FEATURED INSIDE:

Everyday science
K-State research lives in our daily lives

Improving the framework
Researchers build on infrastructure investment

A statewide movement
K-State 105 helps counties across Kansas
Three-dimensional education

Engineers at the Kansas State University Technology Development Institute in the Carl R. Ice College of Engineering work with researchers in the College of Veterinary Medicine to design and develop new tools for teaching.

Using 3D-scanning technology, irregular shapes such as this horse skull can be scanned and captured with software and manipulated on a computer that allows for various features to be modified for training aids. In the model on this page, the teeth were redesigned to be removable and a life-size version of the skull was then 3D printed to be used as an educational tool.

See page 32 to learn more about work that involves the Technology Development Institute.
A statewide movement
K-State 105 helps counties across Kansas

Everyday science
K-State research lives in our daily lives

Improving the framework
Researchers build on infrastructure investments

Transformation across the globe
How K-State research feeds the world

Seek Fall 2023
Seek Fall 2023

We take pride in celebrating our researchers’ work and promoting its impact.

We are pleased to share our latest issue of Seek, Kansas State University’s award-winning research magazine. Research is core to our mission as a great land-grant university, a public research university and a university dedicated to learning, discovery and innovation. We take pride in celebrating our researchers’ work and promoting its impact. We invite you to learn more through the pages of this beautiful magazine.

This issue celebrates a wide range of research at K-State, from research on grand challenges, large-scale systems and the health of our planet and its populations, to everyday science on the farm, in the community, in our homes and on the kitchen table. From discovery deep in the disciplines, advancing the state-of-the-art, to transdisciplinary research that cuts across traditional fields of study to create entirely new ones, advancing our state-of-understanding, K-State research is innovative and impactful.

We also feature a story about K-State 105, one of the four pillars of K-State’s bold Economic Prosperity Plan for Kansas launched in 2021. K-State 105 is connecting K-State research and expertise to the needs of communities in Kansas to build economic opportunity and the core elements that support it: child care and early childhood education, health and well-being, housing, transportation and infrastructure, small business development, food security and statewide connectivity.

By focusing on the people conducting research at K-State and the impacts of their work — locally, nationally and globally — we hope our magazine and the research being highlighted inspires both curiosity and pride. Thank you for your interest, support and engagement with K-State research.

Go ‘Cats!

David V. Rosowsky, Ph.D.
Vice President for Research
Kansas State University is leaning into its land-grant heritage and mission with its Next-Gen K-State strategic plan.

Built from input from more than 10,000 students, faculty, staff, alumni, donors and other university stakeholders — including the 2,457 Kansans who participated in last academic year’s regional community visits across the state — the plan outlines how the university will transform to serve new kinds of learners, solve grand global challenges and contribute to the economic prosperity of the state.

“Being a next-generation land-grant university requires us to renew our commitment to the land-grant mission, which is all about access and opportunity,” said Richard Linton, K-State president. “But access and opportunity today means something different than it did in 1863 — we must evolve to meet the needs of today’s learners who are seeking different kinds of training and education, and we must embrace our responsibility to serve the state, nation and world through research and engagement in new and exciting ways.”

The plan, which outlines key priorities for the institution, four distinct opportunity areas for interdisciplinary focus, and 17 relevant measures of success, will guide the university through the year 2030. Specific goals around student enrollment and retention, academic innovation and applied learning experiences, research growth and impact, and engagement and economic impact will define the future of the university.

“As the nation’s first operational land-grant university, we view it as our responsibility to redefine what that means in modern-day contexts — and by delivering unmistakable value to all who wish to learn, grow and prosper, we will set the standard for what a highly engaged, people-centered, and learner-focused university can and should be,” Linton said.

**Growing research and setting the K-State opportunity agenda**

When it comes to the research arm of the university, the strategic plan outlines a goal of increased annual research expenditures and growing the university’s research enterprise by this measure to $300 million by 2030.

K-State has both an opportunity and an imperative to bring resources and expertise together in a way that respects the university’s unique structure and challenges historical norms.

The university also has identified four interdisciplinary areas of focus where K-State is uniquely positioned to serve: community health and well-being, sustainability, global food security and biosecurity, and enabling technologies. These four areas make up what the university is calling the K-State opportunity agenda.

**Community health and well-being**

This focus area encompasses understanding physical, social and cultural features of a community; researching social dynamics and cohesion within a community; identifying and addressing factors that drive health disparities, including social determinants of health and health care policies; and identifying and enhancing the structures, policies and practices that impact accessibility to education.

**Sustainability**

This focus area includes considerations of water and resource management practices, the natural and environmental factors that impact resource usage, our health, environment and society; the conservation and restoration of biodiversity; and economic policies and cultural practices that affect their impacts on human ecology.

**Global food security and biosecurity**

Relevant work in this focus area includes practices for increasing food production and the impact of social, political and environmental policies and factors on production, as well as strategies for preventing and controlling infectious diseases and environmental factors that contribute to their prevalence. Other areas may include communication and human impact, supply chain considerations and the interactions between policy and economics that affect food access and security.

**Enabling technologies**

This focus area considers how to advance and understand the implications of natural language processing and machine learning, as well as integration of technology across foundational elements of modern human life. It also includes the opportunity to consider the ethical and societal impacts of those integrations.

---

**See Shorts**

Next-Gen K-State plan reimagines educational access and opportunity

Kansas State University is leaning into its land-grant heritage and mission with its Next-Gen K-State strategic plan.

Built from input from more than 10,000 students, faculty, staff, alumni, donors and other university stakeholders — including the 2,457 Kansans who participated in last academic year’s regional community visits across the state — the plan outlines how the university will transform to serve new kinds of learners, solve grand global challenges and contribute to the economic prosperity of the state.

“Being a next-generation land-grant university requires us to renew our commitment to the land-grant mission, which is all about access and opportunity,” said Richard Linton, K-State president. “But access and opportunity today means something different than it did in 1863 — we must evolve to meet the needs of today’s learners who are seeking different kinds of training and education, and we must embrace our responsibility to serve the state, nation and world through research and engagement in new and exciting ways.”

The plan, which outlines key priorities for the institution, four distinct opportunity areas for interdisciplinary focus, and 17 relevant measures of success, will guide the university through the year 2030. Specific goals around student enrollment and retention, academic innovation and applied learning experiences, research growth and impact, and engagement and economic impact will define the future of the university.

“As the nation’s first operational land-grant university, we view it as our responsibility to redefine what that means in modern-day contexts — and by delivering unmistakable value to all who wish to learn, grow and prosper, we will set the standard for what a highly engaged, people-centered, and learner-focused university can and should be,” Linton said.

**Growing research and setting the K-State opportunity agenda**

When it comes to the research arm of the university, the strategic plan outlines a goal of increased annual research expenditures and growing the university’s research enterprise by this measure to $300 million by 2030.

K-State has both an opportunity and an imperative to bring resources and expertise together in a way that respects the university’s unique structure and challenges historical norms.

The university also has identified four interdisciplinary areas of focus where K-State is uniquely positioned to serve: community health and well-being, sustainability, global food security and biosecurity, and enabling technologies. These four areas make up what the university is calling the K-State opportunity agenda.

**Community health and well-being**

This focus area encompasses understanding physical, social and cultural features of a community; researching social dynamics and cohesion within a community; identifying and addressing factors that drive health disparities, including social determinants of health and health care policies; and identifying and enhancing the structures, policies and practices that impact accessibility to education.

**Sustainability**

This focus area includes considerations of water and resource management practices, the natural and environmental factors that impact resource usage, our health, environment and society; the conservation and restoration of biodiversity; and economic policies and cultural practices that affect their impacts on human ecology.

**Global food security and biosecurity**

Relevant work in this focus area includes practices for increasing food production and the impact of social, political and environmental policies and factors on production, as well as strategies for preventing and controlling infectious diseases and environmental factors that contribute to their prevalence. Other areas may include communication and human impact, supply chain considerations and the interactions between policy and economics that affect food access and security.

