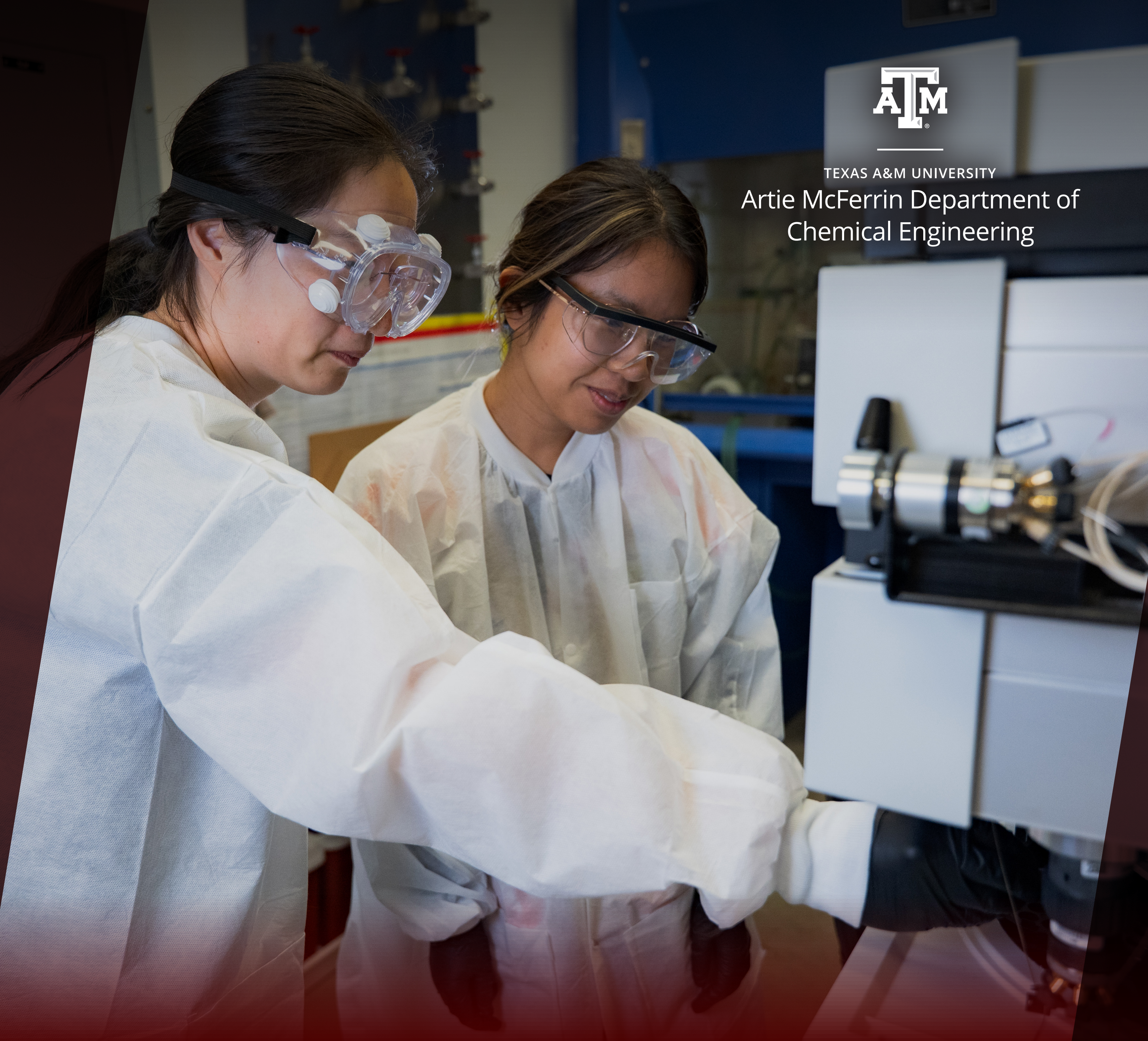

TEXAS A&M UNIVERSITY
Artie McFerrin Department of
Chemical Engineering

FALL 2025

CHEMICAL *ENGINEERING*

National Academy of Sciences, Engineering and Medicine Report Seeks to Combat Atmospheric Methane Emissions on **page 7**

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Howdy from the Artie McFerrin Department of Chemical Engineering!

I have completed my first year as the head of Artie McFerrin Department of Chemical Engineering. It has been a stimulating year of joy, learning, and serving our students, colleagues, and community. I could not be in a better place; I am humbled by the opportunity to serve and the rewarding experience and feedback from our stakeholders, and most importantly, our former students, generous donors and community members. This department continues to demonstrate exceptional resilience in the face of challenges and transformation, while seizing opportunities.

First, I would like to acknowledge our Aggies and their families, who continue to support this department in every possible way. As always, true to the Aggie spirit of selfless service, they remain deeply committed to their alma mater. I am sincerely grateful to our alumni for their ongoing assistance and support and to the Industry Advisory Council for providing valuable guidance to ensure we remain on track in serving our students and the community. The department fosters a vibrant and aspirational ecosystem of learning and innovation, where our exceptional colleagues consistently outperform even in the most challenging situations.

This year, we exceeded $35 million in research expenditures. Our faculty continues to secure major research awards, fueling groundbreaking discoveries. Our department continues to gain major research grants to support our research, including Dr. Puskar Lele, Dr. Hung-Jen Wu, Dr. Jeetain Mittal, Dr. Greg Reeves, Dr. Abdul Djire and Dr. Manish Shetty. Additional colleagues have been successfully securing multiple research grants from the National Institutes of Health, the National Science Foundation, the US Environmental Protection Agency, the Department of Transportation, and the American Chemical Society.

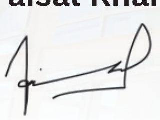
Our students continue to make us proud with their outstanding achievements and national and international recognition. Coby Scrudder, an undergraduate researcher focused on structural batteries, received the 2025 Goldwater Scholarship, a top national award for STEM undergraduates. Zahra Ghiasi won the 2024 Texas A&M Three Minute Thesis (3MT®) Competition with her compelling vaccine research. Graduate students Fatima Mahnaz and Ashfaq Iftakher were selected for the 2025 Global Young Scientist Summit in Singapore.

Our collaboration has remained strong, with major partnerships in frontier areas, including the exploration of the safety of newer marine fuels in collaboration with the American Bureau of Shipping, novel materials and processing with Samsung, scenario generation, and safety training through Generative Artificial Intelligence with EnerSys.

While we had significant success in individual and collaborative grants, we continue to lead multi-year consortium programs, such as the Ocean Energy Safety Institute, supported by the Department of Energy, Department of Interior, and the Electrified Processes for Industry without Carbon Institute, supported by the Department of Energy as part of the Manufacturing USA initiative, co-led by Drs. Mark Barteau and Efstratios Pistikopoulos.

These multifaceted achievements reflect the culture of excellence and innovation that defines the Artie McFerrin Department of Chemical Engineering. They are made possible by the enduring support of our alumni, friends, and industrial partners. Thank you for being an essential part of our journey.

