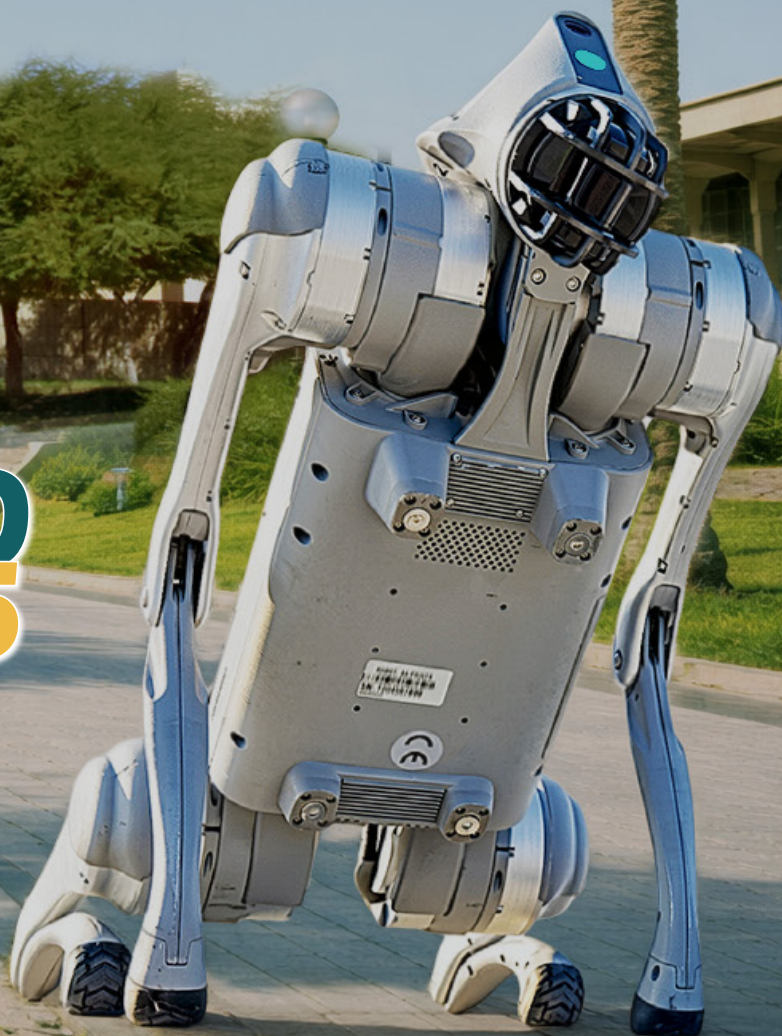




KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

# RESEARCH & INNOVATION

ANNUAL **20**  
REPORT **25**





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On the Cover

A quadrupedal robot navigates KFUPM's campus, with the University's iconic water tower in the background — symbolizing the intersection of heritage and technological innovation.



R&I Annual Report 2025

Message from the Vice President of Research & Innovation

The year 2025 marks a significant milestone in KFUPM’s evolution as a research-intensive, innovation-driven institution. This progress reflects sustained commitment to excellence in research and education, guided by a clear strategy and strengthened through interdisciplinary collaboration.

KFUPM’s advancement to 67th globally in the QS World University Rankings is a strong testament to these efforts. More than a ranking, it represents the collective contributions of our faculty, researchers, students, and partners, and reinforces our growing global standing.

Our research ecosystem has continued to mature in both quality and impact. Publications in top-tier venues and increasing citation impact highlight our academic strength, while a stronger focus on real-world challenges, such as energy transition, sustainability, artificial intelligence, and advanced technologies, demonstrates our shift toward impact-driven research.

KFUPM has firmly positioned itself among the world’s leading institutions in innovation. In 2024, the University ranked 5th globally among the Top 100 universities granted U.S. utility patents, with more than 260 patents awarded. This momentum continued in 2025, with KFUPM securing 320 patents in a single year and advancing to 2nd place worldwide in the National Academy of Inventors (NAI) rankings.

Strategic partnerships have played a central role in this progress. In 2025, KFUPM expanded collaborations with leading government entities, global institutions, and industry partners across key sectors. These partnerships are accelerating the translation of research into deployable solutions aligned with national priorities.

Our innovative ecosystem has also gained momentum. Through Dhahran Techno Valley and structured venture programs, research outcomes are increasingly moving beyond the laboratory toward commercialization and industry adoption. Enabling policies have further empowered our community to transform ideas into scalable ventures.

We remain committed to strengthening the foundations of excellence through continued investment in talent, advanced infrastructure, and interdisciplinary research centers. This has created a dynamic environment capable of addressing complex, cross-cutting challenges.



**Dr. Ali Al-Shaikhi**  
Vice President of Research & Innovation  
King Fahd University of Petroleum & Minerals

Research Highlights 2025

#67 globally and #1 in the Arab World in QS World Ranking, and #25 in THE Impact Rankings, reflecting KFUPM’s significant rise in global standing and leadership in research performance.

3,491 journal publications in 2025 with 74% in Q1 journals, demonstrating strong research output growth and sustained quality.

320 U.S. Patents granted, ranking #2 globally among universities, highlighting KFUPM’s leadership in translating research into innovation.

Launch of the Interdisciplinary Research Center for Advanced Quantum Computing and the Center for Carbon Materials, strengthening capability in frontier and nationally aligned research domains.

398 research projects launched in 2025, aligned with strategic priorities and advancing deployment to drive research impact.

15 strategic agreements and MOUs, expanding collaboration across academia, industry, and government to accelerate research impact.

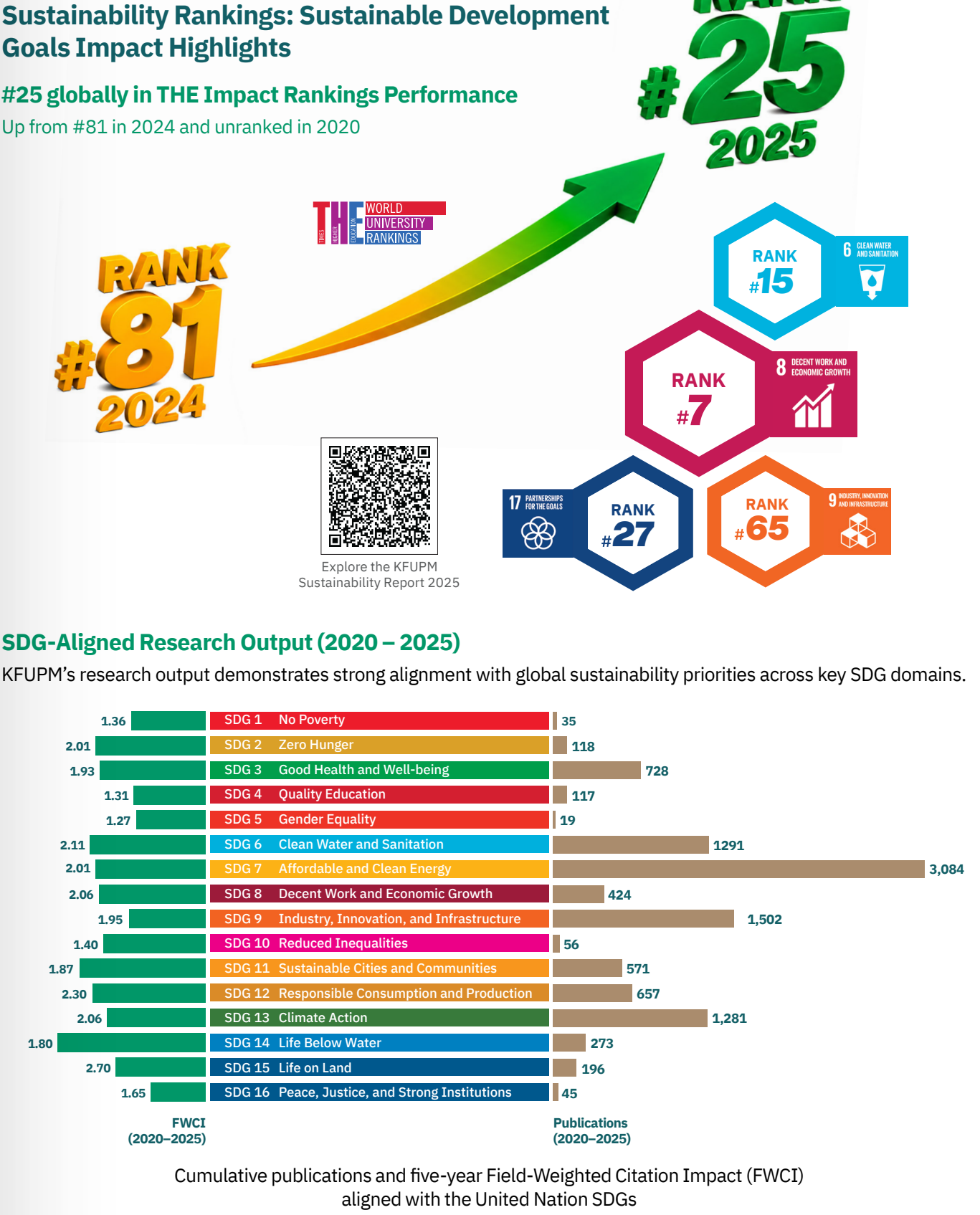
619 faculty members, 90 research scientists, 390 postdoctoral fellows, and 2,301 graduate students, forming a globally connected and rapidly growing research community.

# Global Rankings & Academic Standing in 2025



Source: QS World University Rankings and Times Higher Education (THE) Rankings, based on results available as of early 2026.

# Research Impact & Sustainability Alignment

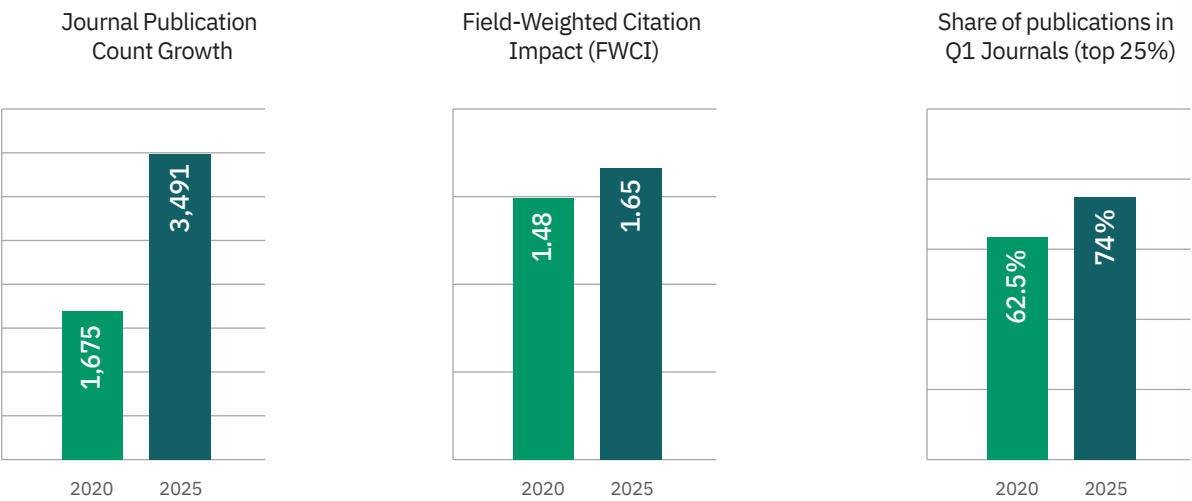


Source: THE Impact Rankings 2025 and SciVal (SDG-aligned publication data, 2020–2025); data retrieved in early 2026.

# Research Output: Publications, Books & Scholarly Contributions

## Research Growth & Impact (2020 vs. 2025)

Since 2020, KFUPM’s research transformation has driven sustained growth in publication output, supported by strategic funding, interdisciplinary collaboration, strengthened research infrastructure, and a strong focus on human capital.