**Enabling technologies**

This focus area considers how to advance and understand the implications of natural language processing and machine learning, as well as integration of technology across foundational elements of modern human life. It also includes the opportunity to consider the ethical and societal impacts of those integrations.
Game-changing research

The Kansas State University Office of the Vice President for Research has selected 10 research teams that will receive fully funded teams and seven finalist teams that are receiving seed funding — to receive inaugural awards from the Game-changing Research Initiation Program, or GRIP.

GRIP supports innovative and groundbreaking research by catalyzing teams of K-State faculty across departments, colleges and campuses to address complex challenges that require a transdisciplinary solution.

“The goals of GRIP are twofold,” said David Rosowsky, vice president for research. “First, to enable teams of investigators that self-assemble from across the university to work together toward a mission and sustained research effort in a timely, cohesive and important area for our state. And second, to begin building a culture that recognizes, supports and celebrates transdisciplinary activity at K-State.”

The three funded teams will receive a total of $910,000 per project. The seven other finalist teams are receiving GRIP seed grant funding that will enable them to keep their teams together, advance their ideas and prepare for future solicitations to keep their teams together, advance their ideas and prepare for future solicitations.

Overall, the 10 teams receiving GRIP funding this year include K-State faculty from the Manhattan and Olathe campuses as well as seven colleges — the College of Agriculture; the College of Architecture, Planning & Design; the College of Business Administration; the Carl R. Ice College of Engineering; the College of Health and Human Sciences; and the College of Veterinary Medicine.

The three funded teams will receive a total of $910,000 per project. The seven other finalist teams are receiving GRIP seed grant funding that will enable them to keep their teams together, advance their ideas and prepare for future solicitations from federal agencies.

The three funded teams will receive a total of $910,000 per project. The seven other finalist teams are receiving GRIP seed grant funding that will enable them to keep their teams together, advance their ideas and prepare for future solicitations from federal agencies.

EPA supports K-State work to revitalize brownfields

The Environmental Protection Agency has awarded $2.5 million to the Center for Hazardous Substance Research at Kansas State University to expand the Technical Assistance to Brownfields, or TARB, program that works to revitalize environmentally distressed properties.

These properties, known as brownfields, are often underutilized or blighted pieces of land that are not chosen for economic or community development plans, address the environmental issues and reuse the properties.

Blase Levin, director of the Center for Hazardous Substance Research, said the EPA funding would help the program expand and complete more projects in its 21-state region, including Kansas and other states from the Great Plains, Rocky Mountain and Great Lakes regions. K-State is also the national leader for working with five other TARB providers that serve the western and eastern regions of the U.S.

The TARB program operates through the Carl R. Ice College of Engineering and collaborates with a variety of K-State units, including the Tim Taylor Department of Chemical Engineering, the Department of Landscape Architecture and Regional & Community Planning in the College of Architecture, Planning & Design, and Engineering Extension. The program also works alongside 35 universities and contractors throughout the region.
A Kansas State University regional partnership has received $1 million from the U.S. National Science Foundation’s Regional Innovation Engines, or NSF Engines, program.

The partnership — called the Advancing Biosecurity, Biodefense, and Biomanufacturing Technologies project — includes core leaders K-State, Manhattan Area Technical College, BioKansas, K-State Innovation Partners and the Manhattan Area Chamber of Commerce as well as many regional and industry partners.

The project is among more than 40 unique teams to receive one of the first-ever NSF Engines Development Awards, which focus on driving innovation in the region and fostering collaboration among universities, small businesses, and other organizations.

Stacy Hutchinson, associate dean for research and graduate programs and professor of biological and agricultural engineering in the Kansas State University Carl R. Ice College of Engineering, is the chair of a thematic task force of the Engineering Research Visioning Alliance that recently released a new report on engineering research priorities to address the complex issues of water security.

The report, “Engineered Systems for Water Security,” identifies critical research priorities related to engineering and water security:

- Develop, test and implement a water management framework that considers the nexus between engineered, natural and human systems.
- Build/create new, resilient, scalable and adaptable infrastructure with the flexibility to opportunistically integrate legacy systems.
- Improve data gathering and analysis and leverage predictive modeling and data-informed operations.

Understanding and addressing water security

Stacy Hutchinson, associate dean for research and graduate programs and professor of biological and agricultural engineering in the Kansas State University Carl R. Ice College of Engineering, is the chair of a thematic task force of the Engineering Research Visioning Alliance that recently released a new report on engineering research priorities to address the complex issues of water security.

The report, “Engineered Systems for Water Security,” identifies critical research priorities related to engineering and water security:

- Develop, test and implement a water management framework that considers the nexus between engineered, natural and human systems.
- Build/create new, resilient, scalable and adaptable infrastructure with the flexibility to opportunistically integrate legacy systems.
- Improve data gathering and analysis and leverage predictive modeling and data-informed operations.
The Kansas State University Salina Aerospace and Technology Campus now has a highly advanced educational space that uses ultramodern technology: a new extended reality, or XR, lab space. The Immersive Technology Classroom combines virtual, physical and augmented reality technology. The facility features an immersive video wall showing multiple views from several different devices and an in-room immersive audio system to provide a much more functional space.

XR has a wide range of applications in various fields, including education, entertainment, health care, engineering and many more. It allows users to experience and interact with virtual objects and environments naturally and intuitively, leading to new possibilities in education, training and research.

AEROSPACE AND TECHNOLOGY

Michael Pritchard, associate dean of research and graduate studies at K-State Salina, said the space will not only be utilized as a classroom where students learn about the theory behind the technology, but it will also be a space where applied projects lead to real-world products.

“This space is used to push the boundaries of cybernetic and cyber human systems research,” Pritchard said. “The new lab and equipment have expanded our ability to develop cognitive processing research across a variety of human-to-machine teaming scenarios. We are engaged with industry on multiple cyber human systems projects, which illustrates that our work in the new XR lab sets our campus apart from many of our counterparts.”

Kansas State University Salina Aerospace and Technology Campus, in partnership with Pure Imagination Studios, the Salina Airport Authority and the state of Kansas, is establishing a $41 million, one-of-a-kind spatial computing studio and learning center.

The Kansas Advanced Immersive Research for Emerging Systems, or K-AIRES, is the most significant investment in the campus’s infrastructure to date. This project will add a new three-story, approximately 35,000-square-foot facility that will bring with it more than 100 new jobs to the Salina area and propel the community to the forefront of the spatial computing industry. The headquarters for Pure Imagination Labs also will be on the K-State Salina campus.

The studio and learning center at K-State Salina will feature state-of-the-art equipment and immersive technology to transform the education experience and establish new frontiers. Faculty and researchers will be able to leverage immersive environments to reimagine what 21st-century education should be. The hands-on application of embedded industry projects with collaborative, multidisciplinary problem-solving drives the learning experience.

“K-AIRES brings world-leading simulation and artificial intelligence capabilities to the major industry sectors of Kansas, with a heightened focus on aerospace, advanced manufacturing and defense,” said Alysia Stablos, K-State Salina CEO and dean. “Once complete, this facility will provide exciting and engaging ways to educate and train students in the enabling technologies of the future. We also expect large-scale research grants, sponsored research projects and targeted industry partnerships to support the growth of local and state workforce and economic development.”

K-State Salina unveils new extended reality lab

Imagining a new spatial computing studio and learning center

The studios and learning center at K-State Salina will feature state-of-the-art equipment and immersive technology to transform the education experience and establish new frontiers. Faculty and researchers will be able to leverage immersive environments to reimagine what 21st-century education should be. The hands-on application of embedded industry projects with collaborative, multidisciplinary problem-solving drives the learning experience.