Faisal Khan



Professor, Chemical Engineering

Mike O'Connor Chair II

Director, MKO Process Safety Center

Director, Ocean Energy Safety Institute

Affiliated Faculty, Industrial & Systems Engineering, Multidisciplinary Engineering, Ocean Engineering and Petroleum Engineering

FACT SHEET

RANKINGS *(U.S. NEWS & WORLD REPORT, PUBLIC)*

#12
UNDERGRADUATE *(2025)*

#14
GRADUATE *(2025)*

ENROLLMENT *(Fall 2024)*

704
UNDERGRADUATE

133
MASTER'S

165
DOCTORAL

DEGREES AWARDED

Degrees Awarded (Fall 2023, Spring 2024, Summer 2024)

214
UNDERGRADUATE

65
MASTER'S

19
DOCTORAL

FACULTY

6
ENDOWED PROFESSORSHIPS

8
CHAIR HOLDERS

8
ENDOWED FACULTY FELLOWS

RESEARCH AREAS

- Biomedicine and Biomolecules
- Catalysis and Reaction
- Energy
- Sustainability
- Materials and Nanotechnology
- Process Systems
- Process Safety

AI and Gaming Platform Aims to ***Revolutionize Emergency Pipeline Training***

Researchers and industry partners are looking to create a game-like training tool using artificial intelligence (AI) to make pipeline safety training more effective.

The Mary Kay O'Connor Process Safety Center (MKO) and EnerSys Corporation are partnering to create a multiplayer "game" that provides real-world scenarios and measurable outcomes of how pipeline operations respond to abnormal and emergency situations in a safe, controlled environment.

“This utilizes artificial intelligence as a tool to create a gaming platform and looks at all the different scenarios that can impact the pipeline operations response,” said Faisal Khan, director of the Mary Kay O'Connor Process Safety Center.

Funded by the Pipeline Hazardous Materials Safety Administration, an agency within the Department of Transportation, this project aims to develop a realistic training system for teams to practice handling hazardous condition response and emergency response.

“In using this multiplayer gaming platform, it should become very much like actually working with pipelines,” said EnerSys Corporation CEO Russel Treat. “That's the goal, and ultimately, if that's the case, when incidents do occur, they should be responded to and mitigated more effectively.”

Pipelines are critical for infrastructure, so understanding how they operate can prevent major accidents, protect the economy and improve emergency response to issues like leaks.

The platform simulates various pipeline failure scenarios and incorporates those into the training system designed for pipeline operators.

“Pipeline incidents are exceedingly rare,” Treat said. “Most people who work with pipelines work their entire lives and never have direct experience. What that means is when they do occur, for many people, it's a first-time experience. By doing this training and giving people real-world experience, then they will be prepared when an incident does occur, which means they should respond more quickly, more effectively.”

MKO will provide knowledge and understanding of the pipeline and its safety issues along with creating mathematical models to the project, while EnerSys Corporation will merge industry and facilitate research and the data collection from industry while serving as the Principal Investigator of the program.

“We have a mathematical representation of how a pipeline should be operating in an idealistic condition, based on our scientific knowledge and what stimulates a pipeline failure,” Khan said.

The next step is to begin trial scenarios with a research and development team by the end of this year, aiming to collect results and incorporating them into the training, Treat said.

“It's a great opportunity for us to learn, particularly from the industrial experiences, and develop tools that enable fusion of knowledge and experience to improve safety," Khan said.

National Academy of Sciences, Engineering and Medicine Report Seeks to ***Combat Atmospheric Methane Emissions***

To combat methane in the atmosphere, Dr. Faruque Hasan and other experts have authored an extensive report that lays out the future research agenda.

In early 2023, Hasan was appointed to a national committee on “Atmospheric Methane Removal: Development of a Research Agenda,” formed by the National Academies of Sciences, Engineering and Medicine.

Committee members come from different areas and include experts in engineering science, social science, economics, industry and academia.

According to Hasan, the committee’s overall goal was exploring different possibilities and technological pathways for atmospheric methane removal. The idea was to bring experts together to identify the challenges and opportunities of different options for removing methane from the atmosphere.

The report, **A Research Agenda Toward Atmospheric Methane Removal**, looks at ways we can reduce where the emissions stem from and what is already emitted into the atmosphere.

Hasan explained that in the atmosphere, there is a very small amount of methane, about two parts per million. That means for every 1 million molecules you take, only two of them are methane.

“Although methane is considered as the second most important greenhouse gas after carbon dioxide, it is eighty times more potent than carbon dioxide in its first twenty years in the atmosphere and contributes to global warming,” Hasan said. “There is an increasing concern that we are having more methane in the atmosphere from anthropogenic activities and leaks, as well as from natural sources.”

One of the committee’s recommendations is to increase research on different ways of methane removal. These could include both semi-closed systems and open systems. The report also emphasizes the need for increased measurement, reporting, and verification (MRV) of methane in the atmosphere.

The committee also examined and assessed current pathways and challenges related to technologies for methane removal. These technologies include semi-closed systems like methane reactors and concentrators.

“We need to develop new materials and synergistic process integration techniques to improve the performance of these technologies,” Hasan said. “Removing methane at a two ppm level is a very challenging technological problem. We may not be able to get two ppm immediately, but maybe we can now handle more concentrated systems.”

Because of the effects methane has on the ecosystem, the committee proposed an ecosystem uptake enhancement, which would research limits on atmospheric uptake and its impacts on ecosystems.

Additional suggestions by the committee include engagement to inform research and policy and incorporating social perspectives into decision-making.

The report identifies key research priorities to be addressed within the next three to five years. This will enable a more thorough second-phase assessment of the technical, economic, and social viability of methane removal technologies.

“This report addresses a very important global problem, so it is humbling to say that I was a part of this report towards making an impact,” Hasan said.

Graphite Production Gets a *Makeover*

Collaboration efforts between the Texas A&M University Artie McFerrin Department of Chemical Engineering and the U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E) have led to innovative research on how petroleum coke is processed.

This almost $3 million three-year research project will convert petroleum coke to graphite for energy storage. The newer process uses a lower temperature and shorter time to produce graphite from petroleum coke.

This new catalytic graphitization technology will decrease the emissions, cost, and processing time associated with conventional synthetic graphite production.

The research team includes groups from Associate Department Head Dr. Micah Green, Professor Dr. Faruque Hasan, and the National Energy Technology Laboratory.

The project is part of the ARPA-E VISION OPEN program that looks to transform energy in critical areas across the energy spectrum, like nuclear fusion, grid reliability and approaches to developing chemicals and fuels, according to the ARPA-E website.

Petroleum coke is produced from crude oil. Petroleum coke can then be turned into graphite through a long, high-temperature process, Green said.

Ultimately, this new study looks to develop new technologies to process petroleum coke to graphite where it converts fossil feedstocks into valuable carbon products rather than fuels.

“Our grant is about changing the process by using catalysts so we can make petroleum coke into synthetic graphite that’s good for applications like batteries and for reducing American reliance on foreign sources of graphite,” Green said.

