



KENAN INSTITUTE

ENGINEERING, TECHNOLOGY & SCIENCE

NC STATE UNIVERSITY



William R. Kenan, Jr. Institute for Engineering, Technology & Science
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KENAN INSTITUTE GOALS AND ACCOMPLISHMENTS FISCAL YEAR 2022-2023

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A MESSAGE FROM THE DIRECTOR

With the resources so generously provided by the William R. Kenan, Jr. Fund for Engineering, Technology & Science, NC State University, and our corporate, government, and philanthropic partners, in 2022-2023 the Kenan Institute continued to support and advance innovation in science and technology as a vehicle for our economic development and growth as a state and nation.

The Kenan Institute for Engineering, Technology & Science focuses its intellectual, human and financial resources in support of innovative individuals and programs involved in science, mathematics and engineering driven enterprises with demonstrated potential for high impact educational, economical and other benefits to society. Specifically, the Institute continues to support and enable core competencies in four strategic areas: high technology research; science, technology, engineering, and math K-12 education; technology commercialization and entrepreneurship; and science and technology policy.



We remain committed to encouraging multidisciplinary, multi-institutional teams involving government, university, and corporate partners to solve scientific and societal problems, generate technology-based economic development, and bring together the public and private resources necessary to successfully tackle the emerging issues of our time. We do this while maximizing the leverage from the significant strengths of NC State University students, faculty, and staff while focusing on programs that are consistent with the university's strategic goals in research, education, and engagement.

Our Institute support and leadership enables individuals and programs at NC State and at other institutions to continue to produce world-class research and scholarship, which enhances knowledge and learning, produces and supports new innovative companies, and informs sustainable practices and effective public policies that will have lasting impacts.

We really appreciate your interest in the Kenan Institute and welcome your comments and questions on our work and our programs.

Sincerely,

A handwritten signature in black ink, reading "Ruben G. Carbonell". The signature is stylized and fluid.

Ruben G. Carbonell

OVERVIEW OF GOALS

The Kenan Institute for Engineering, Technology & Science (KIETS) aligns its goals with NC State University strategic plan goals. KIETS also has focus areas of its own. Those goals and how KIETS has accomplished them through its varied programs and initiatives are outlined in this document.

GOAL 1: Empower Students for a Lifetime of Success and Impact

KIETS Goal: Identify and support NC State student focused initiatives and novel educational approaches to enhance undergraduate and graduate education.

ACCOMPLISHMENTS

KIETS Climate Leaders Program

The KIETS Climate Leaders Program (CLP) led by its Director Amanda Mueller and Senior Faculty Fellow Professor Jeremiah Johnson supports student scholars' engagement with leaders and organizations working on climate change



solutions to help empower, educate and inspire young people to embark on careers and become innovative leaders in mitigating climate change. In FY 22-23, the program expanded from 10 students in 2022's inaugural cohort, to 15 students in 2023. These 3 undergraduates and 12 graduate students, representing 6 NC State Colleges, were paired with 16 NC State Faculty Mentors who helped guide their progress in the program. The Scholars began their program in January 2023 and attended monthly evening sessions in Spring 2023 and engaged in internships in Summer 2023. A three-day Leadership Academy was held May 8-10, 2023 in Morehead City, NC and the scholars and faculty engaged with several community members to learn of the climate impacts on and needs of the community. The 2023 cohort of 15 students is strengthening their understanding, communication, engagement and leadership around climate change through their work with water

quality, biodiversity, agriculture, carbon capture/sequestration, energy and material alternatives, landscape and building design, public policy, and environmental justice and equity. The first [Climate Leaders Symposium](#) was held on October 10-11, 2022.

Technology, Entrepreneurship and Commercialization (TEC) Program

In FY 22-23, KIETS actively engaged and advised *TEC program* graduate students regarding their potential initiation and launch of high-tech companies based on technology developed at NC State and other university, government, and industry partners. During the 2023 NC State annual entrepreneurship competition, TEC students representing startups *BioSensys*, *Cascade Medical*, *Wolfspider*, and *microWatt Energy* received a combined \$20,000 in awards. KIETS Associate Director Raj Narayan served as faculty member and executive in residence to TEC teams.



NC State Social Entrepreneurship Initiative

KIETS collaborated with the *NC State Social Entrepreneurship* initiative to provide students across NC State with opportunities to engage and learn from social entrepreneurs in North Carolina, nationally, and internationally. In FY 2022-



23, the Social Innovation Fellows Program (SIF) completed an intensive yearlong strategic planning effort with high-level community stakeholders and donors with the goal of securing a new administrative home and enhancing program funding. This work resulted in the SIF program becoming a part of NC State Innovation and Entrepreneurship under the Vice Provost for Interdisciplinary Programs. 18 new Fellows joined the ranks of six returning Senior Fellows, three Team Mentors, and over a dozen community leaders who offered pro bono expertise. KIETS Associate Director Raj Narayan served as one of the core faculty

team mentors for the Social Innovation Fellows program.

NC State Engineers Without Borders Student Chapter Initiative

KIETS supported the NC State Engineers Without Borders Student Chapter in FY 22-23. The North Carolina Projects (NCP) team made significant progress in implementing their vertical hydroponic gardening project at Inter-Faith Food Shuttle's farm in Raleigh, NC, which focuses on producing and distributing low-cost, sustainable, and healthy food for



multiple underserved populations. The Guatemala Water Systems (GWS) project team continued to oversee maintenance and implementation of rainwater harvesting systems in the indigenous Guatemalan community of Caserio Panhux to provide households with sustained access to and storage of clean water. In December 2022, the GWS project team traveled to Guatemala to monitor systems that were installed in Caserio Panhux. A significant accomplishment of the Sierra Leone Renewable Energy (SLRE) project team this year was the successful planning and execution of an assessment trip to Goshen Academy in Freetown. The Sierra Leone Water (SLW) team also made significant progress in their project of bringing consistent and easy access to water to the Browndel School in

Freetown, Sierra Leone. The SLW team went on an assessment trip in March 2023 to perform a detailed community survey/assessment, perform a technical survey of the geographic terrain, and meet with contractors to put forward a plan in motion. Professor Andrew Grieshop from the College of Engineering serves as the faculty advisor for EWB-NCSU and KIETS Associate Director Raj Narayan serves as a member of their advisory board.

Agricultural Biotechnology in Our Evolving Food, Energy and Water Systems

KIETS supported the AgBioFEWS program in FY 22-23 led by Dr. Fred Gould and the Genetic Engineering in Society (GES) Center. Dr. Gould reported 17 NC State faculty engaged from five different colleges. The first cohort completed two group projects, one that utilized databases to assess impacts of genetic engineering and other agricultural practices on farm biodiversity. The second project looked at what factors affect the research to product pipeline. The output from this second project was an article that was accepted for publication in *Frontiers* and is titled "Lessons for a SECURE future: Evaluating Diversity in Crop Biotechnology Across Regulatory Regimes". The third and final cohort is comprised of 12 students who represent 10 different PhD departments. The third cohort completed their first year of classes and worked intensively in summer 2023 on a project focused on the future of governance for transgenic and gene edited plants and foods.



2023 NC State University Creating Solutions for the Global Blue Economy Ideation Workshop

KIETS collaborated with Professor Christopher Osburn in the Department of Marine, Earth and Atmospheric Sciences to support the Blue Economy Innovation Program (BEIP) Workshop. The 2023 workshop held on March 3-4, 2023 brought together over 60 graduate and undergraduate students, stakeholders, industry experts, and academics to Carteret Community College and the Center for Marine Science and Technology (CMAST) in Morehead City, North Carolina to expose students to innovation and entrepreneurship and develop their ideas in support of a sustainable and equitable blue economy. The BEIP includes members from the KIETS Climate Leaders Program, First Flight Venture Center, and Sea-Ahead, Inc., a bluetech incubator/accelerator company that is working with NC State and other NC universities to establish a blue economy hub in NC for the Mid-Atlantic region.