“K-AIRES brings world-leading simulation and artificial intelligence capabilities to the major industry sectors of Kansas, with a heightened focus on aerospace, advanced manufacturing and defense,” said Alysia Stablos, K-State Salina CEO and dean. “Once complete, this facility will provide exciting and engaging ways to educate and train students in the enabling technologies of the future. We also expect large-scale research grants, sponsored research projects and targeted industry partnerships to support the growth of local and state workforce and economic development.”
Inspiring minds
Prestigious awards recognize early career researchers

By Carson Byers
The National Science Foundation has recognized four Kansas State University researchers as they launch the vital work of these awards, which will help support the development of these researchers as they launch their projects in various fields. The CAREER honor for early career faculty recognizes early career faculty members. The CAREER award is the Early Career Development, or CAREER, award of the National Science Foundation. By Carson Byers

Sonny Lee
Assistant professor in the Division of Biology
College of Arts and Sciences
AREA OF STUDY: The interactions among plants and their soil microbiomes
AWARD: Nearly $901,000 NSF CAREER award
PROJECT TITLE: “How do rhizosphere associated microorganisms and plant host interact to regulate soil microbial processes?”
PROJECT DESCRIPTION: This project will link plant gene diversity to plant-rhizobiome interactions influence ecosystem sustainability, which is critical for anticipating ecosystem responses to environmental change. Lee will integrate education with research and will collaborate with students and citizen scientists to determine this mechanistic interaction and how that affects fitness and drought resistance.
FROM THE RESEARCHER: “We are excited to identify the potential mechanisms in which the plant and its associated microbes can work together to become more resilient under climate change conditions,” Lee said. “We are also thrilled to be working holistically with our citizen science partners and collaborators to extend our research to the public and students.”

Won Min Park
Assistant professor in the Tim Taylor Department of Chemical Engineering
Carl R. Ice College of Engineering
AREA OF STUDY: Protein biomaterials engineering
AWARD: Nearly $550,000 NSF CAREER award
PROJECT TITLE: “Modular protein origami to build genetically programmable biomaterials”
PROJECT DESCRIPTION: This project will develop a simple, modular and versatile technology to direct the folding and assembly of protein biomaterials using a molecular version of origami. This project will examine the genetic programming of complex functionalities into the biomaterials created from this process. Additionally, Park will produce educational activities that will train students in protein biomaterials engineering.
FROM THE RESEARCHER: “This project will focus on understanding the process of nano-scale origami using the building blocks of modular protein origami,” Park said. “The technology of modular protein origami will create next-generation tools for the design and construction of protein origami will create next-generation tools for the design and construction of protein biomaterials engineering.”

Tendai Gadzikwa
Associate professor in the Department of Chemistry
College of Arts and Sciences
AREA OF STUDY: Molecular reactions
AWARD: Nearly $780,000 NSF CAREER award
PROJECT TITLE: “Confinement effects and emergent behavior in multifunctional MOF-based catalysts”
PROJECT DESCRIPTION: Gadzikwa's lab studies, designs and confines molecular materials that are known as metal-organic frameworks. These materials have physical and chemical structures modeled after the active sites of enzymes, which are the most efficient catalysts known to researchers. This project will help understand how the molecular origins of unexpected reactivity and confinement effects within these materials so researchers can design and construct efficient catalysts.
FROM THE RESEARCHER: “Emergence occurs when a system displays behavior that would not be expected given the properties of its constituent parts,” Gadzikwa said. “Such surprising behavior, which no one can yet explain, is exciting to observe because it suggests we are on the verge of discovering something that could transform how chemists think about reactions in confined spaces.”

Raj Kumar Pal
Assistant professor in the Nuclear Engineering, Carl R. Ice College of Engineering
AREA OF STUDY: Elastic wave energy trafast
AWARD: $504,000 NSF CAREER award
PROJECT TITLE: “Guiding and confining nonlinear elastic waves in moiré metastructures”
PROJECT DESCRIPTION: Pal’s research will address a major challenge in wind energy generation. He will explore new architectural metamaterials to provide vibration protection of large-capacity wind turbine blades. The project will focus on the application of these engineered materials, called moiré metastructures, which are able to guide and confine elastic waves in a new, innovative way.
FROM THE RESEARCHER: “The project will train and expose our graduate and undergraduate students to cutting-edge research in vibrations, support international study exchange with our collaborators in France and result in novel devices for wave control,” Pal said.

See Faculty Focus
From the moment our alarm goes off and we hit the snooze button — invented by Kansas State University alumnus Herbert Dimond — science is at our fingertips.

Science makes our complex, everyday actions simple: turning on a light with the flip of a switch, getting water from a faucet inside our home, refrigerating food to keep it cold, driving vehicles with enhanced safety features, using a phone as a small computer, shopping online — the list goes on.

It’s not just the natural sciences that affect our everyday lives. Social sciences help us better understand the world around us: how the economy grows, why people behave in certain ways, what influences our decision-making, how we embrace cultural differences, what makes people happy and the many other ways that influence how we interact with others.

Research drives society forward. K-State researchers are passionate about making the world a better place and helping us understand our society. Continue reading to learn how you experience K-State research every day.
MONEY

Talking about money can be difficult, but financial planners help people discuss the all-too-uncomfortable topic to reach their goals.

The personal financial planning program in the College of Health and Human Sciences specializes in financial therapy, which combines financial planning with marriage and family therapy and psychology. The program’s research explores money’s relational, behavioral, cognitive and emotional elements.

- Martin Seay, professor of personal financial planning and department head, examines how different personalities interpret financial events and the resulting decisions or actions. For financial planners, it is essential to understand how clients view a situation and make financial decisions.
- Megan McCoy, assistant professor of personal financial planning, has been part of a collaborative study examining financial anxiety, which is prevalent, excessive worry about a financial situation. The study found that financial anxiety is prevalent in Americans’ lives, even when access to money is not an issue.

EXERCISE

Daly physical activity is key to improving mood and brain health, strengthening bones and muscles, reducing the risk of disease, managing weight and improving physical function.

The CDC recommends 150 minutes of moderate-intensity activity and two days of muscle-strengthening exercise weekly. Many kinesiology researchers in the College of Health and Human Sciences are evaluating how the body responds to physical activity and how best to promote physical activity so people of all ages can experience its benefits.

- Emily Muske, associate professor of kinesiology, studies workplace interventions to increase physical activity and well-being. Her recent study using height-adjustable desks and an online behavioral support program reduced the number of hours participants sat daily and improved mood, fatigue, focus and productivity.
- Peter Szporer, assistant professor of kinesiology, focuses on increasing physical activity in youth to prevent diabetes and other noncommunicable diseases. His current project assesses physical activity in before- and after-school programs to create a more active environment.
- Aspen Stinson, doctoral student in kinesiology, studies the relationship between promoting and improving access to strength training and women empowerment. Early findings show a positive correlation between becoming physically stronger and physical, mental and social health.

WATER

Parts of the U.S. are currently experiencing drought, while other areas have seen abundant snow or rain, causing flooding and other challenges. The climate extremes affect water availability and can influence the ecology of bodies of water.

Trinetta Moore, associate professor in the Carl and Melinda Heilig Department of Biological and Agricultural Engineering in the Carl R. Ice College of Engineering, examines the water quality of runoff, rivers and reservoirs. She studies the connection between water quality and urban flooding.

Moore, a yogi and Gary Edwards Cornerstone teaching scholar, works with municipalities to develop partnerships with specialty food managers to implement practices that improve water quality and availability throughout the watershed. These practices help attract soil, nutrients and water on the landscape where it is needed to produce food while protecting our downstream waters from harmful algae blooms and sediments. That way, communities throughout the watershed have access toneeded water.

FOOD SAFETY

Every year approximately 48 million people get sick from foodborne illnesses, according to the Centers for Disease Control and Prevention. Food safety scientists continue to develop best practices and ways to prevent these incidents and outbreaks.

Valentina Trinetta, associate professor of food safety and microbiology in the College of Agriculture, is studying how pathogens enter the food system to develop interventions that can reduce and control pathogens in raw and processed foods.

With funding from the U.S. Department of Agriculture and specialized commodity groups, Trinetta primarily studies microorganisms such as listeria, E. coli and salmonella. Her lab is working with the tree fruit industry to understand how common sanitizers control bacteria found on wood, nylon and plastic — the materials typically found in fruit-picking bins and harvesting bags.

BAKED GOODS

The greatest thing since sliced bread is even better bread. And better bread comes from understanding the role of each ingredient.

Researchers in the College of Agriculture’s grain science and industry department are exploring how to best use Kernza grain—a perennial wheatgrass and a cousin to wheat—in food production. This grain is low in gluten with good fermentation properties. The study includes grain handling, processing, pest control and market use.

Elisa Karkle, assistant professor of bakery science and industry department are exploring how to best use Kernza grain—a perennial wheatgrass and a cousin to wheat—in food production. The study includes grain handling, processing, pest control and market use.

Learn more about the food safety research projects.