Graphite is valuable for its use in batteries. If converted from petroleum coke, this approach could lead to new sources for components in Li-ion batteries, according to the ARPA-E website.

“We are not only just solving one problem, in a sense this also reduces emissions,” Hasan said.

Typically, the process involves heating petroleum coke to 3000 °C in a days-long process where the petroleum coke is formed into a powder. It is then mixed with an iron powder and is heat-treated.

“My group is very involved in the actual synthesis and developing the catalyst and showing how that process can be scaled up,” Green said. “We have already done some proof-of-concept experiments at the lab scale, but to transition into industry, we need to show that it can be done at a large scale.”

Hasan’s group plans on analyzing the technology for its impact in terms of reducing cost, life cycle emissions, and greenhouse gases.

With new technologies, challenges arise to scale-up due to lack of reliable designs and estimates on their techno-economic viability at different scales, Hasan said. The goal is to bridge this gap.

“My group specializes in computational modeling, simulation and optimization of emerging technologies,” Hasan said. “In particular, we will determine optimal process design and operability domains for this exciting new technology developed in Dr. Green’s lab for producing highly value-added chemical products from petroleum coke in a sustainable manner.”

Once the scaleup demonstration is successful, an industry partner, Oxbow Carbon, will do pilot-plant runs for the preliminary assessment for large-scale processing.

Pipeline Integrity and Microbial Corrosion Research Earns ***Best Paper Award***

Years of previous research are coming back into focus with Dr. Faisal Khan's risk-based pipeline integrity management work.

Because of the significance of the work, the Artie McFerrin Department of Chemical Engineering department head's *Science Direct* published article has recently been honored with the Best Paper Award by KeAi (a subsidiary of Elsevier) Publishing.

Originally published in 2021 in the Journal of Pipeline Science and Engineering, Khan said the paper presents a deeper understanding of the corrosion mechanism driven by microbial activities.

When research is published, KeAi monitors the use of the material, and based on the citation and the relevance of the research, they award the paper for being the most widely downloaded and used paper in the journal.

Khan's work attracted attention for its practical relevance to the field, resulting in the award. Typically, it takes four to five years for the researched work to become scientifically relevant, he said.

It is a recognition by subject matter experts on corrosion and pipeline engineering highlighting the impact of this work, Khan said.

"The work itself is applied and gets attention early on compared to other work," he said. "The award highlights how certain published research is used by scientists and practitioners. This article provided a foundational understanding of localized corrosion damages ethics."

According to the article, pipeline integrity is important for a sustainable future along with vital energy-transportation mediums of today's energy-intensive economies.

"The paper analyzed data from a range of pipelines operated by major oil and gas companies for localized corrosion and especially the signature of microbially influenced corrosion," Khan said.

Additional work came from Dr. Edison Sripaul, technical lab manager and safety officer for the chemical engineering department, who reviewed and wrote the paper's energy carriers and storage section.

With his knowledge of safety, Sripaul explained the need to enforce safety measures in developing new technologies and processes aimed at achieving decarbonization.

"The goal is to control risks and introduce preventative and protective risk-reducing measures in the development of new technologies to meet decarbonization demands," Sripaul said. "To demonstrate, hydrogen, whose hazardous properties are quite well known as it is already many decades in use as an energy carrier, but addressing the safety issues still in nascent stages is shown as an example."

The ideal is inherently safe and sustainable products and processes, he said, as well as products that, by recycling, contribute to humanity's benefit.

"The research aims to identify the intricacy of localized corrosion, especially microbial-influenced corrosion mechanisms and the mathematical formulation that best described its likelihood of occurrence and rate of growth," Khan said. "The proposed mathematical formulations could be used to study localized corrosion in oil and gas assets, especially oil and gas pipelines."

According to the article, pipeline integrity is tied to environmental, societal and economic failures if not handled properly. Khan's research aims to capture the evolution of risk-based methods in integrity management, focusing on the last two decades.

"I hope this provides a deeper understanding of the localized corrosion-induced failures and how these corrosion mechanisms can be modeled in a probabilistic framework so that it helps in predicting and preventing failures," Khan said.

This collaborative work was supported by Genome Canada and TU Delft Netherlands researcher Dr. Rioshar Yarveisy. This work was part of Dr. Yarveisy's graduate work at Memorial University, Canada, under the supervision of Dr. Faisal Khan (former professor and Canada Research Chair Tier I at Memorial University, Canada) and Dr. Rouzbeh Abbassi of Macquarie University, Australia.

What To Do With Aging ***Solar Panels?***

The National Science Foundation Convergence Accelerator Program has granted $5 million dollars to Phase 2 of the project "Securing critical material supply chains by enabling phOtovoltaic circuLARity (SOLAR)."

SOLAR's goal is to proactively ensure circularity of solar panels by providing solutions to barriers throughout the end-to-end supply chain. The intent is to make solar panels recyclable and find a solution to remanufacturing them at a competitive cost. Achieving this will help promote a clean and resilient energy system in the United States.

The three-year project is led by Battelle Memorial Institute with partner organizations including **Texas A&M University's Energy Institute**. The interdisciplinary team provides the expertise needed to address muti-faceted issues related to solar manufacturing supply chain resilience.

Texas A&M's participation will be led by Texas A&M Energy Institute's associate director of Supply Chain Resilience and Sustainability and the Harvey Hubbell Professor of Industrial Distribution, Dr. Eleftherios Iakovou, with the director of the Texas A&M Energy Institute and distinguished professor in the Department of Chemical Engineering, Dr. Efstratios Pistikopoulos.

The Energy Institute's role in SOLAR is focused on advancing reverse logistics models and next-generation data-driven supply chains specifically for recycling solar panels and reusing their critical materials, such as silicon and silver.

"We are enhancing the competitiveness of the U.S. solar manufacturing supply chain by retrieving rare earth minerals from solar panels that are decommissioned, either because they break or have reached end of life," Iakovou said. "These precious rare earth minerals have the potential to be used in other critical and increasingly reshored supply chains, developing a circular economy for solar panels, while further enhancing the overall resilience and sustainability of the nation's energy and manufacturing supply chains within the new geopolitical landscape."

According to Pistikopoulos, transitioning the solar industry towards a circular economy by establishing sustainable recycling pathways for solar panels involves three core areas: sorting, upcycling, and logistics.