Dolphin Tank Workshop (New Program for Fiscal Year 2022-23)

On Saturday, April 15, 2023 the NC State BioMade team hosted the "Dolphin Tank," an interactive workshop focused on the intersection of emerging biotechnologies and responsible innovation. With support from KIETS, 20 undergraduates and 13 graduate students participated, representing at least five colleges at NC State. The full day of activities included creative icebreakers, mini-lectures on "Responsible Research and Innovation" (RRI), and a fast-paced team activity that resembled a cooperative and collaborative version of Shark Tank. The Dolphin Tank Workshop was part of a larger project to develop a comprehensive online course related to bio industrial manufacturing and is targeted to both university students and professionals new to the biomanufacturing industry. Gary Gilleskie, Jason Delborne, Bob Kelly, Melissa Srougi, Katie Barnhill-Dilling were involved in the planning and execution of the Dolphin Tank event.



AIM-Bio Biopharmaceutical Manufacturing Symposium and Student Exchange

Funded by the Novo Nordisk Foundation, the AIM-Bio Program brings together two academic universities, the Technical University of Denmark (DTU) and North Carolina State University, to create an international collaboration to drive innovation in research and education in manufacturing biopharmaceuticals. AIM-Bio held a very successful Annual



Symposium on Biopharmaceutical Manufacturing from November 9-11, 2022 at NC State featuring distinguished speakers from its Biopharma Leaders Network. Topics included continuing education, research, international exchange and time for networking with working groups. The overall goal of the symposium was to build new relationships with Danish industry and academic members that can serve as partners for future extensions of the AIM-Bio program. AIM-Bio leadership requested that KIETS support be applied in fiscal year 2022-23 towards support for international exchange students visiting NC State University from the Technical University of Denmark (DTU). KIETS funding supported onboarding by the Global

Training Initiative (GTI) at NC State University. Sixteen student exchanges and 3 faculty/staff exchanges are in progress or completed.

GOAL 2: Ensure Preeminence in Research, Scholarship, Innovation and Collaboration

KIETS Goal: Identify programs that support faculty research efforts, promote career development, and help enhance the research infrastructure at the university.

ACCOMPLISHMENTS

KIETS is supporting several research programs involving NC State faculty and students:

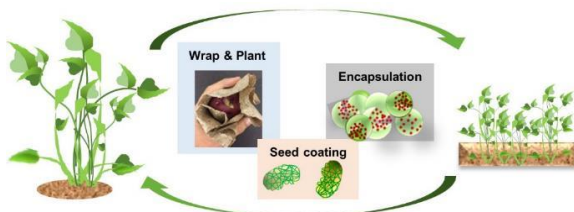
Bioseparations/Bioprocessing Development Center (BBDC)

KIETS supported the *Bioseparations/Bioprocessing Development Center* (BBDC) initiative led by KIETS Director Dr. Ruben Carbonell in partnership with BTEC. The BBDC funding provided by the Kenan Institute is helping BTEC staff, graduate and postdoctoral students participate in industry analytical and process development projects, which are not funded by the State. BTEC provides matching funds in the amount of \$2 million in facilities for this effort. In addition, BTEC is providing leverage in the amount of \$200,000 per year in staff salaries to support the analytical and process services program. BTEC has nearly \$250,000 in bioprocess services projects for small and large companies in NC. BBDC also enabled BTEC to succeed in getting three major grants from the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL), and more recently, from the Clean Energy Smart Manufacturing Institute (CESSMI). In addition to participating in several NIIMBL grants with NC State faculty, BTEC has initiated a long-term contract with NIIMBL to develop a testbed for studies on adaptive process control methodologies for the production of biopharmaceuticals and the development of process and raw materials data ontologies that can be disseminated to NIIMBL companies. This program will provide BTEC with approximately \$1.3 million in new equipment, and several hundred thousand dollars a year during the next five years for support of personnel, supplies and other related expenditures.



Novel Material Platform for Crop Protection

KIETS supported Professor Saad Khan who is investigating ways to create a platform for crop protection from fungi and insects using biodegradable matrices. In FY 22-23, Dr. Khan and his team encapsulated plant growth promoting hormones for switch grass in collaboration with a startup InnoSense Corporation. They have also used some active ingredients from collaborators Valent Bioscience and Valent USA to investigate the encapsulation efficiency and release profile for various hydrophilic and hydrophobic active ingredients. These efforts have helped tailor the delivery platforms based on the nature of the different types and

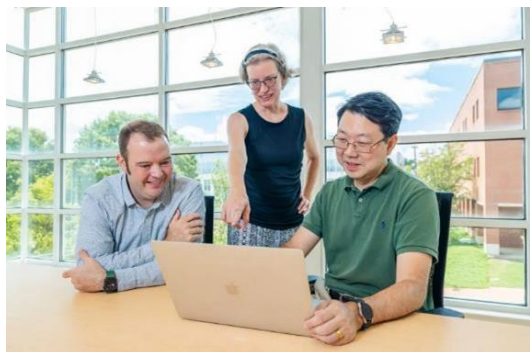


sizes of the active ingredients verifying the universality of their delivery platforms. Several faculty members are involved including Dr. Charles Opperman from Plant Pathology & Entomology department, Dr. Lokendra Pal from Forest Biomaterials, Dr. Daniel Coyne from the International Institute of Tropical Agriculture, Kenya, and Dr. Antoine Affokpon from the School of Plant Sciences, University of Abomey-Calavi, Benin. Dr. Khan also reports two invention disclosures, two patent applications filed, eleven publications generated, four graduate students, three undergraduate and one post doc

supported. Dr. Khan and his colleagues are also investigating the commercial application of these innovations and post doc Dr. Tahira Pirzada participated in NC State's ICORPS program.

Developing an Integrated Marine Environment Observation and Prediction System in Support of NC Energy Initiatives

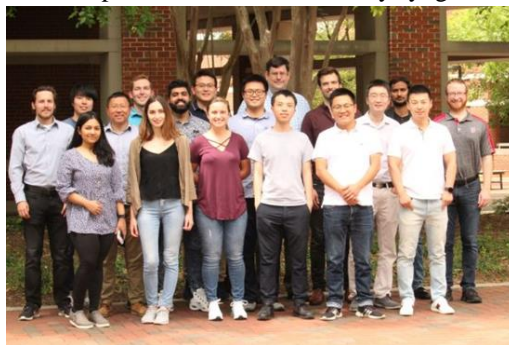
KIETS supported Professor Roy He in FY 22-23 on a project to refine and implement state-of-the-art marine environment observing and prediction capabilities that can support wind, current, and wave energy development, and risk mitigation offshore of NC. Dr. He and his research team along with his startup company Fathom Science engaged with Duke Energy and Avangrid Renewables to provide metocean-modeling information to support their offshore wind farm micro siting and operations. Dr. He is also discussing other modeling support for Duke Energy's outage planning and onshore wind farms in coastal NC. His team has been working to refine and implement state-of-the-art marine environment observing and prediction capabilities that support wind, current, and wave energy development, and risk mitigation offshore of NC. Specifically, Dr. He is integrating a state-of-the-art, data-assimilative, coupled ocean-atmosphere-wave modeling system with a carefully designed observing network and emerging cloud-computing technology to generate accurate, real-time marine environmental predictions at a horizontal



spatial resolution that supports operations. In 2023, Dr. He reported 7 publications, 1 undergrad student, 4 graduate students, 6 post docs, 15 universities, 17 corporate partners engaged in this project, and one startup company – Fathom Science. KIETS support for this project leverages resources from NSF, NASA, NOAA, and the Office of Naval Research.

Renewable Natural Gas from Carbonaceous Wastes via Phase Transition CO₂/O₂ Sorbent Enhanced Chemical Looping Gasification

In FY 22-23, KIETS supported Professor Fanxing Li on a project to develop a significantly intensified, sorbent enhanced – chemical looping gasification (SE-CLG) process, which combines biomass gasification, air separation, and syngas conditioning and cleaning into a single circulating fluidized bed (CFB) gasifier to produce methanation ready syngas. The SE-CLG technology being developed has excellent potential to produce cost-competitive renewable natural gas (RNG) to serve the domestic market. Dr. Li reported that KIETS support enabled optimization and testing of the phase transition sorbents and mechanistic studies to guide the sorbent design. A circulating fluidized bed gasifier cold model was also designed and operated in collaboration with Particulate Solid Research, Inc. based in Chicago and the partners are currently contracting a vendor to construct the hot unit for scale-up demonstration of the technology. Dr. Li reported 7 published articles in leading peer-reviewed journals; one patent application filed for sorbent enhanced gasification and reforming processes; 10 invited seminars and conference presentations; and 2 graduate students and one post doc directly involved in the research project. KIETS support for this research is leveraged with support from the Department of Energy (DOE), Novo Nordisk Foundation, and CatRedox.