Seek Fall 2023

Seek Fall 2023

Seek Fall 2023
CONSUMER BEHAVIOR

Big or small, purple or gray, this or that — the average adult makes thousands of decisions every day. Social scientists across disciplines seek to understand how and why we make these choices.

Buying decisions are sometimes apparent, while others are made on a whim. Understanding a consumer’s decision-making process is a research focus of Junhui Crow, instructor of marketing in the College of Business Administration.

To better understand why fewer girls choose to enter the sciences, Crow is examining the role that STEM toys play in career paths. While many factors influence a child’s career choice, parents may have direct or indirect influence because of the toys they purchase. Crow also examines what influences a parent when buying a toy for a son or daughter.

Her evaluation has found common influences are cultural norms, marketing and packaging differences by demographic, and perceived entertainment value by the parent.

ERGONOMICS

The comfort of a chair, the functionality of an electronic device or digital app and the feel of a tool in your hand are the result of industrial designers’ meticulous attention to detail.

Brongos Kim, assistant professor of interior architecture & industrial design in the College of Architecture, Planning & Design, particularly is interested in ergonomics because of its role in enhancing product usability. Ergonomic design enhances the well-being of users by mitigating muscle fatigue, improving posture or increasing performance.

Kim is working with students in his Human Factors in Industrial Design class to evaluate the feasibility of personalizing everyday objects, such as tools or kitchen gadgets, to fit the user’s hand size and enhance usability, functionality and satisfaction.

CYBERCRIME

The comfort of a chair, the functionality of an electronic device or digital app and the feel of a tool in your hand are the result of industrial designers’ meticulous attention to detail.

Brongos Kim, assistant professor of interior architecture & industrial design in the College of Architecture, Planning & Design, particularly is interested in ergonomics because of its role in enhancing product usability. Ergonomic design enhances the well-being of users by mitigating muscle fatigue, improving posture or increasing performance.

Kim is working with students in his Human Factors in Industrial Design class to evaluate the feasibility of personalizing everyday objects, such as tools or kitchen gadgets, to fit the user’s hand size and enhance usability, functionality and satisfaction.

ENERGY

As you drive down the road, you may not think about your car’s fuel source. Most fuels on the market are petroleum-based, with ethanol being one alternative fuel option. Biodiesel is another very common fuel used in almost every gallon of diesel fuel sold in Kansas.

K-State researchers, such as Edwin Brokesh, assistant professor in the Carl and Melinda Hefley Department of Biological and Agricultural Engineering in the Carl R. Ice College of Engineering, are exploring ways to host reduce dependence on fossil fuels, from modifying Trusted Crop silos to produce large amounts of oil to understanding the best practices for biodiesel use and distribution.

The K-State Biodiesel Initiative, a student-led organization that Brokesh advises, is reducing K-State’s dependence on petroleum-based fuels by converting used cooking oil from the university’s Housing and Dining Services. From collecting the used cooking oil, cleaning it and delivery the finished fuel, students are involved in every step of the production process. See page 40 to learn more about transesterification.

The biodiesel is blended with conventional diesel to fuel K-State Recycling Center utility carts and recycling trucks, while the glycerin is used as compost material or soap product.

In addition to the production, students learn how the biodiesel works in engines and help educate the public on its potential uses.

BIOFUEL

Recycling Center utility carts and recycling trucks, while the glycerin is used as compost material or soap product.

With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Reaching new ways of generating, storing and distributing energy will help with future needs.

While energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. And Pahwa, Logan-Fetherolf chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and to studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegens Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

K-State’s research is explored throughout the College of Architecture, Planning & Design.

K-State researchers find ways to generate, store and distribute energy.

K-State researchers work to make the world a better place.

With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Reaching new ways of generating, storing and distributing energy will help with future needs.

While energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. And Pahwa, Logan-Fetherolf chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and to studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegens Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

K-State’s research is explored throughout the College of Architecture, Planning & Design.

K-State researchers find ways to generate, store and distribute energy.

With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Reaching new ways of generating, storing and distributing energy will help with future needs.

While energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. And Pahwa, Logan-Fetherolf chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and to studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegens Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

K-State’s research is explored throughout the College of Architecture, Planning & Design.

K-State researchers find ways to generate, store and distribute energy.

With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Reaching new ways of generating, storing and distributing energy will help with future needs.

While energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. And Pahwa, Logan-Fetherolf chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and to studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegens Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

K-State’s research is explored throughout the College of Architecture, Planning & Design.

K-State researchers find ways to generate, store and distribute energy.

With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Reaching new ways of generating, storing and distributing energy will help with future needs.

While energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. And Pahwa, Logan-Fetherolf chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and to studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegens Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

K-State’s research is explored throughout the College of Architecture, Planning & Design.

K-State researchers find ways to generate, store and distribute energy.

With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Reaching new ways of generating, storing and distributing energy will help with future needs.

While energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. And Pahwa, Logan-Fetherolf chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and to studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegens Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

K-State’s research is explored throughout the College of Architecture, Planning & Design.

K-State researchers find ways to generate, store and distribute energy.

With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Reaching new ways of generating, storing and distributing energy will help with future needs.

While energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. And Pahwa, Logan-Fetherolf chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and to studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegens Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

K-State’s research is explored throughout the College of Architecture, Planning & Design.

K-State researchers find ways to generate, store and distribute energy.

With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Reaching new ways of generating, storing and distributing energy will help with future needs.

While energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. And Pahwa, Logan-Fetherolf chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and to studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegens Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

K-State’s research is explored throughout the College of Architecture, Planning & Design.

K-State researchers find ways to generate, store and distribute energy.

With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Reaching new ways of generating, storing and distributing energy will help with future needs.

While energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. And Pahwa, Logan-Fetherolf chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and to studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegens Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

K-State’s research is explored throughout the College of Architecture, Planning & Design.

K-State researchers find ways to generate, store and distribute energy.
Improving the framework

By Grant Guggisberg

Researchers build on infrastructure investment

By Grant Guggisberg

It’s very nature, infrastructure is often overlooked. Most of the time, it works without us even being conscious of it. However, when things go wrong, like when a system fails, infrastructure gets the attention it deserves. Bridge collapses, boil advisories and damaging severe storms serve as periodic reminders that life is much harder when the power is out or roads are closed.

Recent breakthroughs, a fermentative and a close examination of the way our society is built and functions is quickly outliving how critical infrastructure is to a thriving civilization. It is a reality that many Kansas State University researchers know and understand.

It’s a reality that has generated congressional attention, too. The Bipartisan Infrastructure Investment and Jobs Act passed in 2021 included nearly $550 billion to rebuild America’s roads and bridges while delivering clean water and building robust broadband networks in communities that previously lacked access. The Inflation Reduction Act of 2022 provided another $500 billion to boost the green energy sector and reduce the nation’s carbon footprint.

Combined, the two laws represent a level of investment in the nation’s infrastructure not seen since since the Federal-Aid Highway Act of 1956, which created the country’s interstate highway system.

But this newest funding isn’t just for use on bridges and roads. Some of the money is allocated toward research that could change the way we build things, the way we travel and even the way we make decisions.

That’s where the Carl R. Ice College of Engineering at K-State is ready to step in.
One of the things that’s unique about what we do is it’s very applied research. It’s about delivering fast, deployable results for Kansas — many times without the traveling public even knowing. — ERIC FITZSIMMONS

The challenge of Kansas infrastructure

Anyone who has driven on Interstate 70 from Kansas City all the way to Sherman County knows that Kansas is not a small state. With more than 81,000 square miles for a population of fewer than 3 million people, Kansas ranks as the 33rd largest state by area in the U.S., but has the fourth highest number of miles of road behind the much more populous states of Texas, California and Illinois.

The state also ranks among the top five in number of bridges, many of which are in desperate need of repair, researchers say.

“If you go back to the U.S. Public Land Surveying system — a grid system,” said Eric Fitzsimmons, George Yeh — Carl and Mary ice Keystone research scholar and Hal and Mary Siegel professor in engineering. “Kansas land is still made up of squares, so almost every mile of land has a road surrounding it, whether it’s dirt, gravel or paved. So, Kansas has more than 140,000 miles of roadways, 126,000 of which are in rural areas, which ranks No. 2 in the country.