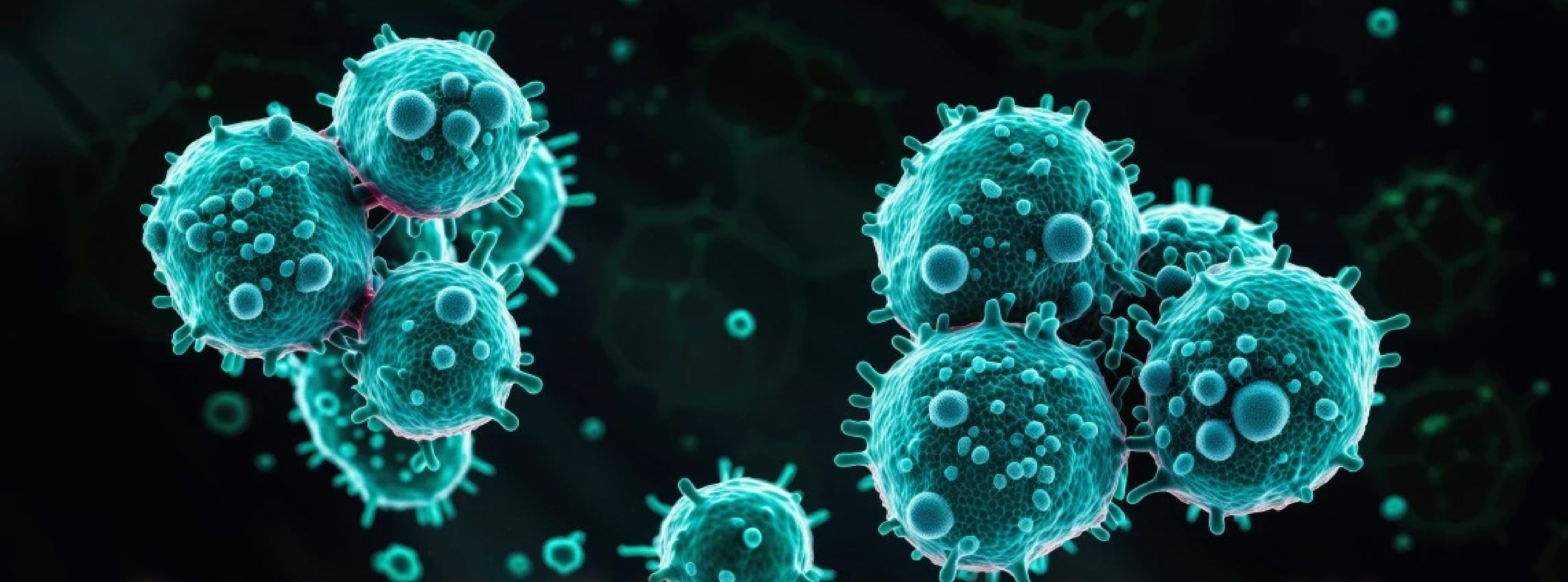
- Sorting focuses on creating field guides, developing workforce skills and deploying sensors for panel damage detection.
- Upcycling is the recovery and purification of critical materials such as silicon.
- Logistics is the component responsible for creating user-friendly modeling tools to streamline supply chain management for recyclable materials.

Together, these three core areas form a comprehensive approach to address the complex challenges in the solar panel ecosystem.

"Our contribution emphasizes the development of reverse supply chain logistics and decision-making frameworks, facilitating a more sustainable end-of-life management," Pistikopoulos said. "By addressing complex logistics and recycling challenges, we aim to enable efficient pathways for re-integrating critical materials into the economy."

During the next three years, the SOLAR team will conduct yearly evaluations to assess progress. They will also integrate new insights to ensure they build on previous findings from Phase 1 while adapting to technological advances and market conditions.

"The knowledge, tools, and technologies we are developing here will play a crucial role in shaping a future where solar energy can be both renewable and circular, ultimately contributing to a resilient and secure materials supply chain for the U.S.," Pistikopoulos said. "As solar panel deployment continues to accelerate, establishing a sustainable and economically viable end-of-life management in terms of reducing waste and regaining important materials is essential."



Cancer Cell Research Paves Way for New Treatments

Ongoing fundamental research on cancer cells could be used to create new drugs and therapies that fight the spread of cancer cells.

The work of Dr. Tanmay Lele, joint faculty in biomedical and chemical engineering, and chemical engineering Ph.D candidate Ting-Ching Wang proves that the mechanical stiffness of tissue can alter the fate of tumor cell populations.

Their research has been published in The Proceedings of the National Academy of Sciences. It examines how the mechanical stiffness of the extracellular matrix (ECM), a network of proteins that surrounds cells and tissues in the body, impacts tumor development.

“Tumors evolve through a process of mutation and selection, driven in part by changes in the tumor’s ECM. One key feature of this changing ECM is that its stiffness becomes progressively altered in tumors, which is why many solid tumors are detected initially as stiff lumps. We investigated whether changes in ECM stiffness can impose selective pressure on tumor cells,” Wang said. “If we can understand how tumor cells adapt to the changing ECM, then we can come up with better treatments targeted at those cells which are fittest for the changed ECM.”

Wang believes that the high genetic variation from cell to cell is the reason that cancer is so difficult to treat.

“Whenever the environment of the tumor changes, variant cancer cells best adapted to the changed environment outcompete the rest of the cells and over time, dominate the population,” Wang said. “Our research has focused on the unique properties of these variant cells.”

In their research, Lele and Wang employed an experiment to study the response of genetically variable cancer cell populations to altered ECM stiffness. What they found was that some variant cells dominated the population over several weeks.

“When we first analyzed these variant cells, we found that they were extremely migratory,” Lele said. “Cancer spreads to other parts of the body through aggressively migrating cells, and so our findings suggest that altered ECM stiffness may select for migrating cells.”

The team’s next stage in the research will seek to directly observe the selection of variant cells under the microscope, Wang said.

“Our studies are shedding light into the fundamental dynamic changes that occur during cancer development,” Lele said. “Cancer is a very difficult disease that we’ve been trying to treat for decades. We hope to better understand how tumors evolve and develop, in order to improve therapies that target these evolving tumors.”

Rising Faculty Recognized for ***Catalyst Materials Discovery***

The American Chemical Society has awarded chemical engineering professor Dr. Manish Shetty the Doctoral New Investigator grant.

The award is bestowed to junior faculty in their first three years of appointment with a research focus in petroleum. The two-year grant of $110,000 will support Shetty's research in catalyst materials.

"It's a good recognition of my early career," Shetty said. "This puts me on a good footing with many peers in the community who have received this award and have been successful in their own right. So, it gives me confidence and backing from the community that I am one of them."

According to the American Chemical Society, the goal of Doctoral New Investigator grants is to further develop the next generation of engineers and scientists and to promote the careers of young faculty by supporting research of high scientific caliber.

Shetty's research on catalysis focuses on understanding how chemical conversions happen inside catalyst materials called zeolites.

Essentially, this makes catalyst materials more efficient, selective and reactive, Shetty said.

Through the research, Shetty and his team can make these materials for petroleum chemistry cheaper and more efficient.

"We're trying to understand how that happens on these classes of materials, whether we can make these materials more reactive and selective," Shetty said. "Rather, we want to understand how these metals or metal-oxides encapsulated inside zeolites perform and interact within dynamic chemical environments of zeolites."

For the end consumer, Shetty's goal is to make cheaper and more energy-efficient end products from hydrogenation reactions of petroleum-based precursors.

"This support will help us continue for the next several years, and hopefully we can get support from other federal agencies for more long-term support," Shetty said. "I think this recognition helps!"

