School

Expanded Convergence Research Expertise



Omnivergent Growth & Development of RESURGE Team, Research Targets & Network

Team-building Workshop, March 2022

Agriculture, Entomology & Insect Farming as Innovative Feed & Food Technologies

Sustainability & Innovation

Biomass, Waste Management & Upcycling to High Value Chemicals, Fuels & Nutraceuticals

Further Expanded Convergence Research Expertise



Jeff Tomberlin
College of Agriculture & Life Sciences



Karen Wooley, PI,
College of Science



Chavis Stackhouse,
Postdoctoral Research Associate, College of Science



Sarbajit Banerjee, co-PI,
College of Science



Ben Kalscheur
Asst. Manager, Office of Sustainability



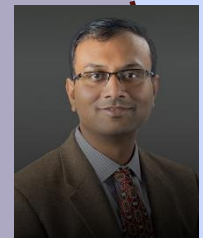
Jacqueline Stillisano
Education Research Center



Sivaranjani Kumarsrinivasan,
Program Coordinator, College of Science



Kayla Rollins
Education Research Center



Ankur Dayal
TAMU Innovation



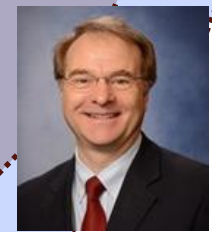
Ami Patel, Graduate Research Assistant, College of Science



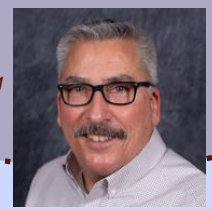
Bjorn Birgisson, co-PI,
UGA College of Engineering



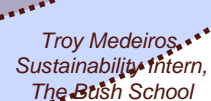
Arnold Vedlitz, co-PI,
The Bush School



Mark Holtzapfle
College of Engineering



Michael de Miranda, co-PI,
College of Education



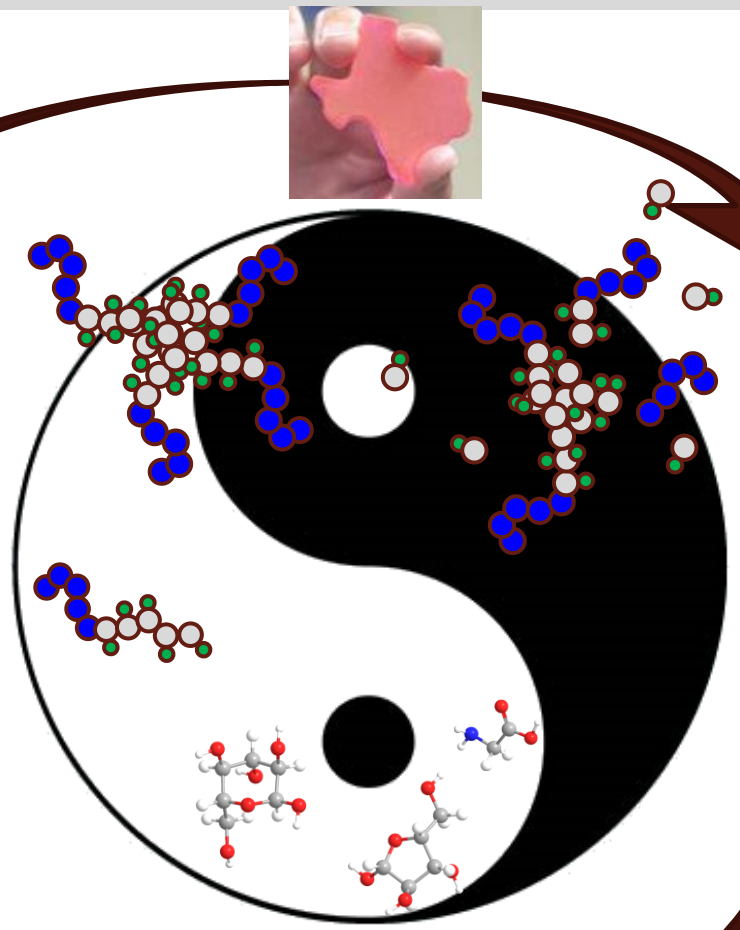
Troy Medeiros,
Sustainability Intern,
The Bush School

- **Research Pillar 1:** Harvest critical metals during coincident water purification/desalination at pipeline and offshore infrastructure
 - Potential circular economy components vital to clean hydrogen transportation
 - Loci for wind farms, solar energy harvesting, solar desalination.
- **Research Pillar 2:** Harness biological systems for circular chemical feedstocks, bioplastics production and plastic recycling
 - Increase the sustainability of and develop a circular economy regarding recycling plastic materials
 - Reduce the petroleum-based feedstock dependence of the chemical industry.
- **Research Pillar 3:** Capitalize upon fundamental materials science to further the preparation of next-generation sustainable, adaptable, dynamically-reconfigurable infrastructure materials
 - Imbue resilience against environmental events
 - to monitor water quality throughout the region
 - Develop methods of harvesting, cleaning, and transporting water at high rates.