“The challenge is that you don’t pay a lot of attention to the amount of infrastructure and a limited tax base for funding the repairs through state funds.”

Fitzsimmons and his colleagues in the civil engineering department are addressing this challenge by finding better ways to build bridges and roads, from improved design to more economical materials, all on actionable timelines.

“One of the things that’s unique about what we do is it’s very applied research,” said Fitzsimmons. “It’s about delivering fast, deployable results for Kansas — many times without the traveling public even knowing.”

Fitzsimmons also focuses on highway vehicle safety. He’s working with Donna Caragea, Don and Linda Glaser Keystone research scholar and professor of computer science, on a project that uses machine learning to determine the underlying factors that affect the likelihood of commercial motor vehicle crashes in Kansas.

“If you can predict commercial motor vehicle crashes, you can direct the Kansas Highway Patrol on where to enforce and allocate resources,” said Fitzsimmons. “Using advanced tools and the vast amount of data collected by multiple agencies in Kansas, we are hoping to save the time and resources of police officers.”

Additionally, Fitzsimmons and his colleagues at the K-State Olathe campus received funding from the U.S. Department of Transportation’s Federal Motor Carrier Safety Administration to host the second Midwest Commercial Vehicle Safety Summit in Kansas City, Missouri, in November 2023. The summit brings together a diverse group of transportation stakeholders, the federal government and academic researchers who all share the same interest of seeing increased safety and fewer crashes involving large trucks and buses on Midwest roadways.

Infrastructure resilience

For Bala Natarajan, the challenges of the COVID-19 pandemic also provided an opportunity.

Natarajan, the Clair N. Palmer and Sara M. Palmer professor of electrical engineering, had an idea for a research project focused on infrastructure resilience that also considered the human element of these decisions.

But he needed a team. So, stuck at home like everyone else, he picked up the phone and began cold calling academics across the state, asking for 20 minutes of their time and pitching his idea to anyone who would listen.

“When I started thinking about resilience from this holistic standpoint, I didn’t know anyone working on this,” said Natarajan, also a Steve Hsu Keystone research scholar in the Mike Waguespack Department of Electrical and Computer Engineering. “The strategy led to a project titled “Adaptive and Resilient Infrastructure driven by Social Equity,” or ARINE. The project is funded through a National Science Foundation Established Program to Stimulate Competitive Research, or EPSCoR, RB Track-1 grant. The total $24 million award involves 17 institutions, including the University of Kansas, Wichita State University and many other four-year and community colleges throughout the state.

Seven K-State researchers are collaborating on the project, including Natarajan; George Amarasinghe and Lior Shamai, both from computer science; Hossein Ansari, civil engineering; Anil Palma, electrical and computer engineering; Vaishali Sharda, biological and agricultural engineering; and Jason Berryfield, agricultural economics.

This is unprecedented. We are not going to see again, in our lifetimes, an investment like this from the federal government on infrastructure.

Bala Natarajan
The project centers on advancing the resilience of various forms of infrastructure across Kansas by creating tools that support the most vulnerable, while also helping communities use these tools to make informed decisions on investment and management of infrastructure in the future.

Natarajan said the group was focused on social equity because the most socially and racially vulnerable people live and work in the most physically vulnerable locations just like other people lose attention from an infrastructure perspective.

The researchers see their year into developing various models and simulations to help solve these problems and have worked with several communities to help guide their decision-making, with more expected in the coming months and years.

The researchers are working with partner communities that are diverse and are highly suspected to be related to disaster resilience. The partner communities include Ford, Finney and Seward counties in southeast Kansas and Wyandotte and Johnson counties in the east.

In this way, the timing of the federal government’s generational investment into infrastructure couldn’t have been better.

“This is unprecedented,” Natarajan said. “We are not going to see again, in our lifetimes, an instrument like this from the federal government on infrastructure. The question is how do we help our communities get some of it?”

While the ARSEP program isn’t contributing capital to fund building projects or repairs, it is partnering with local governments and leaders to capitalize on funding opportunities from the two congressional bills.

“I think that we, universities, can partner with these communities and help them write grants and proposals to actually implement the ideas that we are developing through the project,” Natarajan said.

The team’s size and diversity are some of its strengths. Experts across disciplines — from behavioral science to management of infrastructure in the future — combine all of the team’s research, which creates accurate and realistic models and allows the results to be published in academic journals and other outlets.

“Since this is actual critical infrastructure, we can’t reveal much of the community data publicly,” Natarajan said. “But we want to do fundamental research that can be published. The synthetic city is something we’re still in the process of building. That portion has been a pretty interesting experience on its own.”

Reducing emissions, powering the future

Chuancheng Duan, assistant professor in the Tim Taylor Department of Chemical Engineering, has been busy since his arrival at K-State in 2020.

Duan’s Materials Research Laboratory for Sustainable Energy aims to create materials and devices that convert and store energy with the goal of addressing critical energy-related and environmental issues. He has been awarded more than $7 million in research funding from a variety of organizations and industry partners, including the U.S. Department of Defense and NASA. In the last year alone, he’s secured more than $3 million in funding from the U.S. Department of Energy for his work.

Duan studies a variety of devices that increase efficiency or create new high-value chemicals as part of emissions reduction in large industrial engines, such as those used in power plants.

Think of a catalytic converter in a vehicle, but on a much larger scale. The engine exhaust material is full through the converter, which reacts with the catalysts inside and results in a gas-forming base that is then released into the air through the exhaust pipe.

Duan is designing devices that operate similarly but on large-scale industrial combustors fueled by natural gas. One project focuses on creating small islands that react to stranded natural gas, which is fuel that has been discovered but is economically unavailable because of the expense of additional pipelines or other forms of transport. This fuel is often burned because of a lack of better options. Duan’s device would take that exhaust and create electricity from the burning of the natural gas, and also create liquid fuel that is far simpler and more efficient to transport and use.

“We use the natural gas, we don’t make additional products or produce other types of fuel where we’re just burning the gas, and we get a very clean form of energy,” Duan said.

Similarly, Duan’s largest project focuses on creating a device that functions like a catalytic converter and can be attached to existing natural gas-powered engines. The goal is to increase efficiency and reduce the amount of methane released into the atmosphere by converting the exhaust into hydrogen and carbon dioxide. The carbon dioxide is a less potent greenhouse gas for environmental purposes, while the hydrogen created is a versatile commodity.

“This kind of technology will be very important for the future,” Duan said.

That’s why the Department of Energy is investing almost $8 billion into hydrogen technology.

“Our future infrastructure being developed for electric vehicles to be made obsolete by fuel cell powered vehicles means that we need hydrogen or other types of renewable fuels in the future,” Duan said.

“All you need to create hydrogen is water and electricity,” he said. “This infrastructure being built for current electric vehicles can also be used to produce hydrogen in the reverse mode of a fuel cell.”
TRANSFORMATION ACROSS THE GLOBE

How K-State research feeds the world

By Jarrett Whitson
We think that in three years there could be more than 1 million acres in India planted with varieties that have been selected by and passed through this collaborative work.

JARED CRAIN

Jared Crain, research assistant professor of plant pathology, is studying how to increase food production from existing farmland without damaging the environment. This involves crop management, agronomy and genetics, which includes developing new varieties, as well as socioeconomic intensification, which includes human and institutional capacity, environmental policy and product markets.

One of SIIL’s focus countries in Bangladesh, where researchers are identifying new crops — sunflowers, sesame or legumes such as mung beans — to grow between rice crops. One issue is a shortage of labor and the increased price of labor, which creates a need for mechanization.

“If we are able to achieve more efficient planting and harvesting methods, that will save farmers time and allow for another short-duration crop to be planted and harvested in the 60 to 70 days,” said Varun Prasad, a director of K-State’s wheat breeding and professor of agronomy, approximately 7% of wheat harvested in Kansas can be traced to K-State scientists.

Until recent economic disruptions such as the Russia-Ukraine war, Fritz estimated Kansas exported approximately 50% of its wheat outside of the U.S. — proof that K-State work in the breadbasket of America also plays an important role in wheat production.
We want people to have food, but it must be safe. We can produce food all day long but if it’s not safe, people can get sick from it and might not be able to sell it. Neither having no food nor having foodborne illness are good situations. Challenges with conservation

An important piece of the global food system is conservation, biodiversity, land use and land cover change — all areas that interest Marcellus Caldas, professor of geography and geospatial sciences in the College of Arts and Sciences.