Matrix Assisted Pulsed Laser Evaporation

In FY 22-23, KIETS supported NC State Professor Roger Narayan's research on the translation of an existing physical vapor deposition technology known as matrix assisted pulsed laser evaporation for instantly manufacturing the dry product form of the Measles-Rubella (MR) vaccine. The matrix assisted pulsed laser evaporation approach would be transformative for vaccine manufacturers in developing countries since the matrix assisted pulsed laser evaporation process instantly creates the dry product vaccine. A NC State Biological Use Authorization (BUA) "Measles Dry Product Vaccine Evaluation and Virus Production and Training Development" was approved in November 2022. Dr. Narayan's students will be working with live attenuated vaccine strains of measles to run standard quality control testing. Work with measles vaccine material will be conducted under BSL-2 conditions at BTEC, Annex, Keystone Center. An authorization for the matrix assisted pulsed laser evaporation (MAPLE) processing was submitted in January 2023 and is under review by NC State Environmental Health & Safety. Dr. Narayan has also received support from the Bill and Melinda Gates Foundation for this project.



GOAL 3: Expand and Advance our Engagement with and Service to North Carolina and beyond, defining the standard for a 21st-century land-grant University

KIETS Goal: Support strategic partnership among industry, state government, federal agencies, and state school districts to enhance STEM education in our schools.

ACCOMPLISHMENTS

Kenan Fellows Program for Teacher Leadership (KFP)

The 2022-23 cohort consisted of 24 Fellows from 18 North Carolina counties. Fifteen members of the new cohort teach in Title 1 (i.e., economically disadvantaged) Schools, 21 are female, three are male and eight are lateral entry teachers. More than half of this cohort is from rural communities and the majority teach in high school or middle school; five teach at the elementary level. Funding partners for the Fellowships included American Zinc Products (AZP), Biogen Foundation, Burroughs Wellcome Fund, Charlotte-Mecklenburg Schools, Duke Energy, Dogwood Health Trust, Goodnight Educational Foundation, Kenan Institute for Engineering, Technology & Science, North Carolina Department of Public Instruction, North Carolina's Electric Cooperatives and Randolph EMC, North Carolina Farm Bureau and Stokes County Farm Bureau, NC State University, Meta, and an NSF grant to Dr. Toshi Hige of UNC-Chapel Hill. A complete list of the universities, industries, and foundations that provide support for the KFP



through funding and/or hosting/mentoring Fellows can be found at <https://kenanfellows.org/partners/> and <https://kenanfellows.org/mentors/>. STEMwork is one of KFP's newer initiatives and seeks to activate the 600+ KFP alumni and engage them as facilitators for small teams of local teachers in a given county or school district. The yearlong course consists of visits to local businesses and industries and eight online asynchronous modules that guide the teachers through the process of developing Project Based Learning (PBL) units that they implement in their classrooms. To date, fifty-five KFP alumni have been prepared to lead STEMwork teams. Local school districts recruited 89 teachers who formed 18 STEMwork teams distributed across four regions of the state. In 2022-23, these 18 teams participated in 34 industry site visits with 27 of KFP's industry partners. The KFP also developed and piloted a new line of programming dubbed Mountains to Sea Scholars (MTS) to create a semester-long experience for teachers that focuses on giving them a statewide perspective on a single topic. 25 educators – half of them KFP alumni – learned about water quality, environmental justice and the ways that these issues are similar and different in the Mountains, Piedmont, and Coastal regions. KFP published its sixth issue of its *Journal of Interdisciplinary Teacher Leadership* in December of 2022, which included seven articles: *JOITL Vol. 6, No. 1*. Since the journal was founded in 2016, KFP has published articles from 18 national universities.

NC Children's Museum

In FY 22-23, KIETS supported the Kidzu NC Children's Museum initiative. KIETS support allowed for weekly meetings



and guided discussions on such topics as Avatars & Digital Identity, Addressing Community Needs, Digital Developmental Play & Learning, and Digital World building, resulting in a robust annotated bibliography of compiled research related to online spaces for children, guiding principles, and the buildout of sample digital learning environment. KIETS enabled the planning process to continue, involving additional stakeholders with a range of expertise from across the state and overall southeast region of the country to further the concept of a statewide children's museum. Kidzu Children's Museum is in the process of purchasing 45

acres at 510 Mt. Carmel Church Road in Chapel Hill for its new museum home. The property will be home to an early learning campus with indoor and outdoor programming for children – birth through teens, their caregivers, educators, and researchers. Kidzu is also discussing opportunities for partnership and collaboration with the Kenan Fellows Program for Teacher Leadership. Among the partners supporting the NC Children's Museum initiative are the Burroughs Wellcome Fund, GlaxoSmithKline Ribbon of Hope, The Grable Foundation, and the Orange County Partnership for Young Children.

KIETS Goal: Seek and support efforts that will inform research, public policy and engagement for the benefit of North Carolina and the Nation.

ACCOMPLISHMENTS

NC Coastal Federation Newport River Estuary Protection and Restoration Strategic Plan



The NC Coastal Federation (NCCF) is working with key partners to develop a watershed action plan for the Newport River. In FY 2022-23, KIETS support enabled the NCCF and NC State team to collect and analyze important water quality data and trends. NC State researchers Dr. Natalie Nelson and Dr. Angela Harris, and PhD student Julia Harrison developed a water quality sampling and analysis strategy that has been implemented over the course of the year. The work on the plan has already resulted in two restoration projects that are being implemented that will reduce the rate and volume of runoff entering the river. NCCF is working with the N.C. Coastal Land Trust and the NC Land and Water Fund to restore nearly 1,400 of riparian habitat and hydrology on land that is currently ditched and drained. NCCF partnered with the NC Coastal Land Trust to secure \$2.4 million funding for the acquisition of the 1,400-acre Weyerhaeuser tract in the northern part of the watershed.

The Federation was awarded a grant from the NC Land and Water Fund Flood Risk Reduction program to restore the 1400-acre tract to wetlands next year. Once hydrology is restored, the project would reduce about 1.5 billion gallons of polluted runoff each year from flowing into the river.

NC Sea Grant /WRI/ NC Space Grant Community Collaborative Research Grant Program

KIETS collaborated with the NC Sea Grant in support of the Community Collaborative Research Grant (CCRG) program to address priority coastal issues in the state through strategically linking local ecological knowledge (LEK) sources with academic experts in the field. The applicants in the 2023 cycle included six Universities (NC State University, University of North Carolina at Chapel Hill, University of North Carolina Wilmington, Appalachian State University, Duke University, Louisiana State University, and one community college (Carteret Community College). Proposals include participation from the Town of Maysville, Jones County, the New Hanover Soil and Water Conservation District, and the NC Department of Environmental Quality. Other participants included the following 15 NGOs and/or private businesses (NC Catch, The Hackney, Apex Seafood and Market, Saltbox Seafood Joint, Catch Restaurant, Mastermind Image and Photography, Core Sound Waterfowl Museum and Heritage Center, Southern Breeze Seafood LLC, MERROW Foundation, Carolina Gold Oyster Company, Shell'em Seafood Company, Coastal Carolina Riverwatch, the Chowan Edenton Environmental Group (CEEG), and the Boys and Girls Clubs of the Coastal Plain. KIETS Associate Director Raj Narayan served on the CCRG review and selection committee. Projects awarded in April 2023 include Samantha Krop, Neuse Riverkeeper, Sound Rivers, *Embracing Ways to Engage Research in the Walnut Creek Watershed*; Liz DeMattia, Research Scientist, Duke University, *Connecting Citizen Science and Youth Action within Local Coastal Communities to Decrease Plastic in Our Stormwater and Advocate for Clean Water*; Barbara Garrity-Blake, President, NC Catch, *Recognizing African American Participation in the North Carolina Seafood Industry*; and Astrid Schnetzer, Associate Professor, NC State, *Spatiotemporal Patterns of Algal Toxin Contamination in Small and Juvenile Fish Across Albemarle Sound and its Tributaries*.