## Five-Year Research Output & Impact (2021–2025)



2020 serves as the baseline year; cumulative metrics reflect the 2021–2025 transformation period.

## Scholarly Books & Monographs: 14 Volumes Published in 2025

In 2025, KFUPM scholars advanced the University’s global academic presence through high-impact authored and edited volumes with leading international publishers. 14 books spanning AI, energy, sustainability, and advanced materials underscore the depth and interdisciplinary strength of KFUPM’s research ecosystem.

Source: Scopus and SciVal, based on results available as of early 2026.

# Turning Research into Strategic Innovation

KFUPM’s innovation performance reflects the translation of research excellence into protected intellectual property, with strong U.S. patent outcomes aligned with strategic research priorities.

## Global Patent Performance in 2025



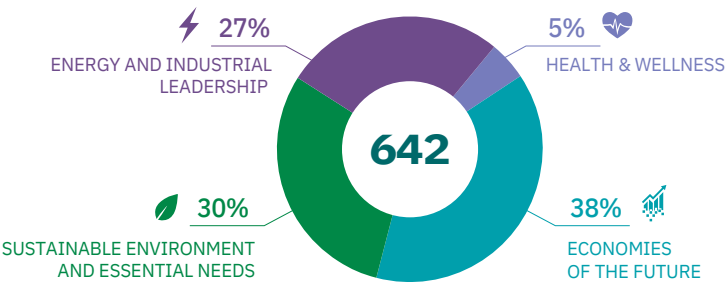
## Five-Year Innovation Output (2021–2025)



## Global Ranking in U.S. Patents



## Invention Disclosures by National Focus Areas in 2025



KFUPM’s innovation activity aligns with national research priorities, with strong contributions in Cognitive Cities, Innovative Water Research, Net Zero Aviation, and Geoenergy Leadership, alongside high invention activity in Clean, Economic Hydrogen, Reuse of Materials and Products, Health and Bioengineering Innovation, Renewable Energy, and Electric Vehicles (EVs) and EV Batteries.



# KFUPM's Institutional Journals: Reach & Impact

KFUPM strengthens its global academic influence through institutional journals that serve as authoritative platforms for research dissemination. Across engineering, science, and mathematics, these journals reinforce scholarly leadership, international visibility, and alignment with national research priorities. In 2025, milestone achievements further elevated their global reach and impact.



## Arabian Journal for Science and Engineering (AJSE)

Published by Springer Nature

KFUPM's flagship multidisciplinary journal advancing research in energy, advanced materials, digital systems, and applied engineering.

### 50<sup>th</sup> Anniversary Milestone

Marked its 50th anniversary and hosted the AI Transforming Systems (ATS) Symposium, reflecting AJSE's engagement with emerging technological directions aligned with Vision 2030 priorities. The milestone was further commemorated through a dedicated special issue celebrating AJSE's 50th anniversary.

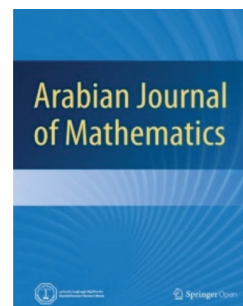
Q2 (Web of Science & Scopus)

Impact Factor: **2.9**

Publications (2025): **1,174**

Acceptance Rate: **9%**

Downloads (2025): **1.4M**



## Arabian Journal of Mathematics (AJM)

Published by Springer Nature

A high-quality mathematics journal advancing pure and applied research across mainstream areas, the Arabian Journal of Mathematics (AJM) also publishes interdisciplinary work in combinatorics, dynamical systems, machine learning, and applied mathematics.

Q2 (Web of Science & Scopus)

CiteScore: **1.9**

Publications (2025): **35** (8 issues)

Downloads (2025): **141,527**

Submissions: **852** from 73 countries

Transitioned to a hybrid publishing model in 2025 while maintaining a no-cost submission policy



## Journal of Undergraduate Research International (JURI)

Multidisciplinary Undergraduate Research Platform

KFUPM's peer-reviewed undergraduate journal fostering early research engagement and advancing student-led scholarship across disciplines.

Publications (2025): **29** (2 issues)

Acceptance Rate: **27%**

International Editorial Board: **60%**

CrossRef Registered | ISSN Secured

Launched in February 2025 with its inaugural issue (Vol. 1), JURI established a dedicated platform for rigorous undergraduate research, reinforcing KFUPM's undergraduate research pipeline and early scholarly engagement.

# Toward the Next Frontier: Strategy Progress & Alignment

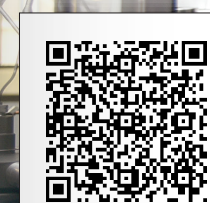
KFUPM's Research Strategy 2024–2030 positions the University as an innovation-based, research-intensive institution aligned with national priorities and focused on addressing grand challenges across energy, sustainability, digitalization, and future economies. The strategy emphasizes interdisciplinarity, impact-oriented research, and progression across the full research-to-deployment spectrum. KFUPM monitors the implementation of its research strategy through clearly defined milestones and key results, ensuring steady progress toward its innovation goals. In 2025, this monitoring confirmed strong momentum in project initiation, interdisciplinary collaboration, and alignment with national research priorities, while also highlighting opportunities to further strengthen impact and translation.

Building on implementation experience and progress reviews, KFUPM has initiated a refinement process to further strengthen its research strategy. This includes:

- Proposed adjustments to selected innovation goals
- Identification of emerging grand challenges
- Consideration of evolving national research priorities

These refinements aim to ensure that KFUPM's research agenda remains adaptive, forward-looking, and positioned at the forefront of scientific and technological advancement.

Driven by national priorities and global demands, KFUPM is actively turning deep research into real-world innovation. This relentless drive has sparked the launch of cutting-edge research centers and new capabilities, positioning the University for its next major wave of growth.



Explore the KFUPM Research Strategy

## 2025 Project Portfolio

### 398 Projects Launched: A Strong Pipeline

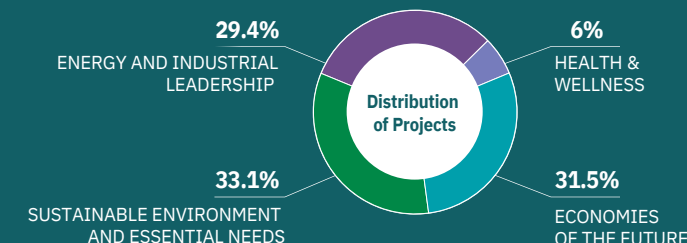
A strong pipeline of new interdisciplinary and contracted projects was initiated, reflecting continued momentum in strategy execution.

### Strategy Alignment: Over 90% of Projects Directly Aligned

Demonstrating strong strategic focus, over 90% of KFUPM's 2025 projects align directly with its Research Strategy. The remaining projects are deliberately reserved for exploratory research, providing essential space for scientific breadth, unbound creativity, and breakthrough innovation.

### Launched Projects by National Focus Areas

The distribution of projects launched in 2025 shows that a significant percentage is concentrated in national focus areas, energy and industrial leadership, sustainable environment and essential needs, economies of the future, and health and wellness, highlighting focused investment in nationally and globally relevant domains.



### Research-to-Deployment Balance Across the TRL Spectrum

The 2025 project portfolio spans the full Technology Readiness Level (TRL) spectrum, with a strong foundation in basic research (TRL 1–3) and applied development (TRL 4–6), alongside a growing share of projects progressing toward near-market readiness (TRL 7–9), consistent with the strategy's impact-oriented focus.



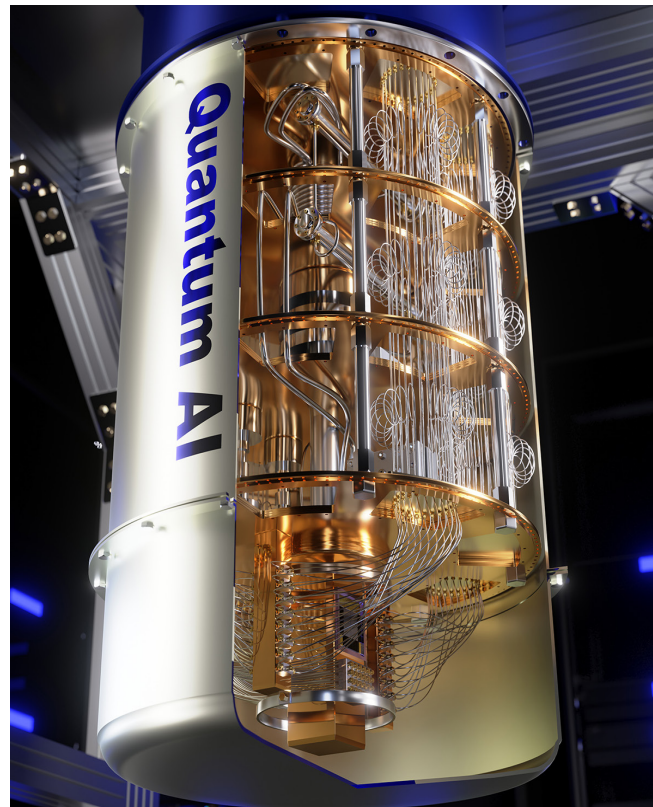


# Strengthening the Research Frontier: Two New Centers in 2025

## Interdisciplinary Research Center for Advanced Quantum Computing

The Interdisciplinary Research Center for Advanced Quantum Computing (Center for Quantum) is a strategic hub dedicated to advancing research in quantum sciences. Aligned with KFUPM's Research Strategy, the center focuses on accelerating the transition from foundational quantum theory to practical, real-world applications. Through interdisciplinary collaboration, the center addresses complex challenges across physics, chemistry, medicine, and engineering. Its research activities are organized around six core pillars: Quantum Hardware, Quantum Matter, Quantum Simulation, Quantum Sensing and Metrology, Quantum Communication, and Quantum Software. With integrated theoretical and experimental capabilities, the center strengthens KFUPM's capacity in quantum information science and contributes to positioning Saudi Arabia within the global quantum ecosystem.

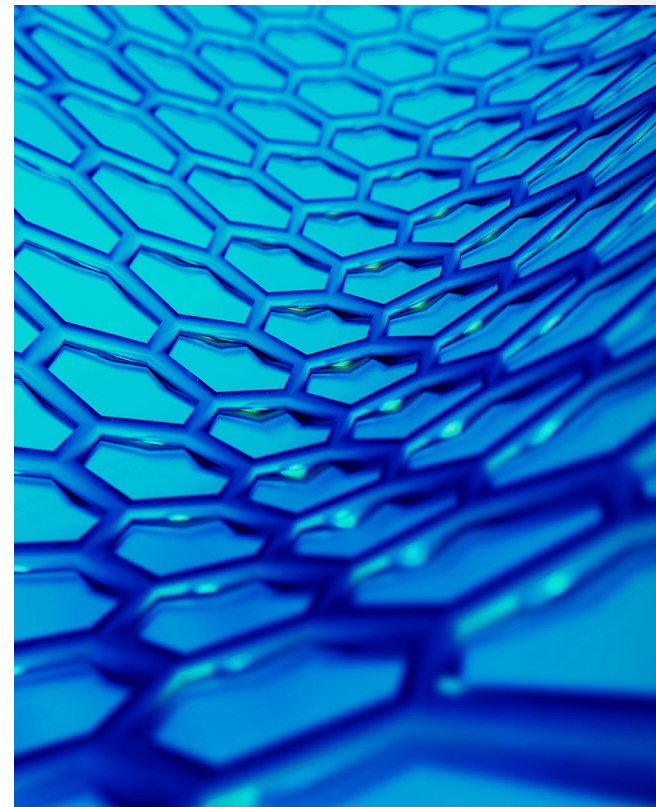
Together, these centers reflect KFUPM's strategy-driven commitment to building research capabilities that translate scientific excellence into long-term national and global impact.