Graduate Students Selected for ***Annual Global Young Scientist Summit***

Two outstanding Ph.D. students from the Texas A&M Chemical Engineering Department, Fatima Mahnaz and Ashfaq Iftakher, have been selected to attend the Global Young Scientist Summit (GYSS) 2025 in Singapore.

Representing Texas A&M University on the global stage, Mahnaz and Iftakher will join 300 other young scientists and postdocs from across the globe to engage with Nobel Laureates, Fields Medalists, Turing Fellows, and esteemed researchers.

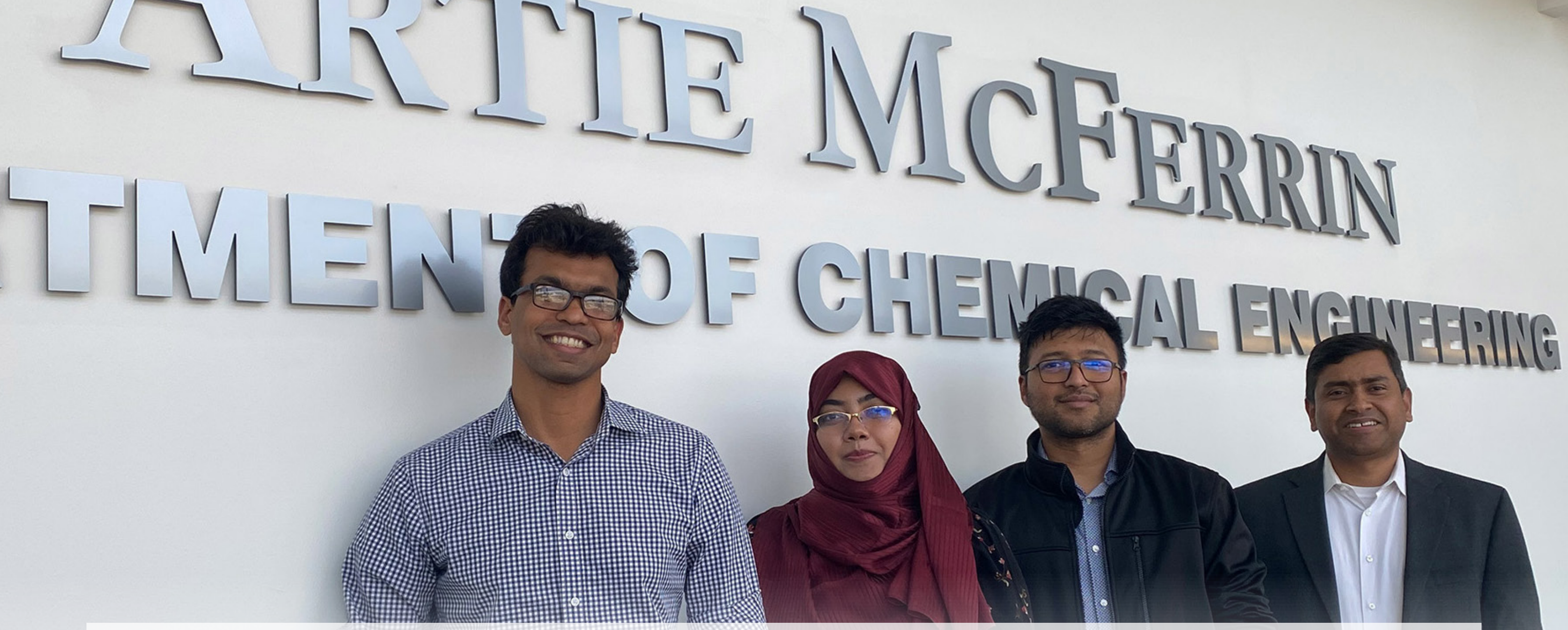
According to the Global Young Scientists Summit's (GYSS) website, this summit aims to inspire and connect the brightest young researchers from around the world and share compelling research propositions with scientific leaders to address major global challenges.

"This summit is one of the most premier scientific events in the world," Iftakher said.

"They bring together around 300 Ph.D. students and postdocs from around the world," Mahnaz said. "I'm very excited to be selected for the summit and have the opportunity to represent Texas A&M and the department."

Mahnaz and Iftakher were nominated for the summit by their respective advisors, Dr. Manish Shetty, professor of chemical engineering, and Dr. Faruque Hasan, associate professor of chemical engineering.

"This recognition is a testament to Fatima's accomplishments and dedication to her research," Shetty said. "She represents the best in the department. GYSS should give Fatima good exposure



to cutting-edge research and researchers and help her seek and motivate higher standards in her research."

Mahnaz and Iftakher will have the opportunity to showcase their individual research, meet renowned scientists, and network with peers. Mahnaz's research includes converting carbon dioxide into gasoline.

"What we're doing is designing bifunctional catalytic materials that can convert carbon dioxide and green hydrogen, to fuels and chemicals," Mahnaz said. "We need to tackle the carbon emission challenge. Through CO_2 hydrogenation, we can produce carbon-neutral fuels and chemicals as alternatives to fossil fuels, for our transition towards a circular carbon economy."

Iftakher's research focuses on developing computational models and methods for computer-aided molecular and process design.

"One of the new classes of materials that we're working on is called ionic liquid," Iftakher said. "We are trying to identify the optimal ionic liquid that can effectively separate mixed refrigerants that possess high global warming potential. It boils down to identifying the optimal materials and processes that will minimize the environmental impact of these harmful chemicals."

As the two prepare for the summit, they are starting to get excited about the possibility of rubbing elbows with recipients of the Nobel Prize, Fields Medal, Millennium Technology Prize, and Turing Award. These award winners will be speaking on topics including chemistry, physics, medicine, mathematics, computer science and engineering.

At the summit, Fatima hopes to learn and discuss global challenges with fellow scientists.

"I want to learn what are the critical global challenges we need to address and how to think about those challenges," Fatima said. "We can interact with other giants in the field to get to know about them and learn from their thinking process."

Iftakher feels the same and is looking forward to interacting and presenting his work in front of Nobel Laureates.

"I have always been very inspired and fascinated with all of these big scientists," Iftakher said. "To be able to meet them in person and hopefully discuss research and present mine, that's probably the highlight of the entire summit."

Mahnaz and Iftakher's future plans include joining academia; by attending this summit, they will get the chance to connect and network with luminaries in various fields that could impact their careers.

"Ashfaq is truly an outstanding student and a valuable member of my research group," Hasan said. "He has consistently impressed me with his deep intellectual curiosity, intriguing research ideas, unwavering dedication, maturity and genuine passion for addressing complex challenges in the broader area of multiscale process systems engineering. His work not only demonstrates technical brilliance but also a mix of scientific rigor, diligence and creativity."

Mahnaz and Iftakher are not only unified in their studies but also in their relationship as a married couple.

"Getting this opportunity together and traveling to Singapore for a conference, that's going to be exciting," they said. "I think as a couple, we both push each other, and I think it's important having support to and from your spouse."

Secrets of How Microbes Feel Their Way Around

Understanding how bacteria form communities on surfaces, including biofilms, has significant implications for both health and industry. Cells use tactile sensors to detect surfaces and convert the sense of touch into biochemical signals to colonize surfaces.