One Example Project: Research Pillar 2: Insect-harvested Regenerative Plastics for Circular Economy (I-RePlaCE)

Naturally-sourced, Next-generation Plastics that Address Plastics Hazards & are Capable of Degradation-induced Metamorphological Phase Complexities

- Polysaccharides
- Proteins
- Lipids/Fatty acids
- Cholesterol, Vitamins, Other Small Molecules



Full Circularity

Insect-harvested Building Blocks Generated from Insect-recycled Polymers



Dual Support and Events to Accomplish a Major Thematic Stakeholder Workshop, October 2022

**Hagler Institute for Advanced Study (HIAS) Symposium
October 13, 2022**

**“Aspirations & Opportunities for a
Sustainable High-Tech Future”**

**RESURGE Stakeholder Workshop
October 14, 2022**

**"Reimagining the Chemical Heartland with Omnivergent
Land, Sea and Space Innovations"**



Omnivergent Growth & Development of RESURGE

Team, Research Targets & Network

Thematic Stakeholder Workshop, October 2022



Andrea Ashley Oyewole
PVAMU



Jeremy Bartsels
ChampionX



Karen Wooley, PI,
College of Science



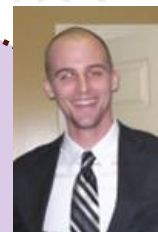
Chavis Stackhouse,
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Associate, College of Science



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Ben Kalscheur
Asst. Manager, Office
of Sustainability



Rob Keiser
Orsted Onshore N.A.



Samantha Kristufek
Texas Tech.



Kevin Bowcutt
Boeing



Tim Bremner
Advanced Sealing
Technologies



Jeff Tomberlin
College of Agriculture
& Life Sciences



Jacqueline Stillisano
Education Research
Center



Sivaranjani
Kumarsrinivasan,
Program
Coordinator,
College of
Science



Kayla Rollins
Education Research
Center



Ankur Daya
TAMU Innovation



Carl McAfee
Prochemist



Kirt McGhee
Pura Vida
Bioplastics



David Germack
Kraton



Marco Giles
PVAMU



Ami Patel, Graduate
Research Assistant, College
of Science



Bjorn Birgisson, co-PI,
UGA College of Engineering



Arnold Vedlitz, co-PI,
The Bush School



Mark Holtzapfel
College of Engineering



Neil Mendes
Alpine Polytech.



Lora Urbaniak
Sustainable Solutions



Brett Giroir
Alteza Biosciences



Michael de Miranda, co-PI,
College of Education



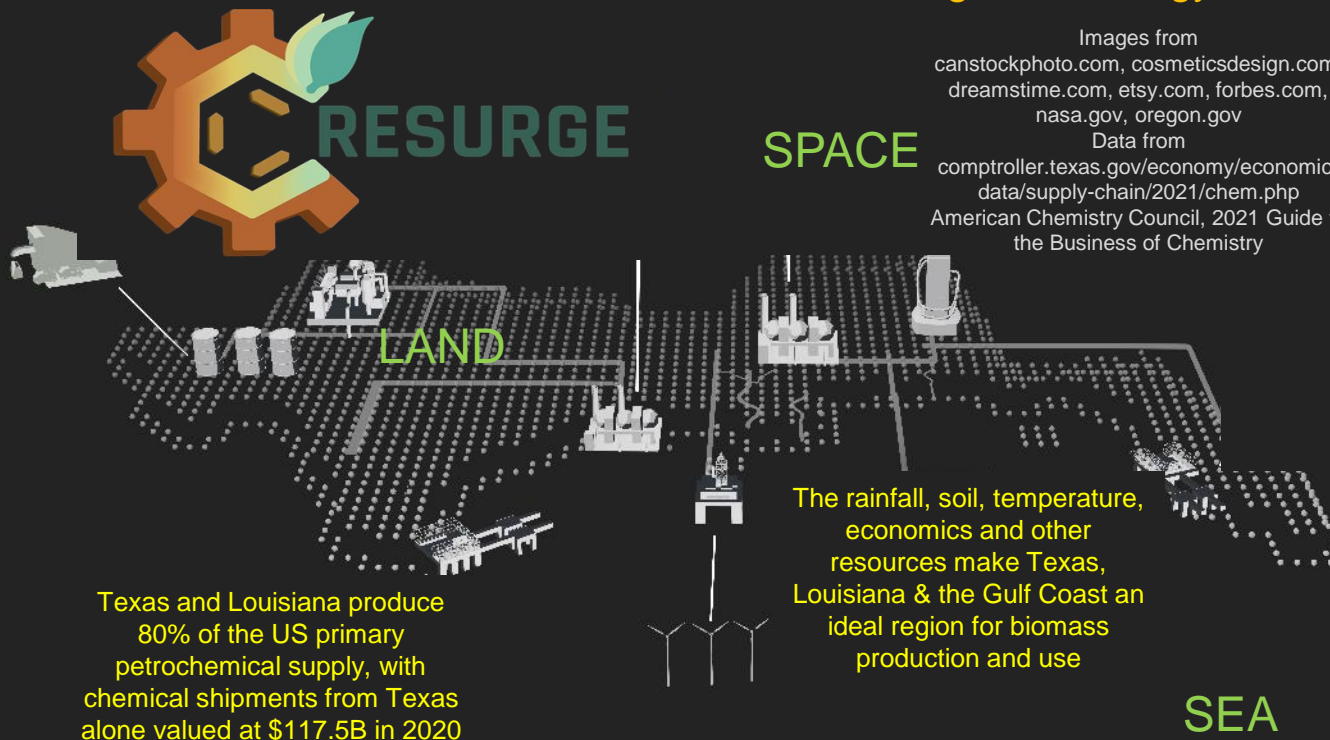
Troy Medeiros,
Sustainability Intern,
The Bush School

**Expanded
Convergence
Network
Academia + Industry**

**Priorities to Expand
Government & Community
Engagements**

Overview of SRS-RN: REsilient SUstainable Roadmap for Gulf-coast Economies (**RESURGE**)

RESURGE: Reimagining the chemical heartland with omnivergent land-, sea- and space-infrastructure innovations for a sustainable high-technology future



RESURGE focuses on fundamental research and development, translation of innovations to practice, education and workforce development within an inclusive innovation ecosystem that aims to harness Gulf Coast regional strengths to address critical challenges sustaining, strengthening, diversifying & growing beyond the current petrochemically-centered chemical manufacturing supply chain