Cryogenic quantum computing hardware, representative of the research infrastructure at the Interdisciplinary Research Center for Advanced Quantum Computing.

## Center for Carbon Materials

The Center for Carbon Materials was established through a strategic partnership between KFUPM and Saudi Aramco to advance next-generation, sustainable, high-performance carbon solutions. Aligned with KFUPM's Research Strategy, the center supports the translation of advanced materials research into applications that address energy transition and industrial needs. Through coordinated research efforts, the center advances innovation across key domains including Carbon Fiber, High-Performance Composites, Graphite, and Nano-Carbon. Aligned with the Crude Oil-to-Chemical Conversion national research priority, the center is designed to address long-term industrial demand for advanced materials and to serve as a platform for technology translation and commercialization, strengthening Saudi Arabia's advanced materials ecosystem.



Scanning electron microscope view of a carbon nanomaterial, illustrating the advanced materials research conducted at the Center for Carbon Materials.

# KFUPM Research Centers: The Full Ecosystem

## Interdisciplinary Research Centers (IRCs)



## Applied Research Centers (ARCs)



## Joint Research Centers (JRCs)





# Core Research Facilities: Infrastructure & Investments in 2025

Core Research Facilities (CoreLab) enables shared research infrastructure, ensuring efficient, reliable, and scalable laboratory operations across the University.

|                                     |                                                         |                                                             |                           |
|-------------------------------------|---------------------------------------------------------|-------------------------------------------------------------|---------------------------|
| CoreLab Strategic Objectives        | Efficient use of shared research infrastructure         | Sustainable infrastructure planning                         |                           |
|                                     | Reliable and efficient research operations              | Advanced equipment utilization                              |                           |
| Research Support by CoreLab in 2025 | 1,561<br>Service Requests Completed                     | 6,279<br>Samples Analyzed                                   | 19<br>Depts/Center Served |
| 2025 Infrastructure Investments     | SAR 45 Million<br>Major Equipment (above SAR 1 million) | SAR 67.2 Million<br>Non-Major Equipment (SAR 0.1–1 million) |                           |

## Key Additions to Research Facilities in 2025

In 2025, KFUPM strengthened its research ecosystem through strategic investments in advanced laboratories and shared facilities aligned with national priorities.

### Energy and Industrial Leadership

- Multiple Reactor System
- Laser Doppler Vibrometer (Mechatronics)
- Controlled-Atmosphere Glove Box System
- Materials Characterization Facility (Thermal, Optical and Surface Analysis)
- CPG Imaging Facility Upgrade (Geoenergy)
- Arc Melting Furnace

### Economies of the Future

- Urban Intelligence and Internet of Things Laboratory
- Robotic Metal Additive Manufacturing Cell (DED – Meltio)

### Sustainable Environment and Essential Needs

- High-Pressure Volumetric and Break-through Analysis Systems
- Lab-Scale 3D Concrete Printing Facility
- Cyclic Triaxial Soil Testing System
- Automated Marine Nutrient Analysis System

### Health and Wellness

- Biomechanics Laboratory

# Featured Research Facilities in 2025

## High-Throughput 4-Parallel Reactor Facility with Gas Chromatography

This flagship facility strengthens KFUPM’s experimental capabilities in clean and economic hydrogen research by enabling parallel testing of catalytic materials under industrially relevant conditions. The platform supports rapid screening, benchmarking, and optimization of catalysts for ammonia decomposition and hydrogen-related reactions, accelerating discovery while ensuring high-quality, the reproducible results. Aligned with the national priority “Clean, Economic Hydrogen”, the facility advances catalyst development, scale-up assessment, and technology readiness, while serving as a shared platform for industry engagement, international collaboration, and inter-center research across the University.

## Reconfigurable Intelligent Surface (RIS) Communications Testbed

This flagship testbed establishes an integrated experimental platform for evaluating next-generation wireless communication systems enabled by reconfigurable intelligent surfaces. By combining software-defined radios, programmable RIS panels, and FPGA-based signal processing, the facility enables practical performance assessment of high-frequency, non-line-of-sight communication scenarios under realistic conditions. Aligned with the national priority “Cognitive Cities”, the testbed supports the development of reliable, high-data-rate connectivity solutions and advances KFUPM’s research agenda in the future digital infrastructure, while enabling collaboration with industry, international partners, and interdisciplinary research teams across the University.

## LUMOS II FTIR Imaging Microscope

High-resolution infrared spectral imaging provided by this facility supports detailed chemical characterization of environmental samples, including microplastics, organic films, and mineral or biological particles. The capability enables forensic-level identification of pollutants and their distribution across sediments, biota, and water, complementing broader chemical and ecological assessments. Aligned with national priority “Biodiversity”, the facility strengthens environmental surveillance and biodiversity research, informs evidence-based ecosystem management and policy decisions, and positions KFUPM as a national reference capability for contaminant characterization and collaboration with regulators, industry, and international research networks.

## Biomechanics Laboratory

The Biomechanics Laboratory provides an integrated research capabilities for the design, fabrication, and mechanical validation of functional prototypes and bio-inspired systems. By combining advanced additive manufacturing, small-batch production, and biomechanical testing, the facility bridges early-stage research with manufacturable and test-ready solutions. Aligned with the national priority “Health and Bioengineering Innovation”, the laboratory accelerates applied and translational research, supports progression across technology readiness levels, and enables industry-relevant outcomes, while serving as a collaborative platform for inter-center research and external partnerships in biomaterials, medical devices, and human-centered health technologies.

## Human–Machine Teaming Laboratory

The Human–Machine Teaming Laboratory advances KFUPM’s capabilities in automation and intelligent systems by enabling direct interaction between humans and autonomous machines through the interpretation of the brain and physiological signals. By integrating biosignals such as EEG, fNIRS, EMG, ECG, and EOG, the laboratory supports human-centered autonomy in which intent, cognitive state, and physiological response informs perception, decision-making, and control. Aligned with the national priority “Automation of Logistics”, the facility enables safer, more intuitive collaboration between humans and autonomous platforms and supports research in intelligent mobility, assistive technologies, and future autonomous systems.

## Fixed-Bed Reactor and Sustainable Chemicals Catalytic Testing Facility

This facility enables advanced catalytic reforming and process evaluation of renewable gaseous feedstocks, supporting the conversion of biogas derived from landfill waste into syngas. The resulting syngas provides a flexible platform for downstream upgrading into fuels and chemicals, including methanol and sustainable aviation fuel. Aligned with the national priority “Net Zero Emissions”, the facility advances waste-to-energy pathways and aviation-sector decarbonization, while supporting interdisciplinary research and industry collaboration to enable scale-up, process integration, and technology translation



# Building the People Power Behind Research & Innovation

In a rapidly evolving, talent-rich society, human capital is central to sustained research excellence and innovation. KFUPM adopts a holistic approach to attracting, developing, and empowering talent across all career stages, fostering a research culture grounded in curiosity, rigor, collaboration, and global engagement. The University attracts leading researchers from around the world, while investing in

the continuous development of its academic community. Through structured recruitment, postdoctoral training, student research pathways, and capability-building initiatives, KFUPM nurtures a diverse and globally connected research environment that enables cross-disciplinary collaboration and impactful research outcomes.

## Research Workforce at a Glance

**619**

Faculty Members

**390**

Postdoctoral Fellows

**90**

Research Scientists

## Graduate Students

**1,228**

Master's Students

**1,073**

PhD Students

# Faculty Excellence & Research Leadership

KFUPM's faculty and researchers form a globally diverse and research-intensive community, bringing expertise from across disciplines and geographies. Rooted in a model that integrates education with research, the University fosters collaboration across interdisciplinary research centers, enabling the co-creation of knowledge aligned with national and global priorities.

In addition to their academic appointments, faculty members are affiliated with one or more interdisciplinary research centers, accelerating collaboration and enabling

impactful research outcomes. This model strengthens the integration of education and research by connecting departments with the research centers.

Faculty members contribute across the full research ecosystem, from foundational science to applied innovation, while engaging students at all levels in active research. This integrated approach strengthens research quality, supports talent development, and advances KFUPM's position as a leading research-driven institution.

## Sponsored Chair Professorship: Advancing Research Leadership

The sponsored Chair Professorships at KFUPM attract internationally recognized scholars who provide leadership in strategically important research areas. Supported through external partnerships, these positions strengthen research capacity, advance high-impact research, and foster collaboration with industry and global institutions.



**Prof. Mohamed Aroua**  
Aramco Chair



**Prof. Daniel da Costa**  
RDIA Chair



**Prof. Yogesh Dwivedi**  
Riyadh Bank Chair



**Prof. Mohammad Hammoudeh**  
Aramco Chair



**Prof. Jie Liu**  
RDIA Chair



**Prof. Daniel Loss**  
RDIA Chair



**Prof. Shirish Patil**  
Aramco Chair



**Prof. Konstantinos Triantafyllidis**  
Aramco Chair





# Postdoctoral Research: Driving Research Momentum & Growth

Postdoctoral researchers play a central role in advancing KFUPM's research agenda and sustaining momentum across its multidisciplinary research ecosystem. As a primary research workforce embedded within research centers and large-scale projects, postdoctoral fellows contribute directly to high-impact publications, technology development, and international collaboration.

Postdoctoral fellows benefit from access to world-class research infrastructure, strong mentorship, and active

collaboration with faculty members and industry partners. The close alignment between postdoctoral training, research centers, and education further strengthens career development, positioning postdoctoral fellows for successful academic, industrial, and entrepreneurial pathways. In 2025, KFUPM attracted more than 3,000 research professionals from 29 countries, reinforcing its position as a global destination for research excellence. Looking ahead, KFUPM continues to expand its postdoctoral community in alignment with its research strategy.

## Postdoctoral Programs at KFUPM

### Postdoctoral Research Fellowship

- Focused on advanced research across KFUPM's interdisciplinary research centers
- Emphasizes publications, collaboration, and contribution to strategic research priorities
- Strong mentorship and integration with faculty-led research programs

### Postdoctoral Startup Fellowship

- Designed for postdocs pursuing technology development and commercialization
- Combines research activity with entrepreneurial support and incubation
- Leverages Dhahran Techno Valley and KFUPM's innovation ecosystem



"My work at KFUPM reflects a strong focus on advancing impactful research in aviation and space systems within a collaborative, interdisciplinary environment. I have contributed to and led the development of integrated space mission concepts, including a CubeSat mission, while supporting student research and academic programs that connect theory with real-world application. This work plays an important role in enhancing capabilities in satellite systems and facilitating knowledge sharing through industry collaboration and outreach initiatives, aligning with the University's expanding involvement in space research and education."

**Asia Saeed Kajo Habila**

Postdoctoral Fellow — IRC for Aviation & Space Exploration



"KFUPM provides a rigorous and innovation-driven research environment that enables high-impact contributions in sustainable energy systems. At IRC for Sustainable Energy Systems, my work focuses on power system modeling, renewable energy integration, and geospatial assessment of utility-scale solar and wind resources, research that has been featured by PV Magazine. During my tenure, this work has led to high-quality publications, including a Nature Reviews article, industry-funded projects and international recognition among the Top 2% Scientists Worldwide. The university's strong research infrastructure and collaborative culture have been instrumental in advancing these outcomes."

**Mohamed Ragab Mustafa Elkadeem**

Postdoctoral Fellow — IRC for Sustainable Energy Systems

# Advancing Research Skills: Training & Global Exposure

## Research Skills Development & Global Engagement

KFUPM invests strategically in capability-building initiatives that strengthen research skills, enhance productivity, and expand global reach across its research community. Through targeted training and research enablement, the University equips researchers with the competencies and platforms needed to deliver high-quality, internationally visible research outcomes, while maintaining a strong focus on research excellence and impact.