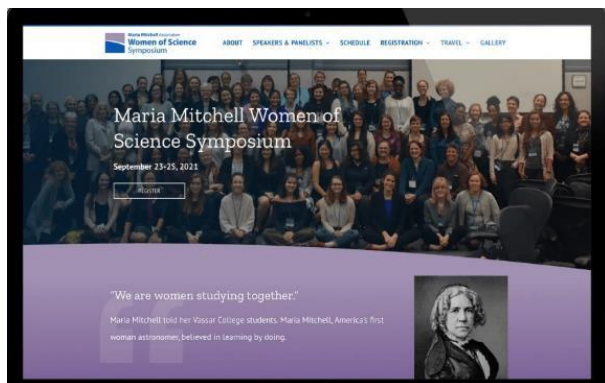
GOAL 4: Champion a Culture of Equity, Diversity, Inclusion, Belonging and Well-Being in All We Do

KIETS Goal: Seek opportunities for enabling diversity and inclusion, maximizing efficiency and effectiveness, enhancing resources for KIETS operations and continuously improving services for our stakeholders and partners.

ACCOMPLISHMENTS

Maria Mitchell Association Women of Science Symposium

In FY 22-23, KIETS supported the Maria Mitchell Association (MMA) Women of Science Symposium



(MMWSS/Symposium). The MMA held its third Biannual MMWSS on September 22-24, 2022. The goal of the MMWSS is to promote and support women of all ages in STEM. The 2022 online MMWSS saw over 200 registrants. Undergraduate and graduate students, post-doctoral candidates, professors, teachers, administrators, scientists, non-profit and for-profit employees of STEM-related entities – all were in attendance. On the introduction of KIETS, some of the featured speakers at the MMWSS were Dr. Nancy Gray, Director of the Gordon Conferences and Ms. Shauna Young, Kenan Fellow and Director of the Scratch Foundation. KIETS support helped with

transitioning to a virtual format and leveraged resources from the Simons Foundation, Massachusetts Space Grant, Novartis, Mass Bio, Mount Holyoke College, Dana Farber Cancer Institute, DE Shaw and Company, Tupancy-Harris Foundation, Schwartz Hannum, Vassar College, The American Philosophical Society, and Siemens.

Catalyst Program Reach for the Stars

Led by Joann Blumenfeld, a Kenan Fellow Alumnus, Catalyst is a high school program at NC State's Science House designed for students with disabilities to motivate and prepare them to enter post-secondary educational training programs and careers in STEM. Catalyst achieves this goal by providing participants with hands-on STEM activities, job exploration counseling, work-based learning experiences, mentors, field trips to STEM research labs and businesses, and counseling on postsecondary education and training options. In FY 2022-23, KIETS supported the Catalyst trip to NASA (April 6-9, 2023) including a visit with Tracy Minish, who is visually impaired and currently a Mission Control Flight Center Manager for NASA. 36 high school students with disabilities participated in this trip and visited the historic Apollo 11 Mission Control where they spoke with Astronaut Rex Welheim about his work and career path and Mission Director Garrett Heham. Joann Blumenfeld was recognized by the NC State Friday Institute for Educational Innovation with the Friday Medal in November 2022 for her work advancing educational equity. KIETS support of the Catalyst initiative leveraged resources from NASA, NC Space Grant, The Rossi Fund, the Burroughs Wellcome Fund, Red Hat, Eastman, ABB, NC State College of Sciences, and NC Vocational Rehabilitation.



Enabling Diversity, Equity, and Inclusion

The Kenan Fellows Program (KFP) for Teacher Leadership added procedures, support mechanisms, and professional development into their program to ensure that diversity, equity and inclusion (DEI) are an important strategic element of the KFP. KFP collaborated with the Burroughs Wellcome Fund to create seven Diversity in Leadership Kenan Fellowships. Three of these Fellowships have assisted STEM Ecosystems in NC with asset mapping regarding DEI while providing them with the capacity to update their maps as well. Two of these Fellowships have enabled connectivity for all KFP alumni through collaborations with the Dudley Flood Center, the Color of Education Summit, and the DRIVE (Developing a Representative and Inclusive Vision for Education) Summit through the Governor's office. Mark Townley, Assistant Director of Programs for KFP serves on the Governor's Teacher Advisory Committee and has been a part of the planning process for the DRIVE Summit's as well. The NC State Office of Institutional Equity and Diversity (OIED) has served as a mentor for KFP Diversity in Leadership Fellows along with Alfred Mays at the Burroughs Wellcome Fund, the NC DPI Office of Educator Engagement, No Kid Hungry, and the Village of Wisdom organization. In the 2023 Fellowship cohort, KFP added two more Fellowships partly funded through the Burroughs Wellcome Fund. The first fellowship partners with the Southern Appalachian Wilderness Stewards to provide resources to educators that make sure that all students and community stakeholders feel safe to hike, camp, and more outside. The second fellowship partners with

LatinXEd to provide them with a Hispanic educator that can build community connections and engage bi-lingual educators within their communities. Through its STEMwork initiative, KFP collaborated with organizations such as LatinXEd, Profound Ladies, and Profound Gentlemen to create two or more STEMwork teams of five to seven educators from underrepresented groups each year. In order to connect more strongly with the University, and to provide support for pre-service teachers in NC, KFP has partnered with the NC State University Teaching Fellows Program to provide them with DEI programming that exposes NC State students to the different communities that exist in NC and beyond, as well as resources and pedagogical skills to ensure they are learning to be as inclusive as possible in their classrooms.

Collaborating on University Wide Initiatives

KIETS collaborated with the Office of the Provost in support of the KIETS Climate Leaders Program as well as with the NC State Coastal Resilience and Sustainability Initiative. KIETS support for the Climate Leaders Program is leveraged with complementary support from the Office of the Provost. KIETS also continued its collaboration with the Vice Chancellor for Research in supporting the Research Innovation Seed Fund (RISF) Program as well as the newly implemented Global Health and Climate Change RISF. KIETS also continued to work collaboratively with the NC State Advancement on the NC State Day of Giving to identify and develop resources for priority initiative such as the Kenan Fellows Program. KIETS supported the Goodnight Scholars and Caldwell Scholars annual interviews providing space and organizational support. KIETS University Program Associate Tara Spivey helped organize and support the annual interviews, which were held at the Kenan Institute offices in Spring 2023. KIETS also engaged with NC State Innovation and Entrepreneurship (TEC Program and Social Innovation Fellows), the Office of University Interdisciplinary Programs (Long View Initiative), Centennial Campus Partnerships Office (Daugherty Initiative) and Office of Research Commercialization (ICorps and Spark Plug) initiatives.

Improving Program Effectiveness, Outcomes and Impact

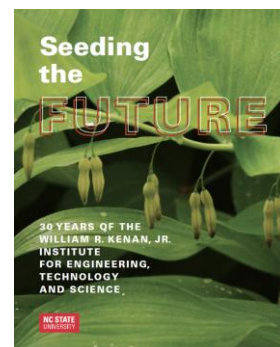
The Kenan Fellows Program (KFP) for Teacher Leadership continues to refine its processes and adapt novel strategies for improved program effectiveness, outcomes, and impact while implementing strategies for long-term sustainability. The NC State Friday Institute conducts the KFP annual program evaluation. In addition to this external evaluation, the KFP gathers data regarding the impact that the current cohort of Fellows is having on students, teachers, and other key stakeholders. At the close of FY 22-23, each Kenan Fellow had completed 80 hours of professional development and a three-week internship with their business/industry or university mentor. In addition, the KFP impact log reflects the following activities since they began the Fellowship in June: The KFP reported that the 2022-23 cohort reached over 4,300 students and 1,250 other teachers, 8 state and regional presentations given to more than 500 attendees, \$40,000 in grant funding secured, and 3 Teacher of the Year award recipients.

Leveraging KIETS Resources

In FY 22-23, KIETS' core operating and program investments of \$2,037,101 were leveraged by approximately \$41,498,213 in complementary funding from NC State University and external partners. While only a portion of these funds flows directly through KIETS, the resulting impact of the Institute's ability to enable leveraged support for its programs is significant and continues to grow annually. KIETS continued to maintain a healthy and active portfolio of 31 supported projects representing a 36% turnover ratio and 21% new projects at the start of FY 22-23.