Caldas has been involved in multiple projects in his home country of Brazil, including recently published research in the journal Science with colleagues from the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production. “In a place that is considered a breadbasket such as the Cerrado, farmers are going to want to pay to put more land in production,” said Caldas, also the associate professor of food and Extension to improve food safety awareness and practices.

The research looked at how conservation policies in Brazil, such as the Forest Code and Native Vegetation Protection Law, have positively affected areas like the Brazilian Cerrado. The area is a tropical savanna southeast of the Amazon rainforest that is rich in biodiversity, but a significant portion of the land has been converted to use for crop production and cattle ranching. The research found that private protected areas accommodate up to 14.5% of the threatened vertebrate species range, which increases to 25% when considering the distribution of remaining native habitat.

While the laws seem to be helping biodiversity, Caldas said farmers don’t receive any compensation for doing this, which has led to pressures to change the law. He said offering incentives to farmers could be a solution, and gave the example of the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production.

“Sensory analysis and consumer behavior are important because people don’t eat or use products that they don’t like,” said Chambers, who also directs the K-State Sensory Analysis Center. “In one study, we literally saw children spit out our food and refuse to eat more because it didn’t taste good. Parents refused to take it anymore if it was deemed off for free.”

In another study, Chambers examined how different cultures accepted insect-based foods. The results showed that people in Mexico and Thailand were more willing to accept them than people in the U.S., Japan, Spain and Australia. In another similar study, he found that adding 10-20% of insect powder into chocolate chip cookies was liked as well as a regular cookie in the U.S. and Spain, and it was preferred by Mexico when the insect powder’s presence was unknown. “This told us that it was not a matter of food quality, taste or appearance, but rather of perception of eating a product containing insects,” Chambers said.

Another project in Tanzania has aimed to develop a sorghum-based product to be used in food programs for young children, many of whom are malnourished. The researchers have stories for young children, many of whom are malnourished. The researchers have stories of conservation to the overall system is conservation, biodiversity, land use and land cover change — all areas that interest Marcellus Caldas, professor of geography and geospatial sciences in the College of Arts and Sciences.

Caldas has been involved in multiple projects in his home country of Brazil, including recently published research in the journal Science with colleagues from the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production. “In a place that is considered a breadbasket such as the Cerrado, farmers are going to want to pay to put more land in production,” said Caldas, also the associate professor of food and Extension to improve food safety awareness and practices.

The research looked at how conservation policies in Brazil, such as the Forest Code and Native Vegetation Protection Law, have positively affected areas like the Brazilian Cerrado. The area is a tropical savanna southeast of the Amazon rainforest that is rich in biodiversity, but a significant portion of the land has been converted to use for crop production and cattle ranching. The research found that private protected areas accommodate up to 14.5% of the threatened vertebrate species range, which increases to 25% when considering the distribution of remaining native habitat.

While the laws seem to be helping biodiversity, Caldas said farmers don’t receive any compensation for doing this, which has led to pressures to change the law. He said offering incentives to farmers could be a solution, and gave the example of the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production. “In a place that is considered a breadbasket such as the Cerrado, farmers are going to want to pay to put more land in production,” said Caldas, also the associate professor of food and Extension to improve food safety awareness and practices.

The research looked at how conservation policies in Brazil, such as the Forest Code and Native Vegetation Protection Law, have positively affected areas like the Brazilian Cerrado. The area is a tropical savanna southeast of the Amazon rainforest that is rich in biodiversity, but a significant portion of the land has been converted to use for crop production and cattle ranching. The research found that private protected areas accommodate up to 14.5% of the threatened vertebrate species range, which increases to 25% when considering the distribution of remaining native habitat.

While the laws seem to be helping biodiversity, Caldas said farmers don’t receive any compensation for doing this, which has led to pressures to change the law. He said offering incentives to farmers could be a solution, and gave the example of the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production. “In a place that is considered a breadbasket such as the Cerrado, farmers are going to want to pay to put more land in production,” said Caldas, also the associate professor of food and Extension to improve food safety awareness and practices.

The research looked at how conservation policies in Brazil, such as the Forest Code and Native Vegetation Protection Law, have positively affected areas like the Brazilian Cerrado. The area is a tropical savanna southeast of the Amazon rainforest that is rich in biodiversity, but a significant portion of the land has been converted to use for crop production and cattle ranching. The research found that private protected areas accommodate up to 14.5% of the threatened vertebrate species range, which increases to 25% when considering the distribution of remaining native habitat.

While the laws seem to be helping biodiversity, Caldas said farmers don’t receive any compensation for doing this, which has led to pressures to change the law. He said offering incentives to farmers could be a solution, and gave the example of the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production. “In a place that is considered a breadbasket such as the Cerrado, farmers are going to want to pay to put more land in production,” said Caldas, also the associate professor of food and Extension to improve food safety awareness and practices.

The research looked at how conservation policies in Brazil, such as the Forest Code and Native Vegetation Protection Law, have positively affected areas like the Brazilian Cerrado. The area is a tropical savanna southeast of the Amazon rainforest that is rich in biodiversity, but a significant portion of the land has been converted to use for crop production and cattle ranching. The research found that private protected areas accommodate up to 14.5% of the threatened vertebrate species range, which increases to 25% when considering the distribution of remaining native habitat.

While the laws seem to be helping biodiversity, Caldas said farmers don’t receive any compensation for doing this, which has led to pressures to change the law. He said offering incentives to farmers could be a solution, and gave the example of the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production. “In a place that is considered a breadbasket such as the Cerrado, farmers are going to want to pay to put more land in production,” said Caldas, also the associate professor of food and Extension to improve food safety awareness and practices.

The research looked at how conservation policies in Brazil, such as the Forest Code and Native Vegetation Protection Law, have positively affected areas like the Brazilian Cerrado. The area is a tropical savanna southeast of the Amazon rainforest that is rich in biodiversity, but a significant portion of the land has been converted to use for crop production and cattle ranching. The research found that private protected areas accommodate up to 14.5% of the threatened vertebrate species range, which increases to 25% when considering the distribution of remaining native habitat.

While the laws seem to be helping biodiversity, Caldas said farmers don’t receive any compensation for doing this, which has led to pressures to change the law. He said offering incentives to farmers could be a solution, and gave the example of the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production. “In a place that is considered a breadbasket such as the Cerrado, farmers are going to want to pay to put more land in production,” said Caldas, also the associate professor of food and Extension to improve food safety awareness and practices.

The research looked at how conservation policies in Brazil, such as the Forest Code and Native Vegetation Protection Law, have positively affected areas like the Brazilian Cerrado. The area is a tropical savanna southeast of the Amazon rainforest that is rich in biodiversity, but a significant portion of the land has been converted to use for crop production and cattle ranching. The research found that private protected areas accommodate up to 14.5% of the threatened vertebrate species range, which increases to 25% when considering the distribution of remaining native habitat.

While the laws seem to be helping biodiversity, Caldas said farmers don’t receive any compensation for doing this, which has led to pressures to change the law. He said offering incentives to farmers could be a solution, and gave the example of the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production. “In a place that is considered a breadbasket such as the Cerrado, farmers are going to want to pay to put more land in production,” said Caldas, also the associate professor of food and Extension to improve food safety awareness and practices.
A statewide movement

K-State 105 connects research and innovation to Kansas communities

By Jennifer Tidball

Through K-State 105, we are fulfilling our land-grant promise of economic prosperity for all Kansans.

“Through K-State 105, we are fulfilling our land-grant promise of economic prosperity for all Kansans,” said Jessica Gnad, K-State 105 director. “We’re bringing people and partners together across the state because we are the university for Kansans.”

While K-State 105 is a pillar of the university’s Economic Prosperity Plan, it is also a key piece of the Next-Gen K-State strategic plan. K-State 105 leverages academic research and resources from all of the university’s colleges and campuses in partnership with corporations and small businesses to deliver economic prosperity in all 105 counties, delivering solutions directly to Kansans through the statewide K-State Research and Extension network.