### AI Skill-Up Program: Building Applied AI Competencies

The AI Skill-Up Program is KFUPM's capability-building initiative, designed to equip faculty members, researchers, and selected staff with practical and applied competencies in artificial intelligence. The program is developed and delivered under the SDAIA-KFUPM Joint Research Center for Artificial Intelligence, ensuring strong alignment with national priorities and applied research needs.

Delivered through intensive, hands-on modules, the program enables participants to integrate AI techniques into their domain-specific research and accelerate innovation. Structured across two progressive stages, AI4All and AI4Experts, the program supports skill development from foundational concepts to advanced applications. Since its launch, the program has engaged 300+ beneficiaries across multiple KFUPM units, reflecting its broad reach and impact.

### Research Support: Publishing, Open Access & Conference Participation

In parallel with advanced skills development efforts, KFUPM provides targeted research enablement to enhance productivity and strengthen global engagement. These efforts support researchers in disseminating high-quality outputs, increasing international visibility, and engaging effectively with the global research community.

Enablement areas include:



Professional editing and publication support



Open access publication support



Participation in international conferences and scientific events





# Developing the Next Generation of Researchers

KFUPM integrates research into education across all academic levels, creating a structured pipeline that develops future researchers and innovators. Through curriculum-embedded research courses, hands-on projects, and early talent programs, students engage with research from the early stages of their academic journey and progress toward advanced, independent inquiry.

## Undergraduate Research Engagement

KFUPM integrates undergraduate students into its research ecosystem through curriculum-based research courses and hands-on project participation. Undergraduate students engage in internally and externally funded research projects, contribute to research outputs with formal acknowledgment, and gain early exposure to the research community through conferences and scientific events participation, including non-paper tracks. These experiences strengthen research skills, foster academic curiosity, and prepare students for advanced research pathways.

### Key Undergraduate Research Pathways

|                                                         |                                       |                                                 |
|---------------------------------------------------------|---------------------------------------|-------------------------------------------------|
| <b>RES100</b><br>Introduction to Research               | <b>RES200</b><br>Independent Research | <b>RES201</b><br>Vertically Integrated Research |
| <b>RES299</b><br>Outbound International Summer Research | KFUPM Inbound Summer Research Program | Undergraduate Conference Participation Program  |

## Graduate Research Development

KFUPM’s graduate programs, comprising 14 doctoral and 40 master’s offerings, are designed around advanced, research-led training. Graduate students assume active research roles within interdisciplinary centers and large-scale projects, contributing to knowledge creation, publications, and innovation outcomes. Supported by targeted funding and research engagement mechanisms, this environment develops independent researchers and strengthens KFUPM’s research capacity.



KFUPM-mentored students at the International Science and Engineering Fair (ISEF) 2025, Columbus, Ohio.

### Early Talent Development: The Mawhiba Program

KFUPM plays an active role in identifying and mentoring future scientific talent through national initiatives such as the Mawhiba Research Program. By engaging high-performing school students in university-level research environments, the University contributes to early exposure, mentorship, and research skill development.

This commitment was reflected in ISEF 2025, where students mentored by KFUPM faculty achieved outstanding results, securing eight grand awards and representing a significant share of national recognition. These achievements highlight KFUPM’s role in nurturing scientific excellence well before the university level and strengthening the national research pipeline.

# International Research Engagement & Mobility

KFUPM’s human capacity strategy extends beyond institutional boundaries through structured international research engagement and global talent connectivity. By enabling inbound and outbound research mobility and fostering long-term international collaboration, the University integrates global expertise into its research ecosystem while providing researchers with access to world-class research environments. These initiatives strengthen research quality, expand global perspectives, and position KFUPM as an active contributor to addressing shared scientific and societal challenges.

## Four Flagship International Research Programs

KFUPM drives innovation through a series of flagship international programs. These initiatives serve a dual purpose: enabling researchers to engage with leading global institutions while also attracting international scholars to the University. Through these exchanges, KFUPM strengthens collaboration, supports joint research projects, and ensures its research community remains at the forefront of global scientific discovery.

### Research with Humanity Microgrant

Enables international research collaboration with researchers from low- and middle-income countries to address critical global challenges.

### KFUPM Ibn Sina Global Scholarship Program

Brings high-caliber international scholars to KFUPM, strengthening knowledge exchange and research collaboration.

### KFUPM Ibn Battuta Global Scholarship Program

Enables outbound research visits that support international collaboration, joint research, and high-impact publications.

### MbSC2030 Direct Funded Research Grant

Facilitates joint research collaboration between KFUPM and international partners in Japan across shared priority research areas.

KFUPM operates global engagement at scale. Together, the University’s four flagship international programs have supported over 140 researchers, enabling mobility between institutions and the advancement of joint research. These programs are designed to build and sustain long-term partnerships with the international scientific community.

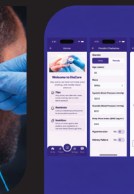
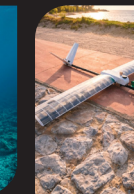
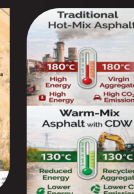
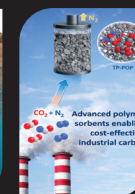
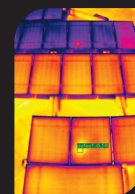
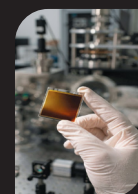
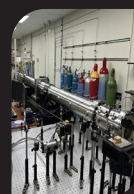
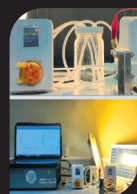


Global Engagement at Scale



# Advancing the Next Frontier

## 20 Flagship Research Projects



ENERGY AND INDUSTRIAL LEADERSHIP

SUSTAINABLE ENVIRONMENT AND ESSENTIAL NEEDS

ECONOMIES OF THE FUTURE

HEALTH & WELLNESS

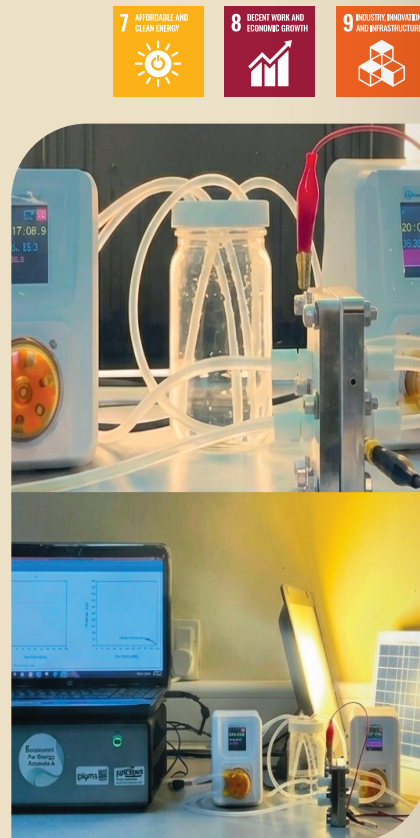


## Innovative Anode Solutions for Cost-Effective Green Hydrogen

Scaling green hydrogen requires electrolyzers that are both efficient and economically viable. A major cost driver lies in the oxygen evolution reaction, where conventional designs rely on expensive noble metals and complex fabrication.

Led by the IRC for Hydrogen Technologies and Carbon Management, this project develops a binder-free Ni-Fe layered double hydroxide (LDH) anode architecture directly integrated onto stainless-steel mesh. By optimizing nanostructure and composition while relying solely on earth-abundant materials, the team achieves competitive catalytic performance without costly components. Full-cell validation demonstrates strong efficiency and operational stability.

The scalable design enhances durability, simplifies manufacturing, and directly supports electrolyzer stack cost reduction. By improving both performance and affordability, the initiative accelerates commercial green hydrogen deployment and supports the goal of reducing the electrolyzer stack costs by 50% by 2030.



Full-Cell Electrolyzer System: Validated for sustained green hydrogen production under full-cell conditions.

## Waste-Derived Catalysts for High-Value Crude-to-Chemicals Conversion

Saudi Arabia generates an estimated 2–3 million tonnes of red mud (industrial waste) each year, creating long-term environmental and storage pressures. At the same time, crude oil upgrading depends on costly catalyst materials that increase operational expenses and resource dependency.

The IRC for Refining and Advanced Chemicals redefines red mud as a strategic industrial resource. Through engineered activation and process optimization, the team converts this metal-oxide-rich residue into durable composite catalysts that enhance crude oil conversion to light olefins, key feedstocks for petrochemical production. The approach replaces conventional catalysts with locally sourced industrial by-products, strengthening resource efficiency across sectors. The resulting catalysts improve conversion performance and product selectivity while reducing reliance on imported raw materials.

By transforming industrial waste into high-value catalytic systems, the project advances circular economy practices and supports the national mission to achieve more than 80% conversion of crude oil to chemicals by 2030.



Red mud valorization into engineered composite catalysts for crude oil-to-chemicals conversion.

## Advancing Fire-Safe Lithium-Ion Batteries for Electric Vehicles

As electric mobility and renewable energy storage expand globally, battery safety has become a defining challenge for next-generation energy systems. Limited understanding of electrolyte combustion chemistry restricts accurate prediction of fire behavior under extreme conditions.

To address this gap, KFUPM has established an advanced shock-tube experimental platform to generate high-fidelity combustion data for lithium-ion battery electrolytes. Leveraging advanced shock-tube diagnostics provided by the IRC for Hydrogen Technologies and Carbon Management, the team generates high-precision ignition delay and reaction data to improve predictive safety models. These experimentally validated insights strengthen the understanding of fire mechanisms at the material level.

The resulting experimental database strengthens predictive fire-risk assessment tools and informs safer electrolyte and battery design. By improving modeling accuracy and mitigation strategies, the project supports safer EV deployment, consumer electronics, and grid-scale storage applications, while contributing to industrial safety standards.

This foundational safety research reinforces KFUPM's Research Strategy, advancing national efforts to develop heat-resistant, durable batteries exceeding 400 Wh/kg and 1,000 cycles.



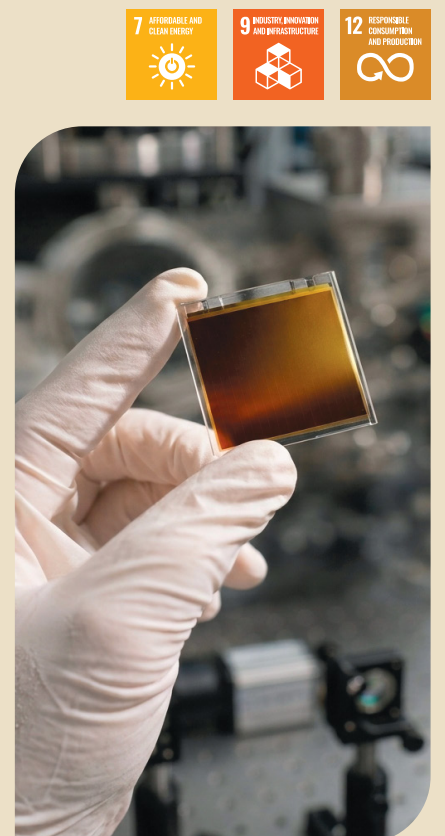
Advanced shock-tube diagnostics platform generating high-precision data for lithium-ion battery safety modeling.

## Stabilizing Next-Generation Perovskite Solar Cells

Perovskite solar cells offer high efficiency at low cost, yet their instability under ambient processing conditions limits commercialization. Manufacturers require materials that maintain performance while supporting scalable fabrication.

This project engineers all-inorganic perovskite layers to resist structural and environmental degradation. By combining compositional optimization with advanced additive design, the team within the IRC for Sustainable Energy Systems improves film integrity and suppresses defect formation during air-based processing.

The enhanced films extend operational stability and device lifespan, bridging laboratory performance with industrial reproducibility. By improving durability and manufacturing consistency, the work accelerates the transition of perovskite photovoltaics into commercially viable solar technologies, supporting national renewable energy targets.