KIETS 30th Anniversary Documentary Initiative

On November 1, 2022, KIETS hosted an event to celebrate 30 years of leadership consistent with its mission to develop partnerships in basic research, education, commercialization and public outreach with individuals and organizations dedicated to the advancement of science, engineering, and technology as a force in improving the economic and social well-being of the nation and the world. Georgann Eubanks and Donna Campbell with Minnow Media, in association with Alexander Isley Inc., collaborated with KIETS to develop a catalogue of stories and collateral material to include a short video, a historical book, and a timeline brochure. The KIETS 30th anniversary commemorative materials are available on the following link: <https://kenan.ncsu.edu/history/>



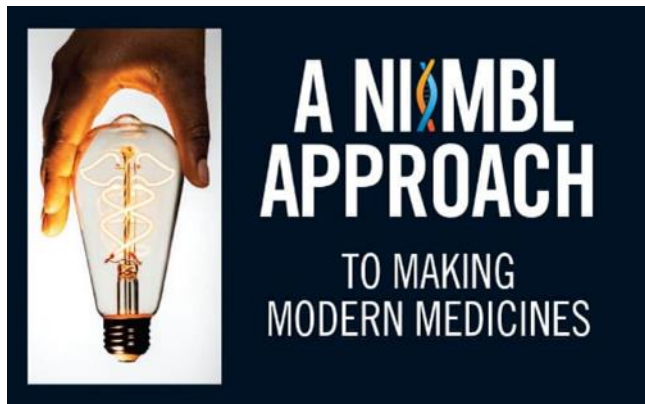
GOAL 5: Improve University Effectiveness Through Transformative Technologies, Cutting-Edge Processes and Actionable Data

KIETS Goal: Identify, develop, and foster new interdisciplinary approaches in research, education, outreach that address the Grand Challenges of Society.

ACCOMPLISHMENTS

National Institute for Innovation in Manufacturing Biopharmaceuticals

KIETS supported the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL), a \$70M collaborative agreement over five years from the National Institute for Standards and Technology (NIST). KIETS Director Ruben Carbonell serves as NIIMBL's as a Senior Technology Strategist. To date, the State of NC has provided \$10 million in funding used as cost-share matches for NIIMBL projects led by NC companies or academic institutions, and laboratory renovations necessary to carry out NIIMBL projects. These funds also helped to pay NIIMBL membership fees for small NC companies and community colleges. 33 different NC entities participate in NIIMBL, including 5 universities (ECU, NCCU, NC State, UNC-CH and UNC-W), 12 community colleges, 15 small- and medium-sized companies (4 in Wilmington, 10 in RTP and 1 in Charlotte), and 2 non-profit organizations. In the first six years of NIIMBL operations, NC members participated in projects totaling \$25.6 million (federal funds, state funds and other member cost share) including \$9.3M of federal funds received by NC entities. Of the \$9.3 million federal project support, \$7.8 million went to



NC Universities, \$1.4 million went to small and medium sized enterprises, and \$100K went to NC non-profits. During the same six-year period, the \$10 million in State cost share funds were utilized as follows: \$5.5 million to NC Universities, \$3.3 million for membership dues, travel awards, and program management, and \$1.2 million for small and medium enterprises, community colleges, and non-profits. From 2017-2023, NC State University has received approximately \$13.8 million in federal funding and \$11.2 million in State cost share for project and operational expenditures.

Research Innovation Seed Funding Program

KIETS provided support for the *Research Innovation Seed Funding (RISF) program*, which is a collaboration with the Vice Chancellor for Research that assists researchers in developing new and innovative pilot projects that have the potential for future support from government agencies, corporations, or foundations towards large-scale research centers or industrial consortia. For reported outcomes since 2010, the RISF program has received 398 proposals and awarded 72 projects. These RISF projects have generated approximately 147 follow-on proposals to external organizations of which 39 received awards totaling \$25,343,979 and leveraged the total ORI/KIETS awards of \$1,656,327 during the corresponding period. In addition, 86 students were supported, 262 publications or presentations made, and 31 workshops/symposia held during that period. KIETS Director Ruben Carbonell and Associate Director Raj Narayan served on the RISF selection committee. The traditional FY 2022-23 RISF proposals include the following: Dr. Rosemary Bayless, College of Veterinary Medicine, *Elucidation of Molecular Targets for a Novel Anti-inflammatory Therapeutic Phytocompound*; Dr. Peter Fedkiw, College of Engineering, *Self-Healing, Room-Temperature Liquid-Metal Electrodes for Energy Storage*; Dr. Qing Gu, College of Engineering, *Control of Room Temperature Quantum Coherence with Optical Metasurfaces*; Dr. Xu Xu, College of Engineering, *Promote Undergraduate Data Science Learning Through Students' Own Hand Gesture and Motion*.



Global Health and Climate Change Grand Challenges RISF Program

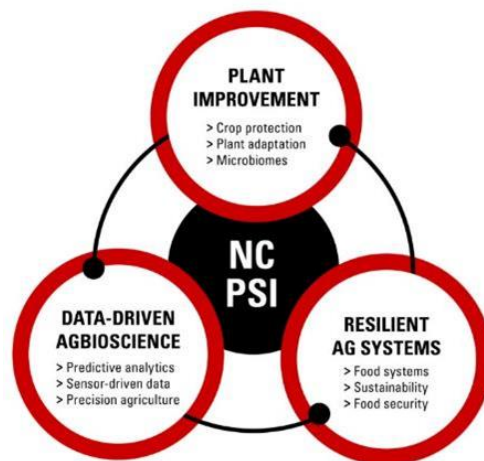
In FY 22-23, KIETS and the NC State Office of Research and Innovation (ORI) continued to support an expanded RISF program focused on Global Health and Climate Change. These topic areas were featured in the FY 2022 and FY2023 funding cycles due to their societal significance and the opportunities each provides for innovation. These research areas are also likely to be dominant national research themes for the foreseeable future and targets for significant amounts of federal research funding. The ORI and KIETS investment plays a role in raising NC State's visibility as a key contributor to solving some of society's grandest challenges. FY 2022-23 RISF Global Health / Climate Change projects include the following: Dr. Marcelo Ardon, College of Natural Resources, *Hydroclimatic Change and the Structure and Function of Streams in the Galapagos Archipelago*; Dr. David Eggleston, College of Sciences, *Using the Underwater Soundscape to Assess the Interacting Effects of Climate Change, Ocean Management, and Biodiversity*; Dr. Fernando Garcia Menendez,



College of Engineering, *Supporting Climate Change Mitigation in Latin America by Linking Reduced Deforestation Policies to Air Quality and Public Health Co-Benefits*; Dr. Rebecca Ward, College of Sciences, *Promoting Climate Literacy Through Teacher Training*; Dr. Shu Yang, College of Sciences, *Harnessing Data Science to Drive Precision Policy for Marine Protected Areas*; Dr. Jingjie Hu, College of Engineering, *Transcatheter Injectable Biomaterial for Next Generation Tumor Embolization*; Dr. Andrey Kuznetsov, College of Engineering, *Computational Models to Understand and Optimize Biomaterial Cell Factories*; Dr. Marie Muller, College of Engineering, *Modeling Mechanisms for Ultrasound Simulation of Platelet-like Particles*.

Game-Changing Research Incentive Program for Plant Sciences Initiative (GRIP4PSI)

In FY 22-23, KIETS collaborated with the Office of the Vice Chancellor for Research and College of Agriculture and Life Sciences to support the Game Changing Research Incentive Program for Plant Sciences. The GRIP4PSI initiative enables the NC State community to collaborate on integrated research/outreach projects that are focused on plant improvement, data-driven agricultural bioscience, and resilient agricultural systems. The GRIP4PSI projects are as follows: Dr. Christine Hawkes, Department of Plant and Microbial Biology, *FUN-CROPS: Foliar Fungal Endophytes for Enhanced Crop Sustainability and Resilience*; Dr. Jean Ristaino, William Neal Reynolds Distinguished Professor and Director of Emerging Plant Disease, Department of Plant and Microbial Biology, *Plant-Aid: A Data-Driven and Sensor-Integrated Platform for Monitoring Emerging Plant Diseases*; Dr. Katharina Stapelmann, Department of Nuclear Engineering, *Harnessing (Bio-) Electrochemical Technologies as Sustainable Sources for On-Demand Precision Agriculture*; Dr. Cranos Williams, Department of Electrical and Computer Engineering, *Improving Crop Productivity and Value Through Heterogeneous Data Integration, Analytics, and Decision Support Platforms*. Outcomes for the GRIP4PSI second fiscal year 2021-22 of support included the following: 22 follow up funding proposals submitted; 11 follow up funding proposals awarded for a total of \$12,488,238; 28 students supported; 96 publications or presentations generated; and 1 workshop.