Dr. Pushkar Lele, a professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M University, has received a National Institutes of Health's National Institute of General Medical Services (NIGMS) R01 research grant award to investigate how bacteria sense their mechanical environment – termed mechanosensing – triggering intracellular signaling that leads to surface colonization.

"Bacteria constantly sense mechanical signals in their surroundings to identify suitable conditions for establishing multicellular biofilms," Lele explains. "We're trying to determine how the sensor proteins, known as mechanosensors, function."

Unraveling how mechanosensing occurs is somewhat akin to explaining the workings of a hidden key in a grand piano that orchestrates an entire symphony when pressed. Except, researchers in the Lele Lab are attempting to explain the mechanisms at the tiny length scales of the bacterium.

The investigations demand ultra-precise tools, given that cells are approximately a hundred times smaller than the width of a human hair and mechanosensors are a hundred times smaller than the cell itself. This challenge has been met by Lele's acquisition of a new microscope from supplementary funds provided by the NIGMS.

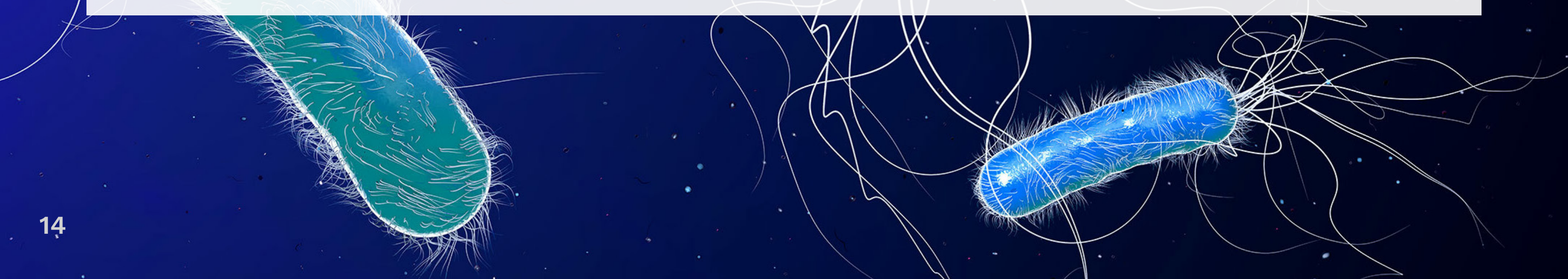
Among the various mechanosensors of interest to the team, one is located in the slender appendages known as flagella, which power bacterial swimming. One of the group's objectives is to determine the functioning of this mechanosensor known as the flagellar stator. These stators perform dual functions – enabling flagellar motility and detecting mechanical cues. Mechanosensing initiates downstream signaling pathways involved in biofilm formation, genetic competence, and pathogenesis, although the underlying mechanisms are not yet fully understood. Learn more about these functions in Lele's latest review in *Biomolecules*.

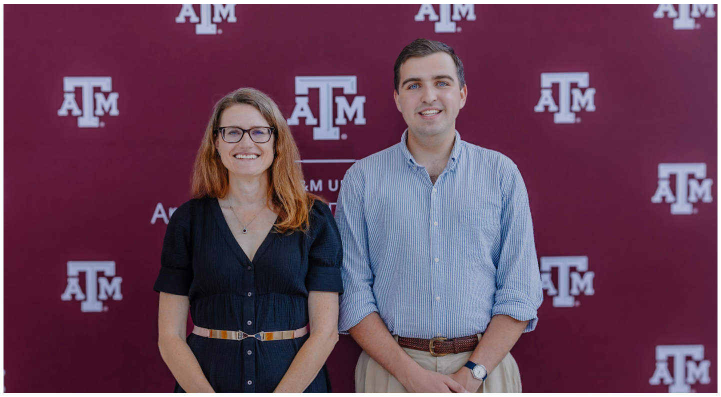
Understanding bacterial mechanosensing is crucial for several reasons. From the perspective of health, bacteria play a vital role in our bodies, both good and bad. Understanding how they colonize tissues and other biotic surfaces can help us better comprehend and improve our gut health. From the perspective of industry, bacterial communities can clog pipes and membranes, damage equipment, and result in significant financial losses for industries, estimated to be billions of dollars. The group's research could lead to the identification of novel molecular targets for preventing unwanted biofouling of industrial surfaces.

"We're not necessarily trying to create new probiotics or anti-biofouling agents," says Lele. "But by understanding the principles of mechanosensing, we're laying the groundwork for future applications in these and related topics."

The group's focus on mechanistic principles governing microscopic life is strongly motivated by its potential to generate unexpected insights in related scientific disciplines. Lele is particularly enthusiastic about the role of the R01 grant, first awarded when Lele was an assistant professor and renewed recently, in expanding the group's research portfolio. The results from NIGMS's continuing support have fueled the group's discoveries on phenomena ranging from novel stress response mechanisms to the unique ways in which bacterial pathogens evade our innate immune cells.

"Fundamental research often leads to unanticipated breakthroughs," Lele says, "More the rule than the exception."





Chemical Engineering Student Receives ***National Scholarship***

Texas A&M University chemical engineering undergraduate student Coby Scrudder has been named a 2025 Goldwater Scholarship recipient, solidifying his future career in batteries and energy storage.

This national scholarship, awarded by the Barry Goldwater Scholarship and Excellence in Education Foundation, supports undergraduates from across the country who are pursuing research careers in science, engineering and mathematics.

Scrudder plans to pursue a Ph.D. in either materials science or chemical engineering, focusing on electrochemistry, research similar to what he has been working on, he said.

"My goal would be to have a startup coming out of my Ph.D. research," Scrudder said. "I think that would be a great way to bridge the gap between academic research and industry; working on something that I helped develop, something entirely brand new and bringing out a novelty from the research lab into the world."

Scrudder learned about this scholarship from his faculty advisor, Dr. Jodie Lutkenhaus, associate dean for research for the Texas A&M College of Engineering and chemical engineering professor.

After almost three years in Lutkenhaus' lab, Scrudder has centered his research on developing batteries for electric aviation.

Scrudder's projects include designing structural, carbon fiber composite batteries that can serve both as energy storage and as the body panels of cars, planes and satellites.

"Our goal is massless energy storage," he said. "We're hoping if we can integrate energy storage into the structural components, we can lower the overall weight instead of having separate structural panels and separate energy storage."

Lutkenhaus believes that although Scrudder's focus was on the processing of the active material, he has developed expertise in materials manufacturing, electrochemistry and battery design.

"Coby worked in our lab as an undergraduate researcher, where he focused on building lithium-ion batteries and organic batteries," Lutkenhaus said. "He is one of the most brilliant students that I have ever mentored, and I am thrilled that he has earned this recognition."

Scrudder noted that because traditional energy sources rely heavily on fossil fuels, improving battery safety and increasing their energy density could make them a more viable alternative for clean energy solutions.

Due to a large amount of fossil fuels being used, Scrudder believes that if batteries can be made safer and with a higher energy density, it could enable alternative energy sources.