All-inorganic perovskite solar cell with enhanced film stability for scalable air-based processing.



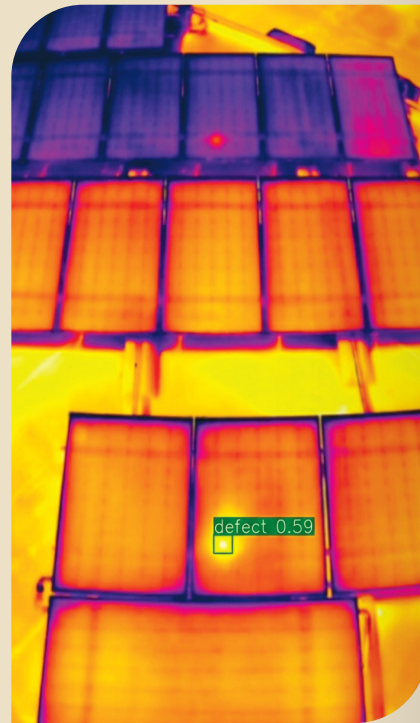
## Intelligent Monitoring for High-Performance Solar Infrastructure

Utility-scale solar farms span millions of panels, where undetected defects, dust accumulation, and installation faults gradually reduce energy output. In harsh environmental conditions, manual inspection becomes slow, costly, and impractical, limiting the ability of operators to maintain optimal system performance.

SDAIA-KFUPM JRC for Artificial Intelligence is developing an integrated AI-drone platform that automates solar panel inspection using advanced computer vision and anomaly detection models to detect and identify faults in real time.

The system benchmarks state-of-the-art algorithms on global datasets and validates performance through field deployment over operational PV installations. By combining artificial intelligence, energy systems expertise, and aerospace engineering, the platform enables rapid fault detection, improves maintenance precision, and enhances operational safety across large-scale solar assets.

The solution reduces inspection time, strengthens efficiency retention, and enables predictive maintenance strategies that protect long-term energy yield. By minimizing downtime and improving reliability, it lowers lifecycle operational costs while supporting sustainable solar expansion. This work advances the objective of reducing solar power degradation by 55% by 2030, reinforcing the Kingdom's transition toward intelligent and resilient renewable energy infrastructure.

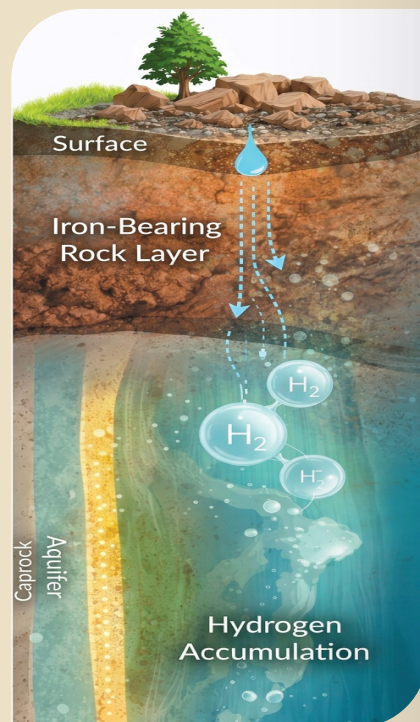


Thermal infrared imaging of solar panels with AI-detected faults for performance monitoring.

## Unlocking Natural Hydrogen Through Water–Rock Reactions

Natural hydrogen generated by water–rock reactions represents a largely untapped geoenergy frontier. Yet without reliable subsurface yield data, its potential as a scalable low-carbon resource remains uncertain. This project moves beyond theoretical modeling to directly quantify hydrogen production from iron-bearing rock formations. By replicating natural geochemical conditions under controlled settings and measuring gas generation in real time, the team links mineral transformations to verifiable hydrogen output. The resulting predictive workflow enables formation screening based on measurable generation capacity rather than assumptions.

By reducing exploration uncertainty and providing data-driven resource evaluation, the initiative opens a new pathway for low-carbon hydrogen development. It strengthens national geoenergy leadership and positions the Kingdom at the forefront of natural hydrogen exploration and sustainable energy diversification.



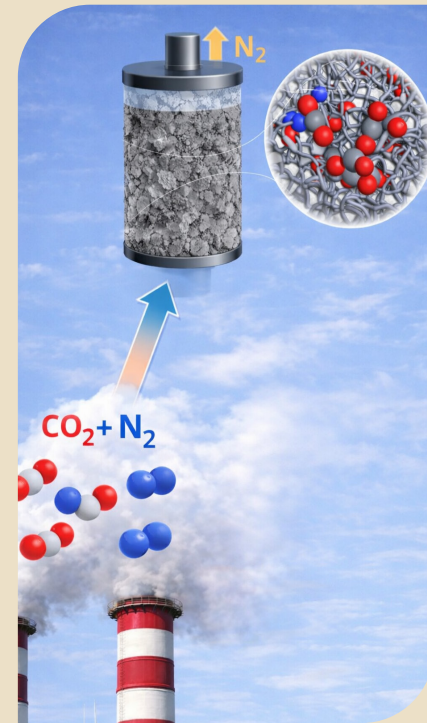
Geological cross-section of natural hydrogen generation via water–rock reactions and subsurface accumulation.

## Reducing Industrial Carbon Capture Costs Through Advanced Polymer Sorbents

Decarbonizing heavy industry depends on lowering the cost and energy intensity of carbon capture. Conventional solvent-based systems demand high regeneration energy and impose operational burdens.

This project develops triptycene-based microporous polymers engineered for selective and energy-efficient CO<sub>2</sub> capture. With support from the IRC for Advanced Materials, the team optimized material synthesis and performance characterization, leveraging specialized facilities to refine adsorption capacity and regeneration efficiency. By tailoring surface chemistry and pore structure, the researchers developed solid sorbents that combine high CO<sub>2</sub> affinity with improved durability. Integrated techno-economic analysis confirms scalability for industrial deployment.

The resulting materials reduce energy demand and operating costs while enhancing durability and process efficiency. By advancing cost-effective carbon capture pathways, the project contributes to the national mission of lowering point-source capture costs and accelerating progress toward net-zero emissions in industry.



Triptycene-based microporous polymer sorbents for selective, energy-efficient industrial CO<sub>2</sub> capture.

## Turning Desalination Brine into a Strategic Resource

Desalination sustains national water security, yet it produces more than 150 million m<sup>3</sup> of concentrated brine each day, which is a costly environmental burden with limited reuse pathways. Managing this high-salinity discharge remains one of the most pressing sustainability challenges in large-scale water production.

The team from the IRC for Membranes and Water Security reimagined brine as a resource stream rather than waste. KFUPM has developed a selective mineralization platform that recovers calcium and magnesium while simultaneously sequestering CO<sub>2</sub> through stable mineral formation. By converting calcium into CaCO<sub>3</sub> and magnesium into Mg(OH)<sub>2</sub>, the system integrates carbon capture and mineral recovery into a single circular pathway.

The approach reduces brine discharge, lowers environmental impact, and generates high-value industrial minerals that offset operating costs. By positioning desalination plants as resource-generating hubs, the project advances the innovation goal of reducing net operating costs by 50% and transforming brine into a strategic asset by 2030.



Recovered minerals from desalination brine using CO<sub>2</sub>-assisted selective mineralization processes.



# Establishing a National Marine Surveillance and Fisheries Framework

Marine ecosystems in Saudi waters face rising pressure from inconsistent gear standards and limited traceability. Without standardized data and coordinated monitoring, sustainable fisheries management remains difficult to implement at scale.

Through the MEWA Fisheries Program, KFUPM provides the scientific backbone for modern fisheries governance. The team conducted a nationwide assessment across more than 88 landing sites, standardizing fishing gear specifications, mapping fishing grounds, and establishing traceable monitoring protocols. This structured framework enables consistent compliance checks and supports adaptive, science-based regulation.

Beyond data collection, the initiative embeds surveillance capabilities directly into national management systems. By improving gear selectivity oversight, reducing habitat impacts, and strengthening enforcement, the program safeguards fish stocks, supports coastal livelihoods, and enhances food security. The initiative develops an advanced, integrated, and smart environmental surveillance network, reinforcing long-term marine resilience and responsible resource stewardship.



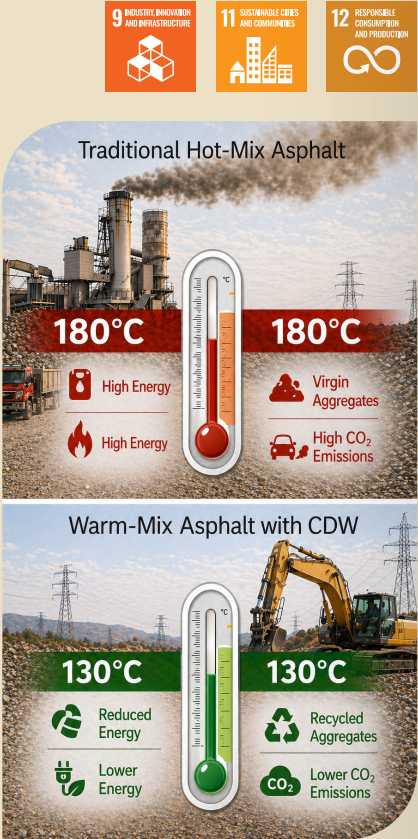
Nationwide mapping of fish landing sites across Saudi waters under the MEWA Fisheries Program.

# Turning Construction Waste into Low-Carbon Road Infrastructure

Nearly 50 million tons of construction and demolition waste are generated annually in Saudi Arabia, much of it is landfilled. Meanwhile, conventional asphalt production consumes significant energy and emits substantial CO<sub>2</sub>.

Led by the IRC for Construction and Building Materials, this project develops a high-performance stone-mastic asphalt mixture incorporating recycled aggregates and warm-mix technology below 130°C. The approach reduces production temperatures by approximately 50°C while improving pavement durability and extending service life.

By diverting waste from landfills and reducing reliance on virgin aggregates, the innovation lowers emissions and lifecycle costs. The project advances circular construction practices and supports national targets to recycle 30% of construction waste by 2030



Comparison of conventional hot-mix and energy-efficient warm-mix asphalt production processes.

# Building Sustainable Materials from Date Palm Biomass

Saudi Arabia's 31 million date palm trees generate millions of tons of agricultural residue each year, much of which is burned or discarded, contributing to air pollution and material waste. At the same time, the construction sector depends heavily on imported wood-based panels and building composites.

KFUPM is converting date palm biomass into a new class of bio-based construction panels. By extracting fibers from locally sourced waste and developing durable binder-based and binderless boards, the team creates a new category of sustainable building materials derived entirely from domestic resources.

The resulting fiberboards reduce agricultural waste, cut air pollution from open burning, and decrease reliance on imported products. By enabling local manufacturing and new value chains, the initiative advances circular economy practices and supports Vision 2030 goals for sustainable industry and environmental stewardship.



Repurposing date palm residues into bio-based construction panels turns agricultural waste into a sustainable industrial opportunity.

# High-Performance Protective Coatings from Industrial Byproducts

Corrosion protection is essential for durable infrastructure, yet conventional epoxy-based coatings are costly and often underperform in hot climates. At the same time, large volumes of industrial byproducts remain underutilized, creating disposal and environmental challenges.

This project integrates indigenous industrial waste materials into advanced acrylic-based coating systems designed for local environmental conditions. Applied to steel and concrete substrates, the developed coatings demonstrate enhanced bond strength and superior corrosion resistance compared to standard systems.

The improved performance extends structural lifespan, reduces maintenance frequency, and lowers lifecycle costs for infrastructure projects. By replacing conventional raw materials with locally sourced byproducts, the initiative strengthens circular construction practices while delivering resilient, climate-adapted protection for critical infrastructure.



Corroding steel and concrete infrastructure in harsh environments requires advanced and sustainable protection solutions.