It’s a mission that the Kansas Legislature has supported, too, when it provided $10 million in state funding for the K-State 105 initiative in fiscal years 2024 and 2025. The university is using that funding to collaborate with statewide partners, regional partners and project partners to address child care, affordable housing, health care and other elements that affect prosperity in Kansas.

“The challenges facing communities and businesses are complex,” said Tim Steffensmeier, K-State assistant vice president and director of engagement and outreach. “For instance, early childhood education, affordable quality housing and rural health care require the expertise, resources and creativity of our Kansas higher education colleagues and nonprofit and industry partners. Wearing together a network of resources and services is our best path forward.”
A sample of stories

The many stories of K-State 105 expand across academic disciplines and regions of the state. Learn more about some of the projects in different focus areas.

Affordable and sustainable housing

“Clearly, what affordable housing is the problem of our generation, “ says Michael Gibson, associate professor of architecture. “Today’s housing crisis is affecting the livelihood of everybody, middle class, working families.”

Gibson is the creator and leader of the Net Positive Studio, which is a research-based studio for students in the Master of Architecture program in the College of Architecture, Planning & Design. Students design affordable and net-zero energy homes that use renewable energy generation.

The Net Positive Studio has collaborated with local community organizations to build affordable housing success across Kansas.

• Students designed and built a home at St. John, completed in 2021, and Stafford County Economic Development secured financing to build at least 10 additional homes based on the student-designed prototypes.

• In Ogden, Riley County, the Net Positive Studio worked with developer and Habitat for Humanity as part of the Workforce Solar Housing Partnership, a group that includes Flint Hills Job Corps, Fort Riley’s Home Builders Institute, Manhattan Area Technical College and Flint Hills Renewable Energy and Efficiency Cooperative.

• The K-State students designed and prefabricated zero-energy homes and the partners have completed the homes on-site.

• In 2021, the students designed a net-zero home prototype home for MNK1, a Topeka nonprofit community organization that subsequently secured financing to build four iterations of the home.

Child care collaborations

Bradford Wiles has a challenge: Go find a Kansas community where access to quality, affordable early child care and education is not an issue.

Wiles, associate professor and extension specialist in early childhood development in the College of Health and Human Sciences, sees a possible solution. Partner university researchers with K-State Research and Extension.

Wiles has worked with K-State Research and Extension on child care services – assessments so that agents and community leaders can perceive federal, state and philanthropic support to help establishing child care providers or build new early childhood care and education centers.

Success stories throughout Kansas prove that this approach works, such as Laurn’s Grow and Learns Childcare Center Inc. in Winterset County and the Hillbilly Community Child Care Center in Marion County. Other collaborative child care projects have happened in Kansas and Linn in Edwards County and Otoe in Pottawatomie County.

But Wiles is clear: He doesn’t do the work alone.

“Who is the advocate who brings this work out to the ground in their communities,” Wiles said. “At the end of the day, applied research is supposed to make a difference in people’s lives. A land grant university is supposed to make a difference in people’s lives. I don’t do it alone.”

Technology for economic development

For more than 30 years, the K-State Technology Development Institute, or TDI, in the Carl R. Ice College of Engineering has supported technology development in Kansas.

TDI, a U.S. Department of Commerce Economic Development Administration University Center, connects entrepreneurs and researchers with product design and development, marketing and prototyping as well as business and intellectual support services.

• A TDI partnership with GO Topeka helped a local inventor create the Pesc, a purpose-built surfboard, which removes the scuffs and other damage from surfboards.

• TDI worked with Lawrence-based Leander LLC, which produces chiropractic tables, to redesign paws to improve manufacturability, increase quality and reduce costs.

• TDI also collaborated with the University of Missouri to create a water disinfection demonstration trailer for farmers in Kansas and Missouri.

“Everything that K-State 105 embodies is what we do here,” said Bret Lane, TDI commercialization director. “From a technology development standpoint to grow the economic balance within the state, I think it’s a great opportunity to try and make those connections.”

Building partnerships

The ambitious work of K-State 105 requires a network of transregional and regional partners to advance the economic prosperity of Kansas. These partners include other higher education institutions, state agencies, nonprofits and businesses.

“We know the needs of the state of Kansas and their commitment to not only serve extension agents,” said Gregory Patin, executive director of Kansas State Research and Extension. “With offices in each county, they live in the same communities as the people they serve. Because of this, they are able to assist business owners, local consultants and community leaders in finding the needed expertise to allow their organizations to grow and thrive in their local communities.”

Successful partners NetWork Kansas is collaborating with K-State to advance economic vitality, including small business startups, expanding existing businesses and increasing direct investment in Kansas counties. NetWork Kansas has a network of 77 entrepreneurial communities across Kansas.

Regional partners, called Learn Together community partnerships, are working with local business owners, local coalitions and rural challenges across the state. These partners include the Innovation Center, which provides economic and entrepreneurial services to businesses in 24 northwest Kansas counties, as well as GO Topeka, which works with partners to help local businesses succeed in Shawnee County.

An early example of K-State 105 partnership success is expanding the Kansas Small Business Development Center, which operates as a network of eight regional economic development and business consulting centers that serve all 105 counties in the state. The partnership involves the Kansas State University’s Innovation Center, NetWork Kansas and the Kansas Department of Commerce.

“Simply put, K-State is driving connections — connections to university research and bragging rights to business development across the state. Together, we are poised to make a difference, not only in Kansas, but in Kansas State’s 105 stories.”
Scoular partnership creates opportunities for farmers

By Dalsy Cupp

It’s nothing new to consider the state of Kansas a leader in grain production. Now through a new partnership, Kansas State University and Scoular are using grain for more than food production— they are creating renewable fuel markets.

Scoular, an employee-owned business that buys, sells, stores, handles and processes grain and ingredients for leveraging global networks and expertise in international trade and transportation, is reconceptualizing a grain processing facility near Goodland. The company will convert the facility to crush canola and soybeans to create fuel and animal feed products.

“Farmers will be able to participate in the renewable fuels market,” said David Rosowsky, president of emerging businesses. “It’s big,” said Ed Prosser, Scoular’s senior vice president of international trade and agribusiness that buys, sells, stores, handles and processes grain and ingredients for leveraging global networks and expertise in international trade and transportation.

Stamm, who researches in the College of Agriculture, said farmers and rural communities benefit when companies like Scoular and Kansas State University work together to create new opportunities and growth in the Goodland area and providing access to the renewable fuels market.

“The Scoular facility is an example of how K-State can drive economic prosperity in all 105 counties in Kansas,” Stamm said. “It’s a Kansas State University, with its land-grant mission, come together and think big,” said Ed Prosser, Scoular’s senior vice president of emerging businesses. “It’s natural for Scoular to reach out to K-State for help when we bring new opportunities to the region’s ag producers.”

The efforts of Scoular and Stamm align with the goals of K-State and the university’s Economic Prosperity Plan, particularly the K-State 105 initiative, which is K-State’s answer to the call for a comprehensive economic growth and advancement solution for Kansas. See page 32 to read more about K-State 105.

The Scoular facility is an example of how K-State can benefit the surrounding community and drive economic prosperity in all 105 counties in Kansas,” said Dalsy Cupp, K-State vice president for research.

Seek more” Learn more about the Scoular-K-State initiative and the opportunity to bring even more economic solutions to Kansas.

Engineering epidemiology

Researcher models infectious diseases to understand their spread

The Scoular facility is an example of how K-State can drive economic prosperity in all 105 counties in Kansas.

Imagine this research portfolio: $15.5 million in research funding, 114 journal publications and 49 awarded patents. Those impressive numbers have led Caterina Scoglio, Pasley professor in electrical and computer engineering and Steve Hix Petrie research scholar in the Carl R. Leff College of Engineering, to become the first woman recognized as a Kansas State University distinguished professor in engineering.

“It was the universal laws behind physics, concerning in particular electricity and electronics, that made me want to originally explore electronics engineering,” said Scoglio, who researches in the Mike Wiggins Department of Electrical and Computer Engineering. “I thought that this degree would give me more opportunities to find an interesting position both in research, as that was my dream, but also in the industry.”