"I think energy storage is one of the biggest pieces in the energy transition puzzle," he said. "However, research is necessary to make batteries safer, more reliable, and cheaper to enable them as a practical, wide scale technology."

In addition to his work in the Lutkenhaus Lab, Coby has also had research internships working on batteries . Over a gap year, Scrudder worked for NASA's Langley Research Center in Hampton, Virginia, working on ultra-high-powered, solid-state batteries for electric aviation.

"We're hoping to double the current energy density of batteries," Scrudder said. "We move from around 250-watt hours per kilogram, which is what the batteries and Tesla's are at right now, to upwards of 500 and also to make them safer. One of the issues you've seen is Tesla fires, because of the use of flammable, liquid electrolytes. So, we were hoping to eliminate the liquid electrolyte entirely, so the batteries are inherently non-flammable."

Receiving this scholarship has placed Scrudder in the mindset to prepare himself for that next stage of pursuing research as a career.

"Being recognized as a Goldwater Scholar will propel Coby toward whatever future he wants," Lutkenhaus said. "This recognition could land him a place in a top Ph.D. program or industry."

Moving Toward an **Electrified Solution to Generate Heat for Manufacturing Industries**

When early humans learned to harness fire for heat around 400,000 years ago, it marked a monumental turning point in mankind's history. Heat is used for various purposes in the modern age, particularly in manufacturing, including refining, steel, cement, pulp and paper. The fossil fuels used to generate heat in these manufacturing sectors generate substantial greenhouse gas emissions. Hence, the United States Department of Energy (DOE) is now heavily investing in alternative technologies for heat generation.

Under the Manufacturing USA initiative, the DOE has made a significant stride by awarding $70 million to the Electrified Processes for Industry without Carbon (EPIXC) Institute. This institute, led by Arizona State University and with key partnerships with national labs and universities, including Texas A&M University, is a beacon of hope for the future of electrified heating technologies. EPIXC's funding, through the Office of Energy Efficiency and Renewable Energy's Industrial Efficiency and Decarbonization Office, is a testament to the promising future of these technologies.

"A significant portion of the heat used in manufacturing is currently generated by burning fossil fuels," explained Dr. Mark Barteau, professor in the Artie McFerrin Department of Chemical Engineering and C. D. Holland '53 Chair at Texas A&M. "However, with the potential of abundant carbon-free energy in the future, we could revolutionize the industry by using electrical energy for heating, thereby significantly reducing greenhouse gas emissions."

Texas A&M is a core partner in EPIXC through the leadership of the Texas A&M Energy Institute. Texas A&M researchers will contribute across the EPIXC mission, including development of a "roadmap" for decarbonization of manufacturing processes. The five-year program will be initiated with a two-year "jumpstart" project devoted to developing innovative electrified heating technologies for propane dehydrogenation, a chemical process for converting propane to propylene, a material that has several commercial applications, such as producing plastics, solvents and other chemicals.

As the name suggests, propane dehydrogenation involves the selective removal of two hydrogen atoms from a propane feedstock to make propylene. This reaction takes place in the presence of catalysts to speed up the reaction. But propane dehydrogenation is an endothermic reaction, which means that the chemical reaction consumes heat, which currently comes from burning fossil fuels. With their funding, Barteau and his team aim to (1) develop electrified chemical processes and (2) establish a program for workforce development for manufacturing personnel and researchers.

His team, including Dr. Micah Green and Dr. Benjamin Willhite both professors in the chemical engineering department, is currently developing a reactor based on internal radiofrequency (RF) heating of the propane dehydrogenation catalyst. A reason for using RF is to achieve good radiation penetration depth; that is, the radiation can reach inside the chemical reactor and create uniform heating temperatures. Thus, the team will work on reactor designs that best match the source of electrical energy put into the system.

Another challenge that Barteau will be addressing is scaling these technologies from the laboratory to pilot-scale demonstrations and, ultimately, deployment in the field.

"A world-scale propane dehydrogenation plant will make about 600,000 metric tons of propylene per year. Electrified processes will need to be operable at that scale since these plants will require large amounts of clean electricity," said Barteau. "This energy could be generated on-site, or it could be generated elsewhere and transmitted."

The project could reduce CO2 emissions by 0.3 metric tons per metric ton of propylene produced and increase propylene yields by up to 10%.

The team will be further strengthened by the participation of two key members from the Texas A&M Energy Institute leadership: Dr. Stratos Pistikopoulos, professor of chemical engineering and director of the Texas A&M Energy Institute, Dr. Konstantinos Pappas, associate director at the energy institute. Their expertise will significantly contribute to the development of training curricula for workforce development, drawing upon the institute's modular concept of its renowned educational program.

As climate change and global warming threaten the planet, Texas A&M and partners at EPIXC will strive to reduce the dependence on fossil fuels for heat generation and decarbonize industries by developing technologies to electrify process heating. The successful implementation of these electrified processes could significantly reduce greenhouse gas emissions from manufacturing, contributing to a more sustainable and environmentally friendly industrial sector.

Funding for this research is administered by the Texas A&M Engineering Experiment Station (TEES), the official research agency for Texas A&M Engineering.

Chemical Engineering Doctoral Student Wins *2024 Three Minute Thesis Competition*

After stellar presentations on research ranging from the irrationality of group-thinking to immune system treatments for PTSD, chemical engineering doctoral student Zhara Ghiasi emerged victorious at Texas A&M's 12th annual Three Minute Thesis (3MT®) competition on November 12, 2024.

Her presentation, "Stabilizing mRNA Vaccines for a Global Health Solution," clinched first place in both the doctoral division and the overall competition. In winning the competition, Ghiasi brings the coveted 3MT winner's cup back to the Department of Chemical Engineering, and she also had the honor of representing Texas A&M at the regional 3MT competition in Dallas this past March.

Dallas Williams, from the Department of Soil and Crop Sciences in the College of Agriculture and Life Sciences, was the runner-up and people's choice award winner in the doctoral division for her presentation "Rethinking Rain Gardens: Sustainable Design for a Resilient Future."

In the master's category, anthropology student Alyssa Carpenter won first place for her presentation, "The Origin of 20 Guns Recovered in Savannah, Georgia." Runner-up and people's choice awards went to ecology and conservation biology student Julia Tapilatu for "Safeguarding Zebra Shark Population through Research and Conservation Efforts."

The 3MT® competition, developed by the University of Queensland (Australia) in 2008, gives students three minutes to present a compelling oration of their research and its significance to a general audience using just one slide. The event helps students develop their communications and presentation skills and serves as a venue to showcase graduate student research.

The Graduate and Professional School, along with co-sponsors the Center for Teaching Excellence and the University Writing Center, hosted the event in Rudder Forum before a record live audience of over 170 people in Rudder Forum and streamed for viewers worldwide on Zoom. Dr. Adam Seipp, professor of history and associate dean for graduate studies in the College of Arts and Sciences, served as emcee.