## Securing Human-Centered AI for Resilient Cognitive Cities

As cities evolve into AI-driven ecosystems, human interaction has become the weakest link in cybersecurity. Phishing, insider threats, and misuse of personal data pose systemic risks that conventional technical defenses often overlook.

This project establishes a structured taxonomy and threat-modeling framework focused specifically on human-centric vulnerabilities in cognitive cities. By systematically identifying and prioritizing behavioral and interaction-based risks, the framework enables policymakers and system designers to embed privacy and resilience at the architectural level.

The resulting model strengthens trust in AI-enabled public services, enhances protection of citizen data, and improves continuity of essential urban systems. By placing human-centered security at the core of digital infrastructure, the project advances Saudi Arabia's vision for secure and resilient cognitive cities.



Human-centered AI cybersecurity framework addressing behavioral risks in cognitive city systems.



## Intelligent Fiber-Optic Sensing for Autonomous Pipeline Monitoring

Oil and gas pipelines span vast and often remote regions, where delayed anomaly detection can result in environmental damage and operational disruption. Conventional inspection methods provide limited spatial coverage and require costly manual intervention.

Led by the IRC for Communication Systems and Sensing and supported by the Center for Integrative Petroleum Research, the project integrates Distributed Acoustic Sensing (DAS) with machine learning to enable continuous, real-time monitoring across entire pipeline corridors. By enhancing signal clarity and applying semi-supervised models for event detection, the system identifies leaks, blockages, and disturbances with greater reliability and reduced manual labeling.

The approach improves infrastructure safety, lowers inspection costs, and supports predictive maintenance. By combining distributed sensing with AI-driven analytics, the project strengthens data-driven infrastructure management central to the Kingdom's digital industrial transformation.



Distributed fiber-optic sensing system enabling real-time, AI-driven pipeline monitoring and anomaly detection.

## Enabling Autonomous Air Logistics Through Intelligent Propulsion

Air logistics using unmanned aerial vehicles remains constrained by limited endurance and heavy operator intervention. Conventional engines lack adaptive intelligence, reducing efficiency and mission reliability.

This project develops an intelligent propulsion system integrating hardware design, embedded electronics, and AI-based control to enable adaptive thrust management and predictive health monitoring. By optimizing fuel use in real time and reducing manual oversight, the system enhances endurance and operational autonomy.

The outcome enables scalable, low-intervention cargo operations across urban and remote regions. By localizing advanced propulsion capability, the project strengthens Saudi Arabia's automation of its logistics ecosystem and supports the growth of next-generation aerospace industries.



Fixed-wing UAV with AI-enabled propulsion system for autonomous cargo and logistics applications.

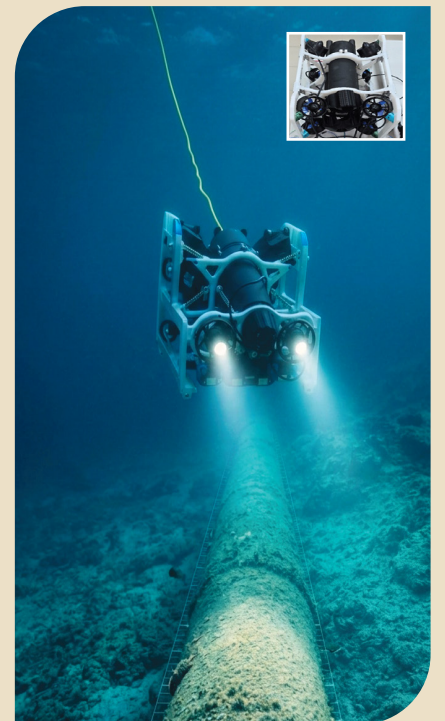


## Marine Autonomy Through a Saudi-Developed Underwater ROV

Underwater inspection and environmental monitoring frequently require diver-based surveys in hazardous conditions, limiting coverage and increasing operational risk.

Led by the IRC for Intelligent Manufacturing and Robotics, the Marjan-R1 Remotely Operated Vehicle is a six-degree-of-freedom demonstrator engineered for subsea inspection and marine sensing. Integrating robust guidance, navigation, and control algorithms with modular embedded systems, the platform performs routine high-risk tasks with improved safety and precision.

Now at TRL 6, the platform strengthens national capability in underwater robotics and intelligent marine systems. The project advances Saudi Arabia's leadership in autonomous technologies supporting both industrial inspection and blue-economy development.



Marjan-R1 remotely operated vehicle (ROV) performing subsea inspection at TRL 6.



## Solar-Battery Hybrid UAV for Low-Emission Infrastructure Inspection

Pipeline and infrastructure inspection often depend on fuel-intensive patrols and manned aircraft, increasing emissions and operational risk.

This project develops a solar-powered hybrid UAV equipped with onboard AI to detect anomalies such as leaks and encroachments in near real time. By combining extended endurance flight with edge-based intelligence, the system reduces reliance on continuous connectivity while improving coverage and response time.

The approach lowers operational emissions, enhances early fault detection, and improves safety. By demonstrating scalable, low-carbon inspection capability, the project contributes to the Kingdom’s Net Zero Aviation pathway and intelligent infrastructure monitoring strategy.



Solar-battery hybrid UAV enabling low-emission infrastructure inspection with onboard AI and extended endurance.

## Building Sovereign Space Capability: KFUPM’s First CubeSat

As urban expansion and environmental monitoring needs intensify, demand for high-resolution Earth observation and secure space technologies continues to grow. Sovereign capability in satellite systems has become strategically essential.

K-Sat1 is an 8U CubeSat designed for hyperspectral Earth observation and in-orbit optical communication demonstration. Developed in-house, the satellite integrates advanced payload calibration, subsystem qualification, and mission validation to deliver a flight-ready platform.

Beyond its scientific mission, the program builds local engineering capacity and establishes a foundation for future space-based services. By advancing indigenous satellite development, the project reinforces KFUPM’s New Space Leadership ambitions.



Building sovereign space capability: KFUPM’s First CubeSat.

## Personalized Ear-Worn Sensors Through Sensitivity Mapping

Wearable and implantable health devices promise continuous monitoring, yet anatomical variation within the ear canal limits sensor accuracy and comfort.

Led by the IRC for Biosystems and Machines, this project performs detailed sensitivity mapping of the human ear canal to inform personalized sensor placement and signal optimization. By characterizing mechanical response variability, the team improves device stability, signal fidelity, and long-term user comfort.

The findings enable next-generation lightweight wearables tailored to individual physiology, expanding access to adaptive health technologies. Through precision mapping and sensor design optimization, the initiative strengthens national capacity in personalized medical devices and next-generation digital health



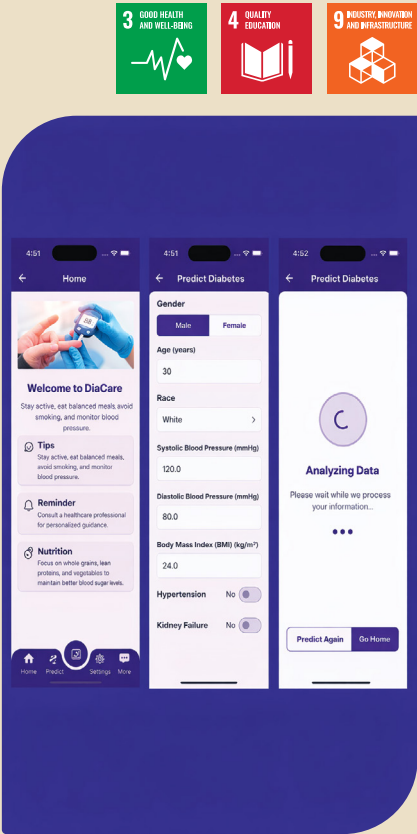
Human ear canal sensitivity mapping to optimize sensor placement for next-generation wearable health devices.

## Predictive Diabetes Care through Explainable AI

Type 2 diabetes continues to impose rising health and economic burdens, often detected only after complications emerge. Many digital health tools provide tracking features but lack personalized, interpretable risk prediction.

This project develops an explainable AI model for early diabetes prediction using large-scale clinical datasets. The validated model powers DiaCare, a digital prototype delivering personalized risk insights, educational content, and AI-assisted guidance.

By combining predictive accuracy with transparency, the system enhances clinical trust and empowers preventive action. The initiative strengthens Saudi Arabia’s AI-in-Healthcare trajectory, supporting data-driven, preventive health systems aligned with the national health and wellness priority.



DiaCare application prototype with AI-driven diabetes risk prediction and patient data analysis interface.



# Advancing Impact Through Partnerships

## 2025 Partnership Activity: Key Metrics

KFUPM strengthens its research impact through strategic industry partnerships that translate academic excellence into applied solutions. In 2025, the University expanded its national and international collaboration footprint, launching new contractual research projects, formalizing strategic agreements, and advancing industry-integrated academic programs aligned with national priorities.

|                                          |                                         |                                                             |
|------------------------------------------|-----------------------------------------|-------------------------------------------------------------|
| <b>15</b><br>Strategic Agreements Signed | <b>9</b><br>Licensing Agreements Signed | <b>24</b><br>Contractual Applied Research Projects Launched |
|------------------------------------------|-----------------------------------------|-------------------------------------------------------------|

## Strategic Partnerships & National Collaboration

In January 2025, under the patronage of His Royal Highness Prince Abdulaziz bin Salman bin Abdulaziz, Minister of Energy and Chairman of the Board of Trustees of KFUPM, the University formalized 15 strategic agreements with leading government entities and major organizations.

These agreements advance collaboration across renewable energy, nuclear technologies, artificial intelligence, transportation systems, defense innovation, healthcare, environmental sustainability, and advanced materials, reinforcing KFUPM's role as a national anchor for research-driven development.

Key partnerships include King Abdullah City for Atomic and

Renewable Energy (K.A.CARE); the Ministry of Defense and the General Authority for Defense Development; the Ministry of Transport and Logistics Services; and the Ministry of Economy and Planning. Additional agreements with SDAIA, NEOM, King Faisal Specialist Hospital & Research Centre, Aramco, the National Center for Environmental Compliance, and Bank Albilad further strengthen applied research, innovation acceleration, and workforce development aligned with Saudi Vision 2030.

Collectively, these partnerships establish a coordinated framework for advancing applied research, technology localization, and national capacity building across priority sectors.



HRH Prince Abdulaziz bin Salman, Minister of Energy and Chairman of KFUPM's Board of Trustees, presides over the signing of 15 strategic agreements with government entities and industry partners, January 2025.

# Partnership Spotlights

## PSI Switzerland | Strategic Partnership in Advanced Nuclear Engineering

Through the IRC for Industrial Nuclear Energy, KFUPM formalized a Memorandum of Understanding with the Paul Scherrer Institute (PSI), Switzerland, strengthening collaboration in nuclear research and training. The partnership advances joint research, specialized technical programs, and scientific knowledge exchange in advanced reactor systems.

In 2025, 13 students completed immersive training at PSI and the Jožef Stefan Institute, gaining hands-on experience in research reactors and nuclear facilities. The collaboration enhances technical expertise and workforce readiness aligned with national energy priorities.



Signing of the MoU between KFUPM and the Paul Scherrer Institute (PSI), Switzerland.

## ispace | Lunar Exploration & Spacecraft Development Collaboration

Through the IRC for Aviation and Space Exploration, KFUPM formalized a Memorandum of Understanding with ispace, Inc., a global lunar exploration company, to explore collaboration in lunar technologies and spacecraft development. The partnership establishes a framework for joint research in lunar science, in-situ resource utilization (ISRU), and advanced mission capabilities, including potential transportation of KFUPM payloads to the Moon.

The agreement also supports capacity building for students and faculty, strengthening aerospace research and advancing the Kingdom's ambitions in emerging space technologies.



KFUPM and ispace, Inc. at the signing of their MoU, February 2025.