Scoglio grew to become an industry pioneer who has opened the door for the next generation of women engineers while simultaneously becoming a research leader. She challenges electrical and computer engineering paradigms by combining them with a multitude of disciplines to solve disease problems through network-based theoretical approaches.

“The topic she most heavily researches is the spread of infectious diseases,” said Dalsy Cupp, K-State vice president for research.

those for airborne transmitted diseases.”

The topics she most heavily researches is the spread of infectious diseases.”

The topics “I found at K-State a very relevant dream, but also in the industry.”

“Those systems are more complicated. They have a lot of dependence with climate, temperature, soil and vector abundance,” Scoglio said. “Our goal now is to try to develop models for vector-born diseases that can be as accurate as those for airborne transmitted diseases.”

Despite Scoglio receiving national and international attention for her groundbreaking research, her true passion has been mentoring more than 40 doctoral and master’s students.

“It’s one of the most important and rewarding parts of my work,” Scoglio said. “For all my work and publications, I have grown a lot of the credit to them. I have had very good students and every one contributed in different ways.”

Seek Fall 2023
A scholar-practitioner
Graduate student studies leadership to make change
By Taylor Provine

Graduate student Chibuzor Mirian Azubuike already has an impressive list of life accomplishments. She’s a public speaker and the author of “My Birthmark, My Gift.” She also has created a clean water nonprofit, the Haske Water Aid and Empowerment Foundation, and empowers others to seek scholarly and personal development opportunities. But she’s not stopping there.

Azubuike, from Nigeria, is pursuing her doctorate in the leadership communication program in Kansas State University’s School of Leadership. She is researching her passions of women’s issues and leadership and is applying her philosophy to her work.

“A scholar-practitioner is one to me who not only does research but also implements the solutions in real-life situations,” Azubuike said. “A scholar-practitioner is a change-maker who is actively involved in social change.”

For her doctoral dissertation, she is studying the resilience of Indigenous women.

“Women have been studied a lot from a place of dispossession and powerlessness, but I think women have been practicing leadership in many ways and there is a lot to learn from these daily practices of leadership,” Azubuike said. “I’m looking at resilience and how women have been resilient over the years.”

Azubuike conducted a pilot study that included interviews and a literature review of previous scholarly work on the resilience of Indigenous women. “The pilot study has shown the potential of studying Indigenous women and people can learn a lot from that as pertaining to how to lead in difficult situations,” she said. “The findings from this research will also be translated into creating a leadership model and programs for women.”

A committed change-maker, Azubuike is the founder of the Haske Water Aid and Empowerment Foundation, which has provided clean water for more than 60,000 Nigerians. Azubuike was awarded the prestigious International Degree Fellowship from the American Association of University Women. She also has received several awards and fellowships, including the Outstanding Researcher Award from the Sealy School of Leadership, a Mandela Washington Fellowship, a Next Generation of African Scholars Fellowship from the Social Science Research Council, a Harry Frank Guggenheim Young Scholars Award and many other awards.

Azubuike and her adviser, Andy Wefald, associate professor of leadership, recently received a grant from the Associated of Leadership Educators to facilitate a workshop for 30 women change-makers. The workshop was available in-person option in Onitsha, Nigeria. The participants described the workshop as new and transformative.

Preparing for outer space
Student explores combined effects of gravity and cosmic radiation
By Matthew Culbertson

Matthew Culbertson is researching the effects of cosmic radiation on Earth.

Culbertson, Kansas State University senior in physics and mechanical engineering, recently presented his research in the College of Arts and Sciences and the Carl R. F. Clay College of Engineering to see conducting research. He is working with Amir Bahadori, associate professor, Steve Siegel, professor and Mary Sage professor in the Alan Leorns Department of Mechanical and Nuclear Engineering. Their research sets the stage to characterize how human cells would react to being subjected to partial gravity, which will give scientists a better understanding of what happens inside the human body in space.

Their research began with a project exploring active shielding — creating a charged electric field to repel highly ionized space radiation particles. “If we build a base on the moon or Mars, we’ll want shielding there since there is no atmosphere to absorb radiation or magnetic fields to deflect the particles like we have on Earth,” Culbertson said. “Active shielding around the base or spacecraft could repel the particles and not allow a human’s susceptibility to absorbed radiation.”

Culbertson has tested shielding setups using specialized software, including the Monte Carlo method, Parker and COMSOL. Multiphysics programs, to simulate individual radiation particles moving through space millions of times and see how the particles would react to active shielding. The simulated active shielding system moved radiation particles around the shield, including active shielding could be effective in space.

To test how cell samples react to space radiation, Culbertson customized and programmed a random positioning machine — a device consisting of two rotating frames, one inside the other, that operates on two axes. A pathing program directs the movement of the frames, which can be used to simulate various conditions, including zero gravity, partial gravity or normal gravities — and optimized the machine’s form and efficiency.

“We wanted an on-the-ground analog for how a cell sample would react in space without spending millions of dollars on actually sending a sample into space,” Culbertson said.

“Working with a prototype created by a previous team, we revolutionized the pathing system to produce varied gravities — such as Martin and lunar and zero gravities — and optimized the machine’s efficiency.”

The random positioning machine can be placed in the beam paths of K-State’s TRIGA Mark II nuclear reactor facility, where high-energy neutrons are expelled directly toward the cell sample.

“The machine’s frame is designed to limit how much radiation is blocked or deflected from the beams,” Culbertson said. “You put the cell sample at the center of the machine and the beam port so the cell sample can be irradiated while it’s on the machine, effectively replicating the desired gravity and radiation of space for the sample.”

Culbertson received a prestigious NASA Graduate Scholarship for his work with the random positioning machine and presented his research at the 2023 American Nuclear Society’s annual conference.

We wanted an on-the-ground analog for how a cell sample would react in space without spending millions of dollars on actually sending a sample into space.
transesterification

trant(e-s)t(e-r-a)-fə-ˈkā-shən

Edwin Brokesh, assistant professor of biological and agricultural engineering in the Kansas State University Carl R. Ice College of Engineering, explains, in fewer than 100 words, what transesterification is and why it is important in the biodiesel production process.

Transesterification is the chemical process where a triglyceride is combined with an alcohol in the presence of a catalyst to create a product called alkyl ester. Triglycerides are lipids commonly found in vegetable oils and animal fats. They are often present in food sources with larger protein content. A common reaction is to combine a vegetable oil, such as soybean oil, with methanol in the presence of sodium hydroxide, the catalyst. This reaction produces a Fatty Acid Methyl Ester, or FAME, and the byproduct glycerin. FAME is commonly available at many local filling stations as a fuel called biodiesel.

See page 14 to read more about K-State projects that involve transesterification and biodiesel and see page 36 to learn about a new partnership focused on renewable fuel.

Remarkable women of K-State

Kansas State University is dedicated to the land-grant university mission of providing access to education. Women researchers and educators have long played key roles in the work of the university. Four scholars — Minnie Howell Champe, Nellie Sawyer Kedzie Jones, Mary F. Winston, and Mary T. Harman — were among the women who pioneered the way in the first 50 years of K-State’s history. Read more about these notable women in their individual captions. See pages 8, 37, and 38 to read about some of today’s women creating positive K-State.

1. Minnie Howell Champe was the first Black woman to graduate from K-State and was a member of the class of 1901. She taught public school in Topeka and later served as department head of home economics at Southern University and A&M College in Louisiana.

2. Nellie Sawyer Kedzie Jones was the first woman at K-State to become a full faculty member and hold the ranks of professor and department head. She was a faculty member from 1882-1907. Kedzie Hall is named after her.

3. Mary F. Winston served as the K-State mathematics chair from 1897-1900. She was also the first woman in America to earn a doctorate from the University of Göttingen in Germany.

4. Mary T. Harman taught in K-State’s zoology and entomology department from 1912 until her retirement in 1948. She also served as president of the Kansas Academy of Science and authored more than 50 professional articles and several textbooks.

Photos courtesy of the Richard L. D. and Marjorie J. Morse Department of Special Collections.
As the nation’s first operational land-grant university, Kansas State University is dedicated to research that will better our community, state and world. It’s why we exist. Look inside to learn about our world of discovery, share in our successes and explore how we are improving lives in Kansas, across the nation and around the globe every day.