The panel of judges, representing a diverse array of expertise, included Stacy Colvin, operations manager for KBTX; John Cullen, distinguished professor of toxicology at North Carolina State University; Megan Lacy, vice president of strategic initiatives in Texas A&M's Division of Marketing and Communications; Al Pulliam, executive advisor for recruitment initiatives at the Texas A&M Foundation; Andrea Porter, 2023 Texas A&M 3MT® champion; and Jörg Steiner, Texas A&M Regents Professor and University Distinguished Professor of small animal medicine and surgery and veterinary pathobiology.

Ghiasi's victory marks the third consecutive overall win for the College of Engineering, following the triumphs of Chih-Shen Ching (civil engineering) in 2022 and Andrea Porter (multidisciplinary engineering) in 2023. The College of Engineering now boasts four wins in the 12 years Texas A&M has held a 3MT competition, just behind the College of Arts and Sciences with five wins.

Ghiasi said she was honored to win against such stiff competition. "The other presentations were outstanding, each addressing important challenges. The quality of the presentations reflects the strength and diversity of Texas A&M's graduate programs," she said.

Dr. Faisal Khan, Ghiasi's faculty advisor in chemical engineering, lauded her drive, commitment and approach to her work: "Zahra is passionate about her research, which drives her to gain a deeper understanding of the research question and its impact on the public."

Khan also praised his department. "We have outstanding faculty who have developed a culture of nurturing young researchers by providing them with opportunities, resources, and support to excel," he said.

Dr. Robert Bishop, dean of engineering, celebrated Ghiasi's win and his college's recent run of success: "We are incredibly proud of Zahra Ghiasi's achievement. Her success is a testament to the talent and dedication within the College of Engineering, which has now produced back-to-back-to-back winners," he said. "And her work highlights the impactful research our graduate students are conducting."

Fuhui Tong, dean of the Graduate and Professional School, praised all of this year's finalists and highlighted increased participation and interest in this year's event. "It's exciting to see that we broke records this year in number of 3MT participants at the preliminary competition, and attendance at the finals," Tong said. "Congratulations to this year's finalists for advancing from an opening round field of 68 competitors and thanks to our community for showing such overwhelming support of graduate student research."

"Representing Texas A&M is an honor, so I plan to keep practicing and fine-tuning my presentation to make sure my performance reflects positively on our university."

The Past Inspires the Future **with New Scholarship**

Attending Texas A&M University would not have been possible for Mark Cooke without the scholarships he received throughout his undergraduate degree. Growing up with five siblings, Mark knew that paying his way through college would not be easy.

"It was pretty much upon each one of us kids… if we wanted to go to college, we had to figure out a way to make that happen for ourselves," Mark said.

With rigorous coursework on his plate and a love for the Aggie Spirit in his heart, Mark learned that this was not a battle he had to fight alone – donors were there to help pave the path forward.

Years later and inspired by those who gave him the gift of education, Mark and his wife Mary established the Mary and Mark E. Cooke '75 Endowed Scholarship in the Department of Chemical Engineering so they can be the difference for other students hoping to attend college.

A Connection to Aggieland

Mark's path to choosing Aggieland started with a classmate known to many, John Sharp, the former Chancellor of the Texas A&M System. Sharp was a senior at Bloomington High School when Mark was a freshman there. Inspired by his classmate's success, Mark decided he could do the same.

During his time at Texas A&M, Mark was actively involved in Alpha Phi Omega and the American Institute of Chemical Engineers. While balancing a busy schedule, Mark served as the President of Tau Beta Pi, the National Engineering Honor Society. In that role, Mark learned what it takes to lead others and organize events.

"Students should not be worrying about where the money is going to come from, rather focusing on enjoying their time in college," Mark said.

After graduating with his bachelor's degree in chemical engineering, Mark started his professional career alongside his wife Mary. In the effort to stay connected with Aggieland, Mark listened to football games on the radio in their one-bedroom apartment.

Mark embarked on a career with Union Carbide and Dow Chemical, serving in various roles and leadership experiences. After nearly 40 years, Mark is now retired, ending his tenure as an Associate Director.

A Helping Hand

Mark and Mary have three kids together, two daughters and a son. Their son Aaron is an Aggie himself, graduating in 2002 with a degree in environmental design. Embracing the culture and new title, Mary now proudly sports an 'Aggie Mom' necklace everywhere she goes.

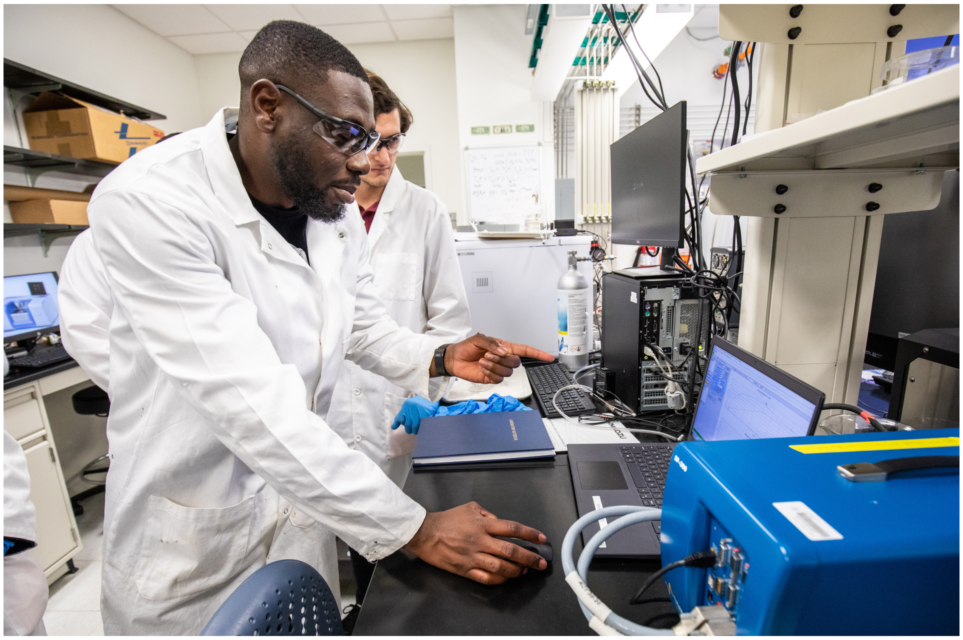
"I think I have gotten swept up into the culture. We are trying to stay connected with Aggieland as much as we can," Mary said.

Mary hopes that the recipients can help give back to students in situations just like they were in college.

"We hope that one day, if able to, they can pay it forward. We want to create a legacy of helping people attain their dreams," Mary said.

The Cookes' story shows that there is more to college than getting a degree. The Aggie Network connects us all, and it is important to step outside of your comfort zone to experience it to its fullest. The Cookes believe that there are two degrees when you go to college, one for academics and one to grow socially. With the creation of this scholarship, Mark and Mary hope to provide a chance for a student to fully give themselves to college life.

"There is so much more than getting an academic degree in college. I encourage students to take full advantage of all the opportunities, the traditions, and the organizations that Texas A&M offers," Mark said.




LEVEL 1





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Chemical Engineering