## MISC Global | Industry Co-Development of Smart Road Monitoring Systems

In collaboration with MISC Global, IRC for Smart Mobility and Logistics co-developed RoaDetect 1.0, an AI-based road health detection system that automatically identifies cracks and potholes. The platform integrates advanced imaging, machine learning, and GIS mapping to generate automated defect reports and spatial analysis.

The project demonstrates effective industry–university co-development, translating research capabilities into a deployable infrastructure solution. RoaDetect reflects KFUPM's commitment to applied research that addresses operational challenges through scalable digital technologies.



RoaDetect 1.0 — an AI-driven road condition monitoring platform integrating computer vision, machine learning, and geospatial analytics.

## JHAH | Strategic Collaboration in Medical Research

Through the IRC for Biosystems and Machines, KFUPM established a collaboration framework with Johns Hopkins Aramco Healthcare (JHAH) to advance joint scientific and healthcare initiatives. The successful delivery of HeartFusion 2025 marked the launch of this collaboration, showcasing an effective model for a multidisciplinary conference execution and institutional cooperation.

The framework enables sustained engagement in medical and scientific programming, reinforcing KFUPM's role as a trusted platform for knowledge exchange between academia and industry.



HeartFusion 2025 marked a milestone in KFUPM–JHAH collaboration, integrating bioengineering, robotics, and data-driven healthcare innovation.



# Strategic Research Consortia in 2025

In 2025, KFUPM’s strategic research consortia accelerated coordinated, multi-partner research across hydrogen and sustainability domains, strengthening technology translation, industrial alignment, and national impact through structured co-investment and shared research infrastructure developments. These platforms play a critical role in translating research into scalable ventures and industry applications.

## Consortium for Hydrogen Future (H2FC)

### Advancing Clean Economic Hydrogen

In 2025, the Consortium for Hydrogen Future accelerated coordinated research to advance cost-competitive, low-carbon hydrogen technologies across production, transport, storage, and utilization. Efforts focused on improving system efficiency, expanding ammonia-based pathways, and strengthening techno-economic performance and lifecycle integration to support scalable deployment aligned with national hydrogen priorities.

Key advancements in 2025 included progress in next-generation production pathways, membrane-based hydrogen separation, and ammonia-enabled storage and transport systems. Licensed hydrogen technologies are advancing deployment readiness and contributing to national cost-reduction targets of <\$0.5/kg by 2030. Through coordinated investment and cross-sector collaboration, the Consortium continues to strengthen Saudi Arabia’s position in the emerging global hydrogen economy.

### H2FC: 2025 Performance Snapshot

|                                                               |                     |
|---------------------------------------------------------------|---------------------|
| SAR 8.5 Million<br>Total Investment                           |                     |
| SAR 375,000<br>New RDIA Funding Secured                       |                     |
| 42<br>Journal Articles                                        | 3<br>Issued Patents |
| 10<br>Conference Proceedings                                  | 2<br>Book Chapters  |
| 20+<br>Graduate Students and Postdoctoral Researchers Engaged |                     |

## Consortium for a Sustainable Future (CSF)

### Materials-Enabled Solutions for Energy, Water, and Circular Systems

In 2025, the Consortium for a Sustainable Future advanced integrated research across clean fuels and energy conversion, carbon capture and conversion, water treatment and desalination, environmental sustainability, advanced materials, and critical minerals processing. Efforts focused on translating materials-enabled research into applied systems and protected intellectual property outputs.

A major milestone was the successful operation of a solar-integrated cooling and desalination prototype, demonstrating system-level validation of energy-water research integration. Ammonia synthesis technology advanced from laboratory validation to industrial licensing, marking a significant step toward deployment. Through coordinated thematic integration and industry engagement, the Consortium continues to advance scalable sustainability solutions with tangible technological and economic value.

### CSF: 2025 Performance Snapshot

|                                                              |                          |
|--------------------------------------------------------------|--------------------------|
| SAR 1.4 Million<br>Total Investment for 2 New Projects       |                          |
| SAR 250,000<br>Award Secured in Roshen/DTV Innovation Summit |                          |
| 19<br>Published Articles                                     | 4<br>Patents             |
| 2<br>Prototypes                                              | 58<br>Proposals Received |
| 1<br>International Collaboration with Stanford University    |                          |

# Research-Based Ventures & Startup Development

## From Laboratory to Market: 2025 Venture Highlights

KFUPM advances structured research commercialization through Dhahran Techno Valley (DTV). In 2025, ventures emerging from advanced materials, hydrogen, artificial intelligence, and sustainable infrastructure progressed from proof-of-concept to funding, pilot deployment, and industry engagement.

## Venture Building Programs

### Deep-Tech Venture Builder Program (DTV)

Through Dhahran Techno Valley, KFUPM annually selects the top 10 venture-ready technologies from faculty and students with validated proof-of-concept. In 2025, 27 projects were shortlisted, and 10 ventures advanced to receive up to SAR 200,000 in seed funding alongside a four-month development program. Support includes joint product development, co-built go-to-market strategies, targeted mentorship, incubation, and structured market access facilitation under KFUPM’s 0-0-0 policy (0% royalty, 0% administrative fees, 0% ownership retention).

### Visionary Program – ROSHNEXT (ROSHN Group)

The Prop-Tech Visionaries Program, established through a strategic collaboration between Dhahran Techno Valley (DTV) and ROSHN Group, accelerates research-driven innovations in PropTech and sustainable urban development. Through structured venture-building, funding support, and pilot deployment opportunities, the program enables scalable market entry. In 2025, the initiative attracted over 130 applicants, with 3 KFUPM startups and securing national awards and SAR 200,000 in development funding each.

## Five Ventures Advancing Toward Market in 2025

### 4NM

#### IRC for Advanced Materials

4NM advances high-performance material systems originating from IRC-AM research. In 2025, the venture progressed to scheduled pilot deployments with The Global Overseas Ltd. (Oman) and Fusion Materials in Saudi Arabia, including investment engagement. These pilots represent a critical transition from laboratory validation to early-stage industrial implementation.

### Sustain

#### ARC for Metrology, Standards, and Testing

Sustain applies guided-wave EMAT sensing technology to externally detect internal pipeline coating defects. By enabling non-intrusive inspection, the technology lowers operational downtime and inspection costs while supporting smarter asset integrity management across industrial infrastructure.

### NeoSorb

#### IRC for Hydrogen Technologies and Carbon Management

NeoSorb develops a regenerable green solid sorbent for cost-efficient industrial carbon capture. Selected among 10 ventures from 71 applicants in the 2025 Deep-Tech Venture Builder Program, it secured SAR 200,000 in seed funding. The technology reduces energy consumption by up to 60% compared to amine systems and targets capture costs below \$20 per ton of CO<sub>2</sub>.

### Net Zero Systems

#### IRC for Aviation & Space Exploration

Net Zero Systems integrates artificial intelligence with drone, aerial, and ground-based sensing to deliver high-precision methane leak detection. By integrating multi-source data analytics, the platform improves the accuracy of environmental monitoring and enables predictive compliance in support of decarbonization and emissions reduction strategies.

### Paradise Cooling

#### IRC for Sustainable Energy Systems

Awarded First Place at the ROSHNXT Innovation Summit (2025), Paradise Cooling introduces a sustainable cooling solution designed for energy-efficient urban environments. Paradise Cooling’s recognition underscores its commercial readiness and alignment with smart city and PropTech development priorities.



# Global Recognition: Awards & Distinction in 2025

## Al-Qassim Award for Excellence and Creativity

SDAIA-KFUPM Joint Research Center for Artificial Intelligence

Awarded May 2025

In 2025, the SDAIA-KFUPM Joint Research Center for Artificial Intelligence, led by Dr. Maad Alowaifeer, received the Al-Qassim Award for Excellence and Creativity from the Qassim Region Emirate and the Qassim Award Foundation. Presented under the patronage of His Royal Highness the Prince of Al-Qassim, the award recognizes the Center's impactful contributions to artificial intelligence research and innovation at both regional and national levels.



## KFUPM Secures 10 Global Awards at the International Exhibition of Inventions in Geneva

Interdisciplinary Research Center for Sustainable Energy Systems, Interdisciplinary Research Center for Manufacturing and Robotics, and Center for Integrative Petroleum Research

Awarded April 2025

In April 2025, KFUPM secured ten prestigious awards at the 50th International Exhibition of Inventions in Geneva, one of the world's leading innovation platforms. Researchers from the Interdisciplinary Research Center for Sustainable Energy Systems, the Interdisciplinary Research Center for Manufacturing and Robotics, and the Center for Integrative Petroleum Research were recognized with gold, silver, bronze, and special distinction medals for groundbreaking innovations in renewable energy systems, advanced materials, robotics, environmental technologies, and engineering solutions.

This international recognition reflects KFUPM's multidisciplinary research strength and its continued success in translating research excellence into globally validated technological impact.

## Saudi Energy Efficiency Awareness and Impact Award

Center of Excellence in Energy Efficiency

Awarded December 2025

On December 12, 2025, KFUPM's Center of Excellence in Energy Efficiency received the Saudi Energy Efficiency Awareness and Impact Award at the inaugural Energy Efficiency Award Ceremony held in Riyadh under the patronage of His Royal Highness Prince Abdulaziz bin Salman.



# Institutional Research Awards and Talent Recognition

In 2025, KFUPM reinforced its culture of research excellence through institutional awards recognizing distinguished scholarship, early-career achievement, postdoctoral performance, and applied innovation. Conferred by the Deanship of Research, these awards uphold performance standards, reward impactful contributions, and cultivate future research leaders across disciplines.

## Distinguished University Professorship Award

Recognizes sustained excellence in international research and academic leadership.

- **Prof. Salaheldin Mahmoud Ahmed Elkatatny**, Professor, Department of Petroleum Engineering
- **Dr. Hafiz Muhammad Ali Arshad**, Associate Professor, Department of Mechanical Engineering and Research Scholar, Interdisciplinary Research Center for Sustainable Energy Systems
- **Dr. Naef Abduljalil Abdulrahman Qasem**, Associate Professor, Department of Aerospace Engineering and Research Scholar, Interdisciplinary Research Center for Aviation and Space Exploration

## Research Excellence Award

Recognizes outstanding research productivity and measurable impact.

- **Prof. Mohammad Mozahar Kubad Hossain**, Professor, Department of Chemical Engineering and Research Scholar, Interdisciplinary Research Center for Refining and Advanced Chemicals
- **Dr. Murtada Al-Jawad**, Associate Professor, Department of Petroleum Engineering

## Early Career Researcher Award

Recognizes emerging scholars demonstrating exceptional research promise and leadership potential.

- **Dr. Abdul Waheed Abdul Hameed**, Research Scientist, Interdisciplinary Research Center for Membranes & Water Security
- **Dr. Dahiru Lawal**, Senior Research Scientist, Interdisciplinary Research Center for Membranes & Water Security

## Postdoc Excellence Award

Recognizes postdoctoral researchers whose scholarly contributions strengthen research performance.

- **Dr. Mohamed Jaffer Mohamed**, Postdoctoral Researcher, Department of Physics
- **Dr. Mohamed Zayed**, Postdoctoral Researcher, Interdisciplinary Research Center for Sustainable Energy Systems

## Applied Research Award

Recognizes impactful research translating scientific knowledge into practical solutions aligned with industry and national priorities.

- **Dr. Medhat Nemitallah**, Research Scientist, Interdisciplinary Research Center for Hydrogen Technologies and Carbon Management
- **Dr. Murtada Al-Jawad**, Associate Professor, Department of Petroleum Engineering





# Research Engagement & Knowledge Exchange in 2025

KFUPM advances knowledge exchange and strengthens the societal and economic impact of its research excellence. Through the KFUPM Institute for Knowledge Exchange (KIKX) and strategic convening, the University enhances global engagement and cross-sector collaboration. KFUPM aims to:

- Advance knowledge exchange initiatives.
- Elevate research visibility and impact.
- Strengthen interdisciplinary and industry collaboration.