The Long View, Conversations on the Future

KIETS supported *The Long View, Conversations on the Future* initiative led by Professor Rob Dunn, NC State Senior Vice Provost for Interdisciplinary Programs, in collaboration with Greg Raschke, Director of NC State Libraries to help guide future planning for NC State's diverse portfolio of interdisciplinary centers. Professor Dunn and his colleagues are conducting in person conversations with leading researchers about the intermediate and far future contextualized in light of stasis and business as usual models of the future. To date, several conversations have been held with leading researchers on the following topics: *Disruptive Science*, with Russell Funk, Associate Professor of Strategic Management and Entrepreneurship, Carlson School of Management, University of Minnesota; *AI in Higher Education*, with James Lester, Director of the NSF AI Institute for Engaged Learning and NC State Distinguished Professor of Computer Science; *Demographic Change and U.S. Enrollment Trends*, with Patrick Lane, Vice President of the Western Interstate Commission for Higher Education's Policy Analysis and Research unit; *Academic Big Data*, with Daniel Larremore, Assistant Professor of Computer Science, University of Colorado, Boulder; *Massive Online Classes*, with Pia Sorensen, Senior Preceptor in Chemical Engineering and Applied Materials, John A. Paulson School of Engineering and Applied Sciences, Harvard University.

In addition to these conversations, the Long View Initiative also is conducting and cataloging small group interviews on topics such as *The Future of Geospatial Analytics*, *The Future of Antibiotic Resistance*, and two interviews on *The Future of Genetic Engineering*. Additional interviews are being planned for *AI and Education*, *The Future of Sensors*, *Emerging Pathogens*, and *The Future of 3-D Printing Enabled, AI-driven Manufacturing*. Professor Dunn is also working with the Office of Research Innovation to engage NC State interdisciplinary cluster leaders in these conversations and held a cluster event on April 12, 2023. Roughly



The Long View Project

NC State's Long View Project seeks to anticipate the intermediate and far future by building on the interdisciplinary expertise of the world's best scholars.

40 faculty members have helped shape the current progress of this project. Outputs of this initiative will include white papers, short form interviews, and open access stories and conversations that are being recorded and archived at the NC State libraries. These white papers have the potential to be used in long-term planning in centers and in university-wide planning regarding the immediate and far future. Professor Dunn indicated KIETS support leverages cash and in-kind commitments from the NC State Libraries, SE Climate Adaptation Science Center, Comparative Medicine Institute, TriCEM, Sigma Xi, NC Museum of Natural Sciences, Danish Natural History Museum, and the College of Agriculture and Life Sciences.

GOAL 6: Lead in Developing Innovative Partnerships, Entrepreneurial Thinking and Applied Problem-Solving

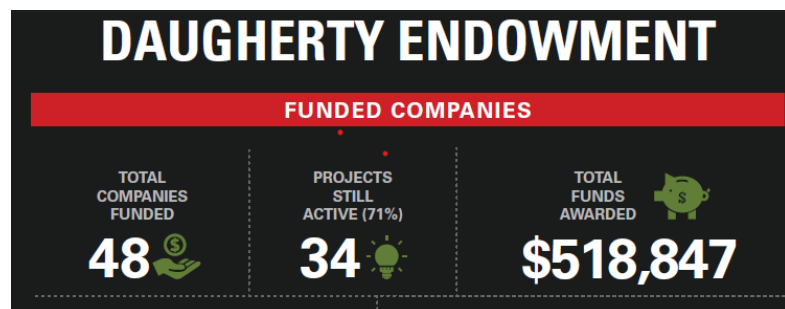
KIETS Goal: Support the launch of high technology start-ups based on NC State innovations and support technology commercialization programs at NC State, North Carolina and the Nation.

ACCOMPLISHMENTS

Richard and Marlene Daugherty Centennial Campus Entrepreneurism Endowment

KIETS provided matching funds for the *Richard and Marlene Daugherty Centennial Campus Entrepreneurism Endowment* that supports startup companies initiated with university intellectual property. The Daugherty Initiative continued its collaboration with the NC State Innovation and Entrepreneurship to feature the selection of the Daugherty Initiative recipients as part of the NC State eGames. The 2023 Daugherty Initiative track at the NC State eGames took place on April 13, 2023. The 2023 Daugherty Initiative awardees are as follows: **1st Place** – \$25,000 – *Hoofprint Biome* is developing a probiotic yeast to eliminate methane emissions from cattle by secreting methanogen-degrading enzymes; **2nd Place** – \$15,000 – *Vetletics* is developing an equine pneumatic compression system – the EQ-Press to aid in lymphatic fluid

circulation during tissue recovery post injury and exercise; **3rd Place** – \$10,000 – *SelSym Biotech* is developing a platform technology termed “Hemostatic Healing Hydrogels (H3),” that is a targeted particle-based system that augments the body’s natural blood clotting system, addressing a pressing clinical and military need in bleeding control. Since 2008, the Daugherty Initiative has invested \$518,847 in 48 companies with 71% of the companies still in business. Cumulative follow-on funding received by the awardees



since 2008 is over \$58 million. 2022 Daugherty Initiative first place awardee Vizma Life Sciences received a \$50K grant from NC IDEA, \$1,175,000 from two NIH SBIR grants, and \$75K from the One North Carolina Fund matching program through the NC Board of Science and Technology. 2022 Daugherty Initiative second place awardee Mammas Biosciences received support from the NC Biotechnology Center Industrial Internship Program. The Daugherty Initiative is managed by the NC State Office of Partnerships. KIETS Director Ruben Carbonell and Associate Director Raj Narayan serve on the Daugherty Initiative Governance and Selection Committee.

Wolfpack Investor Network (WIN)

KIETS continued to support the *Wolfpack Investor Network (WIN)* initiative focused on connecting alumni investors with promising NC State-affiliated startup companies to facilitate angel investments. WIN members and sidecar investment vehicles have surpassed investing over \$20 million into NC State-related startups since the network’s inception in December of 2016. During FY 22-23, WIN invested over \$3 million into portfolio company transactions screened by WIN staff. This marked the second fiscal year in a row that WIN had two positive liquidity events, resulting overall in three full exits and one partial exit to date. WIN engaged 12 MBA and STEM graduate students to perform due diligence on each company that presents to the membership. In addition, WIN had three undergraduate interns who were involved in the past year. To date, approximately 55 faculty members have aided in the WIN screening processes. In November 2022, WIN engaged a venture partner, Harbright Ventures, to help with company screenings, due diligence, and carrying out investment transactions. WIN estimates that over 600 jobs have been created within WIN portfolio companies since WIN’s inception in late 2016. NC State University, along with UNC-Chapel Hill and Duke University created the Triangle Venture



Alliance to build a network of angel groups that will tap into each university's alumni base and come together to invest jointly when there are alumni overlap within the startup company as well as shared interest in the investment opportunity. As of 2023, the Triangle Venture Alliance had invested over \$85 million dollars into approximately 98 portfolio companies. The WIN initiative is currently being housed in the Kenan Institute offices and KIETS Associate Director Raj Narayan serves as a member of the WIN Steering committee.

NC State Office of Research Commercialization SBIR/STTR Spark Plug Initiative

KIETS collaborated with the NC State Office of Research Commercialization (ORC) in support of the SBIR/STTR Spark Plug Initiative. The SBIR/STTR Spark Plug program is a coordinated and formalized strategy to assist researchers in NC



State startup companies help write the SBIR/STTR proposals. In FY 22-23, ORC continued a partnership with the First Flight Venture Center (FFVC) and their Liftoff, FAST and Propeller Programs. The goal of these programs is to increase university startup's chances of winning non-dilutive grant funding from the Federal SBIR/STTR Programs. The Spark Plug Program supported four companies in 2022 and two companies in 2023 including the following: *Teen Health Research*: Developing an app for parents of 10 to 13-year-old children who struggle to talk openly with their children about bodies, sexuality, and relationships. KIETS Associate Director Raj Narayan served as an instructor for this company through the NC State ICorps program. *Cosmic Eats*: Developing plant, fungal and algal food production modules combined into one multi-modular system for manufacturing foods. Cosmic Eats was awarded a Department of Defense Phase II SBIR in the amount of \$2,815,086.

KIETS Associate Director Raj Narayan served as an instructor for this company through the NC State ICorps program. *MyoMech*: Developing new wearable ultrasound sensors will provide a clear view of their muscles, to optimize long-term recovery and assistance. *NewCo*: Advancing the novel Autonomous Inducible Directed Evolution (AIDE) platform technology. AIDE allows generation of bacteria harboring tailor-made phenotypes that can address customer-specific unmet needs in the animal and human health space. *Redeem Solar Technologies*: Developing hydrogen storage technology for long term storage and economic H2 transporting in liquid, while eliminating the need for high pressure storage or expensive materials. *Nicelle Technologies*: Upcycling acrylic with lignin for creation of fiber products for faux hair and other fiber markets. Since its launch in late 2019, the Spark Plug program has funded 14 NC State startups that have gone on to generate over \$3.6 million in SBIR/STTR funding.

NC State Office of Research Commercialization NSF ICorps Program

In FY 22-23, KIETS collaborated with the NC State Office of Research Commercialization (ORC) on the NSF ICorps program in support of the Summer 2022, Fall 2022 and Spring 2023 cohorts. Total program participants included 62 total participants. Three new NC State startups were launched in 2023 upon completion of the ICorps program including *Lathyrus Biotechnology*, *Aja Labs*, and *Redeem Technologies*. ORC reported that 12 faculty members, 3 undergraduates, 15 graduate students, and 5 post docs participated in the ICorps Program in 2023. ORC hosted the first annual Mid-



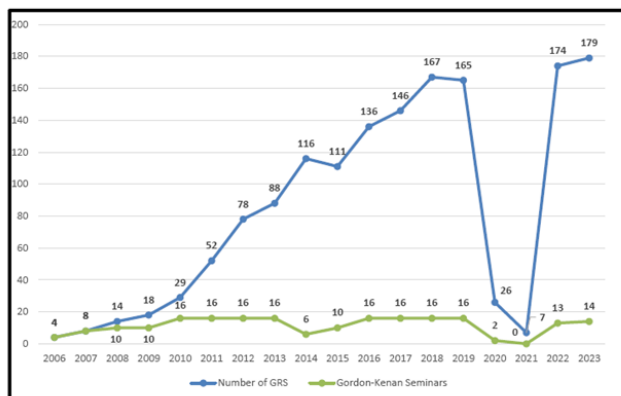
Atlantic I-Corps Hub Annual Meeting in Raleigh in December 2022, with 53 attendees from various member and partner institutions within the Hub. KIETS Associate Director Raj Narayan served as an NC State I-Corps ORC faculty instructor and advised the mentors and entrepreneurial leads in the NC State ICorps program. Some notable accomplishments of recent NC State I-Corps Hub participants include the following: The *Wrap & Plant* team was accepted into NSF's National I-Corps Teams Program in February 2023 receiving a \$50K grant; Startup *Cosmic Eats* received a direct to Phase II SBIR award from the Defense Advanced Research Projects Agency (DARPA) totaling \$2.85 million; Startup *Aja Labs* raised a \$2.5 million seed round to scale its technology that enables plastic-free synthetic fibers for the consumer beauty space, and ten NC State startups and research teams attended the 2023 Consumer Electronics Show (CES) in Las Vegas in January 2023 to present their companies/projects on the trade show floor at Eureka Park.

GOAL 7: Elevate the National and Global Reputation and Visibility of NC State

ACCOMPLISHMENTS

Gordon-Kenan Graduate Research Seminars (GKGRS)

A Gordon-Kenan Graduate Research Seminar (GKGRS) is a two-day meeting designed specifically for graduate students, post-doctoral students, and other scientists with comparable levels of experience. More than 80% of Gordon Research Conferences now have a corresponding Gordon Research Seminar. The Kenan Institute supports approximately 16 brand new GKGRS annually. Dr. Nancy Gray, GRC President reports that the GRC Board has approved requiring all conferences to hold a corresponding GRS beginning in 2024. A total of 551 attendees participated in 14 Gordon-Kenan Graduate Research Seminars from August 13, 2022 to June 23, 2023. The majority of attendees were young investigators, which included a total of 295 graduate students and 158 postdocs. Attendees represented regions throughout the world, however more than 57% of attendees were from regions inside of North America. North Carolina was represented at the seminars in 2022 and in 2023 including participants from Duke University, National Institute of Environmental Health Sciences, North Carolina A&T State University, and the University of North Carolina at Chapel Hill. Since 2001, Kenan Institute support has helped leverage \$11,273,161 from private & federal sources and helped provide registration and travel support for 4,290 GKRS registrants, roughly 43% of all GKGRS participants.



2020 and 2021 meetings were affected by the COVID-19 Pandemic. GRC ran a small sub-set of conferences within the portfolio during this time.

From 2001 to 2022, GKGRS/GRC Chairs have raised \$4,072,666 from federal funding and \$7,200,495 from private industry partners. During that time, 4,712 scientists from North Carolina have attended 3221 GRC conferences or seminars. In addition, NC State University scientists have participated as speakers 307 times and have chaired 20 GRC conferences or seminars.

Novo Nordisk Foundation International Collaboration on Bioprocessing

KIETS supported the Accelerated Innovation in Manufacturing Biologics (AIM-Bio) project enabled by funding from the Novo Nordisk Foundation. KIETS Director Ruben Carbonell and Gary Gilleskie, Director of BTEC, serve as principal investigators for the grant. NC State will receive \$18 million to achieve its activities. NC State and BTEC, in conjunction with the Technical University of Denmark (DTU) in Copenhagen, are in the middle of the third year of a five-year international collaborative research and training program in biomanufacturing science and technology. NC State and DTU are developing eight new combined lecture and hands-on short courses aimed at industry professionals on topics that are particularly relevant to the future of biopharmaceutical manufacturing, including the manufacturing of vectors for gene and cell therapies, automation and process control, and analytical methods. The following accomplishments demonstrate the impact of the program to date: 250 professionals (from both the U.S. and Europe) and graduate students (at NC State and DTU) have received training in courses designed by the AIM-Bio professional development program; Seven new courses have been developed and delivered at NC State with one more in development; Six courses have been transferred and delivered at DTU; Nine research projects are underway that are working with industry to translate results; 16 student exchanges and three faculty/staff are in progress or complete; Three annual symposium meetings have been held. In the AIM-Bio research program, several new scientific discoveries and demonstrations have been made in the areas of Cell Engineering, Process Analytical Technologies and Single-use Devices. The PIs also reported 45 publications generated, seven patents filed or granted, 24 faculty members involved, 13 graduate students, five post docs, and 23 companies engaged.



AIM-Bio Project: An international collaborative addressing the future needs of the biopharmaceutical industry

Novo Nordisk Foundation Research Proposal Initiative in Partnership with ORI / External Affairs

In FY 22-23, KIETS collaborated with the Office of Research and Innovation (ORI) and External Affairs, Partnerships and Economic Development (EAPED) at NC State University to identify multidisciplinary NC State faculty teams and



transformative research concepts that align with the Novo Nordisk Foundation (NNF) 2030 Strategy. The NNF 2030 Strategy centers on three pillars: Health, Sustainability, and Life Science Ecosystem. ORI and EAPED have invited concept papers from multidisciplinary teams that align with the NNF strategy pillars and themes. The aim is to bring faculty from different disciplines together to interact and engage in collaborative discussions, form teams, and create an integrated vision for potentially transformative research projects that may interest NNF. The PIs of the selected concept papers will be expected to work with an internal NC State task force charged with developing the NC State relationship with the Novo Nordisk Foundation. The Kenan Fellows Program for Teacher Leadership and KIETS Climate Leaders Program have submitted a concept paper in consideration of being invited to submit a full proposal. The Office of Partnerships is hiring a program director to manage and develop the Novo Nordisk Foundation relationship to NC State. This will include interaction with Novozymes and Novo Nordisk. Research and education (workforce development, faculty and student exchange) are integral to the Novo Nordisk Foundation research projects that will be supported and developed through the NNF program director.

American Chemical Society Colloids and Surface Science Symposium

The American Chemical Society (ACS) Colloid & Surface Science Symposium (CSSS) is an annual 3-day international conference that brings together approximately 500-700 interdisciplinary researchers from academia and industry from US and across the globe. They convene to discuss the latest topics in their common interest in particles and complex fluids, interfacial phenomena and chemistry, biomaterials, soft matter science, and environmental sustainability. KIETS supported the 97th ACS Colloid & Surface Science Symposium held at the NC State McKimmon Center between June 4-7, 2023. NC State Professors Lilian Hsiao and Orlin Velev from the Department of Chemical and Biomolecular Engineering were the local organizers for the meeting. The meeting at NC State University was organized into 13 sessions and a poster session that covered most areas of colloid and surface science, and included topics that are of special relevance to industry in the area. Modern and emerging topics, such as machine learning and AI in colloids, were included to draw in new researchers who are working in this important area. The meeting engaged students in science and engineering from several perspectives and the influx of 500+ attendees boosted the visibility for NC State University and Raleigh. The Army Research Office provided a substantial amount of funding for the conference and program managers attended. An industry-led session named "Connecting the Dots – from Startup to Corporate Level", featured representatives from a number of chemical and pharmaceutical companies invited to speak on a variety of topics such as translation of basic science to industry, differences between academic and industry R&D, and career tracks in different business sectors. Plenary lectures from worldwide leaders in engineering provided a broad forum for visibility of NC State, and the State of North Carolina.



Staff Leadership

KIETS staff also served in leadership and advisory roles in several initiatives at NC State and with external groups.

ACCOMPLISHMENTS

- KIETS Director Dr. Ruben Carbonell served on the RISF Selection Committee, the IEI National Advisory Board, the College of Engineering Executive Committee, the Daugherty Endowment Governance Committee, the Advisory Board for the FSU-FAMU Chemical Engineering Department, the National Academy of Engineering's Audit Committee, the Plant Sciences Initiative Leadership Committee, the Kenan Institute for Private Enterprise Advisory Board, the Executive Committee of the NC Association for Biomedical Research, and as Chief Technology Officer for the National Institute for Innovation in Manufacturing Biopharmaceuticals. He also served on the National Academy of Sciences Board of Chemical Sciences and Technology, and the EU Academy of Sciences.
- KIETS Associate Director Raj Narayan served as a Professor of the Practice of Entrepreneurship and Executive in Residence in the TEC Program within the Poole College of Management. Mr. Narayan served as a mentor for the NC State Social Innovation Fellows program, the NC Sea Grant CCRG



Review Committee, the Daugherty Endowment Governance Committee, the RISF selection committee, and the Wolfpack Investor Network (WIN) Steering Committee. Mr. Narayan was an instructor with the NC State Office of Research Commercialization ICORPS program. Mr. Narayan also served as Chair of the UNC School of Law Institute for Innovation Board of Advisors. He was also an active participant in the NC Eisenhower Fellows, Marshall Memorial Fellows, and William C. Friday Fellows alumni initiatives and served as Vice President of the NC Eisenhower Fellows Alumni Chapter.

- KIETS Assistant Director for Grants and Finance Cordella Rashid served on the HR Connections Committee, Business Connections Committee, African American Faculty & Staff Organization Committee, the Society for Human Resource Management, and the National Council of University Research Administrators. Ms. Rashid was appointed to the NC State Staff Senate and serves as a representative of the Chancellor's Unit.
- KIETS University Program Associate Tara Spivey served as the Hunt Library building liaison team on behalf of the tenants in our Hunt Library office suite. Ms. Spivey also participated on the following committees: NC State Event Planners Council, Hunt Library Partners Meeting Committee, TSS LanTech Meeting Committee, Facilities Liaison Briefing Meetings Committee, Chancellor's Unit Awards for Excellence, and African American Faculty & Staff Organization. Ms. Spivey completed her Fellowship as a member of the 2020-22 cohort of the William C. Friday Fellows program which is a highly respected cross sector leadership program focused on adaptive leadership and impact on our communities statewide. Ms. Spivey was also nominated for the Chancellor's Unit Award for Excellence in Spring 2023.
- Amanda Mueller was promoted to Director of the KIETS Climate Leaders Program in November 2022. She continued to serve as a collaborator with the Office of the Provost Coastal Resilience and Sustainability Initiative and as co-coordinator of the Climate Change Synergies Workshop (along with the Coastal Resilience and Sustainability Office, Global One Health Academy, and State Climate Office).
- Dr. Roy He (Department of Marine, Earth, and Atmospheric Sciences) completed his term as the inaugural Senior Faculty Fellow of the KIETS Climate Leaders Program and Professor Jeremiah Johnson (Department of Civil, Construction and Environmental Engineering) began his term as Senior Faculty Fellow of the KIETS Climate Leaders Program.
- Vance Kite was hired as the Director of the Kenan Fellows Program in July 2022. Over the past year, Dr. Kite published three research articles that focus on the work of secondary science teachers. These articles published in three of the top education research journals: The Journal of Science Teacher Education, Teaching and Teacher Education, and The Journal of Research in Science Teaching. In addition to his publication, Vance has recently begun service on the doctoral committee of Jesus Esquibal, a doctoral student in the Department of Science Education at Texas Tech University.
- Mark Townley, Assistant Director of Programs for the Kenan Fellows Program served on the Board of Directors for the Exploris School in Raleigh, NC. He also served on the Governor's Teacher Advisory Committee for Governor Roy Cooper. Mr. Townley was nominated for the Chancellor's Unit Award for Excellence in Spring 2023.
- Amneris Solano, Assistant Director for Communications for the Kenan Fellows Program continued to assist KIETS with supporting KIETS website improvements and social media presence. Ms. Solano earned her MS in Communication from NC State University in December 2022.
- Carrie Horton, Program Manager for the Kenan Fellows Program STEMwork initiative began a Graduate Certificate program for Nonprofit Management at NC State in Spring 2023. Ms. Horton also volunteers as a co-leader for the NC Coastal Pines Girl Scout Troop #11 in Johnston County.



- Randy Pinion transitioned from Activities Coordinator to a new role as the Logistics and Data Manager for the Kenan Fellows Program.
- Kenan Fellows Program Director Dr. Vance Kite served as the Executive Editor, Amneris Solano served as the Managing Editor, and Randy Pinion served as the Copy Editor of the Kenan Fellows Program *Journal for Interdisciplinary Teacher Leadership*.

Recommendations and Future Concerns

To build on its past successes, the Kenan Institute requires continued commitment and financial support from its partners including NC State University, the Kenan Fund for Engineering, Technology & Science, and other universities, foundations, and government partners.

In FY 22-23, KIETS remained responsive to stakeholder needs and continued to identify high impact investment opportunities while remaining vigilant of potential impacts to available funding for key initiatives. Among the key priorities for KIETS moving forward remains a focus on grand challenges in global health and climate change. These two areas of focus for KIETS amplify the strategic interests and capabilities of NC State University and its partners toward developing innovative solutions addressing enduring problems in our State, Nation, and the World. KIETS looks forward to building this work in collaboration with key partners including the Provost, Vice Chancellor for Research, and leadership of NC State University's Colleges.

In addition, it remains essential for leadership from within the University, Kenan Fund, and industry to work closely with the Institute's leadership to serve as high-level advocates on behalf of Institute programs such as the Kenan Fellows Program and Climate Leaders Program. This strategic advocacy will help the Institute promote the impact of its programs and build its reputation as an honest broker of best practices in research, education, entrepreneurship, and public policy. In addition to financial support, the Institute will need continued in-kind support from the University such as the office space provided in the Hunt Library and support from units such as the Office of Advancement, Office of Communications, and Office of Sponsored Programs' Integrated Support Services Center. KIETS continues to maintain very efficient operations with a small staff which poses challenges in managing large-scale events. As KIETS continues to develop its programs, it seeks to leverage and complement its resources from university partners including Special Events and the McKimmon Center to help manage event planning and implementation. KIETS will also continue to work closely with University Advancement as it seeks resources to leverage its investment in core programs and operations. Ultimately, these are issues related to the sustainability of the Institute and its programs and how the Kenan Institute is regarded in terms of University fundraising priorities.