In 2025, KIKX advanced significantly in scale, global reach, and institutional impact, strengthening its role as a premier platform for knowledge exchange and innovation engagement.

|                              |                                             |
|------------------------------|---------------------------------------------|
| <b>179</b><br>Speakers       | <b>34</b><br>Countries Represented          |
| <b>6,491</b><br>Participants | <b>SAR 2 Million</b><br>Sponsorship Funding |

## Symposium of Quantum Computing & Technology (SQCT)

IRC for Intelligent Secure Systems

SQCT convened 192 participants from 25 countries to advance frontier developments in quantum computing, with focus areas including cybersecurity, optimization, and advanced analytics. Integrating expert talks, research posters, and hands-on engagement, the symposium strengthened interdisciplinary collaboration and reinforced pathways for translating quantum research into the real-world applications.



SQCT Symposium Participants

## 2025 Engagement at a Glance

| Conferences & Symposia       |                                 |                                   |
|------------------------------|---------------------------------|-----------------------------------|
| <b>5</b><br>Conferences      | <b>3</b><br>Symposia            | <b>24</b><br>Integrated Workshops |
| Knowledge Exchange Platforms |                                 |                                   |
| <b>14</b><br>Webinars        | <b>3</b><br>Seminars            | <b>4</b><br>Forums                |
| <b>1</b><br>Research Rally   | <b>1</b><br>Standalone Workshop |                                   |

## Second Saudi International Conference on Nuclear Power Engineering (SCOPE 2025)

IRC for Industrial Nuclear Energy

SCOPE 2025 brought together 505 participants from 25 nationalities to advance dialogue in nuclear science and clean energy innovation. Featuring 359 research papers, specialized technical tracks, and hands-on workshops, the conference strengthened national capacity, expanded international collaboration, and supported knowledge transfer aligned with Saudi Arabia's long-term sustainable energy strategy.



SCOPE 2025 Conference Session



**The Saudi Next-G Summit** convened 305 participants from 30 countries to position next-generation connectivity as a national priority. Addressing Open RAN, non-terrestrial networks, digital twins, immersive communications, and AI-native systems, the summit bridged academic research, regulatory dialogue, and industry application while aligning with Saudi Arabia's digital transformation agenda.



**Green Innovation for the Kingdom's Sustainable Future (GIKS2)**, organised by the ARC for Environment and Marine Studies, advanced interdisciplinary sustainability dialogue and industry collaboration.



**The Chemistry-ACS (Saudi Chapter) International Conference 2025** brought together over 1,000 participants from 30+ nationalities, featuring Nobel laureate Prof. Morten Meldal and advancing global dialogue on chemistry innovations for sustainable industries.



**The 5th Water Research Community** convened over 200 participants to advance innovation in water sustainability. Featuring 40+ research projects, interdisciplinary panels, and industry engagement, the forum strengthened collaboration in desalination, membrane technologies, and water security while supporting Saudi Arabia's commitment to sustainable water solutions.



**The 33rd Annual Saudi-Japan Symposium**, hosted by the IRC for Refining and Advanced Chemicals, strengthened bilateral research collaboration in fuels, petrochemicals, and sustainable energy technologies.



**Accounting, Governance, and Sustainability (AGS) 2025** convened global scholars to address environmental responsibility, financial transparency, regulatory reform, and ethical finance.



# Nonprofit & Social Development: Programs, Partnerships & Impact

As part of its research, innovation, and knowledge-exchange mission, KFUPM translates research and institutional expertise into societal impact.

KFUPM advances nonprofit sector development through strategic partnerships, capacity-building programs, and national initiatives aligned with Vision 2030. Through the ARC for Non-Profit & Social Development and Al-Fozan Academy, the University strengthens institutional capacity, supports youth empowerment, and enhances cross-sector collaboration.

The Center produced 35 journal papers in 2025 (230 cumulative) and onboarded 12 postdoctoral fellows, strengthening research capacity in social development and impact-oriented studies.

The 12th Annual Forum for Developing the Nonprofit Sector convened leaders, policymakers, and practitioners to advance dialogue on sector development, capacity building, and national collaboration.



Dr. Ali A. Al-Shaikh, Vice President of R&I, and Dr. Basem Al-Madani, Director, ARC for Non-Profit and Social Development, during the 12th Annual Forum for Developing the Nonprofit Sector.

## Strategic Development & Partnerships

### Strategic Plan Development

A strategic roadmap was developed for the Center and Academy, defining priorities across knowledge leadership, partnerships, sector capacity building, innovation, and institutional sustainability.

### Harvard University Partnership

More than 700 social sector leaders accessed 42 courses in management and social development through Harvard's platform.

### MIT Partnership

KFUPM collaborated with MIT to deliver specialized training programs and introduce structured mentoring through the Venture Mentoring Service (MITVMS), strengthening innovation practices and venture development within the ecosystem.

## Ecosystem Development

### Impact Hub Launch

KFUPM established the Impact Hub as a cross-sector platform, enabling collaboration with national partners to design and implement initiatives supporting social development and innovation.

### Volunteer Units Development

|                                   |                                                    |
|-----------------------------------|----------------------------------------------------|
| <b>114</b><br>Established in 2025 | <b>463</b><br>Total Volunteer Units<br>Established |
|-----------------------------------|----------------------------------------------------|

KFUPM continues to expand its volunteer ecosystem, supporting structured engagement, institutional capacity building, and measurable social impact across the nonprofit sector.

## AlFozan Academy: Strategic Programs

KFUPM's programs translate research and evidence-based methodologies into scalable solutions for nonprofit sector development at the national scale.



## 2025 Program Impact

KFUPM programs delivered a measurable impact across youth engagement, nonprofit leadership development, and sector capacity-building initiatives:

|                                         |                                            |
|-----------------------------------------|--------------------------------------------|
| <b>100,583</b><br>Beneficiaries in 2025 | <b>161,759</b><br>Cumulative Beneficiaries |
|-----------------------------------------|--------------------------------------------|

## Number of Beneficiaries of Programs Offered in 2025

|                      |                          |
|----------------------|--------------------------|
| <b>6,527</b><br>RAED | <b>89,557</b><br>RASHEED |
| <b>1,267</b><br>NAMA | <b>3,232</b><br>MOEEN    |

## Organizational Reach: Universities & Nonprofits Served

Through the ARC for Non-Profit & Social Development and Al-Fozan Academy, KFUPM expanded structured capacity-building services across the Kingdom:

|                                                                      |                                                   |
|----------------------------------------------------------------------|---------------------------------------------------|
| <b>4,268</b><br>Educational and<br>Nonprofit Organizations<br>Served | <b>58</b><br>Universities and<br>Colleges Engaged |
|----------------------------------------------------------------------|---------------------------------------------------|

These figures reflect institutional partnerships activated through KFUPM-led capacity-building initiatives.

Through this integrated approach, KFUPM extends its research and innovation mission beyond the laboratory, transforming knowledge into scalable solutions that drive societal impact, strengthen national capacity, and support the Kingdom's Vision 2030.

## Volunteer Impact & Economic Value in 2025

Through structured volunteer engagement across KFUPM's programs:

|                                                |                                                 |
|------------------------------------------------|-------------------------------------------------|
| <b>396</b><br>Volunteers Activated             | <b>13,575</b><br>Volunteer Hours<br>Contributed |
| <b>SAR 313,204</b><br>Economic Value Generated |                                                 |

These outcomes reflect sustained program expansion and the continued growth of KFUPM's nonprofit engagement ecosystem.



CONTRIBUTORS

Ali A. Al-Shaikhi

Vice President of Research & Innovation  
email: vpri@kfupm.edu.sa

Mamdouh Ahmed Al-Harthi

Dean, Research  
mamdouh@kfupm.edu.sa

Fahad Al-Zahrani

Director, KFUPM Institute for  
Knowledge Exchange  
fahadmz@kfupm.edu.sa

Ayman M. Abdallah

Director, IRC for Aviation & Space Exploration  
aymanma@kfupm.edu.sa

Mohamed Al-Osta

Director, IRC for Construction and  
Building Materials  
malosta@kfupm.edu.sa

Afaque Shams

Director, IRC for Industrial Nuclear Energy  
afaque.shams@kfupm.edu.sa

Essam Aljundi

Director, IRC for Membranes and  
Water Security  
aljundi@kfupm.edu.sa

Atif Saeed Al-Zahrani

Director, IRC for Sustainable Energy Systems  
atif@kfupm.edu.sa

Abdullah Shahrani

Director, Center for Carbon Materials  
abdullah.shahrani@kfupm.edu.sa

Wael Ahmed Fouad

Director, Petroleum Conversion  
Research Center  
wael.fouad@kfupm.edu.sa

Salah-Eddine Kabbaj

Editor in Chief, Arabian Journal  
of Mathematics  
kabbaj@kfupm.edu.sa

Mohammad Al-Suwaiye

Director, Research Support Department  
msuwaiye@kfupm.edu.sa

Mohannad Mayyas

Acting Director, IRC for Advanced Materials  
mohannad.mayyas@kfupm.edu.sa

Ahmed Saleh Dalaq

Acting Director, IRC for Bio Systems  
and Machines  
ahmed.dalaq@kfupm.edu.sa

Yogesh Kumar Dwivedi

Acting Director, IRC for Finance  
and Digital Economy  
yogesh.dwivedi@kfupm.edu.sa

Abul Fazal Arif

Acting Director, IRC for Intelligent  
Manufacturing and Robotics  
abulfazal.arif@kfupm.edu.sa

Wael Ahmed Fouad

Director, IRC for Refining and  
Advanced Chemicals  
wael.fouad@kfupm.edu.sa

Luai Alhems

Director, ARC for Environment and  
Marine Studies  
luaimalh@kfupm.edu.sa

Basem Al-Madani

Director, ARC for Non-Profit and  
Social Development  
mbasem@kfupm.edu.sa

Maad Al-Owaifeer

Director, JRC for Artificial Intelligence  
alowaifeer@kfupm.edu.sa

Bassam El-Ali

Editor in Chief, Arabian Journal for  
Science and Engineering  
belali@kfupm.edu.sa

Anwar Abdulhamid

Director, Core Research Facilities  
anwar@kfupm.edu.sa

Daniel Loss

Director, IRC for Advanced  
Quantum Computing  
daniel.loss@kfupm.edu.sa

Daniel Benevides da Costa

Acting Director, IRC for Communication  
Systems and Sensing  
daniel.costa@kfupm.edu.sa

Sulaiman Alturaifi

Acting Director, IRC for Hydrogen Technologies  
and Carbon Management  
sulaiman.alturaifi@kfupm.edu.sa

Muhamad Felemban

Director, IRC for Intelligent Secure Systems  
mfelemban@kfupm.edu.sa

Sami Elferik

Director, IRC for Smart Mobility and Logistics  
selferik@kfupm.edu.sa

Obaidallah Munteshari

Acting Director, ARC for Metrology,  
Standards, and Testing  
obaidallah@kfupm.edu.sa

Theis Ivan Solling

Director, Center for Integrative  
Petroleum Research  
theis.solling@kfupm.edu.sa

Nayef Mesnad Alsaifi

Editor in Chief, Journal of Undergraduate  
Research International  
alsaifi@kfupm.edu.sa

Rayah Salem Algeithy

Director General, Public Relations  
and Information Department  
rayah.gheithy@kfupm.edu.sa

Research Excellence Office  
reo@kfupm.edu.sa

Galal M. Bin Makhashen  
Director

Aysegul Cencer  
Managing Editor

Supporting Team  
Anas Ali Almousa  
Mohammad Al Saleh  
Neelufar Abdulsattar

Graphic Design Team  
Rolando R. Maala  
Ibrahim AlJamaan







## Research & Innovation

King Fahd University of Petroleum & Minerals  
University Box 5040 • Tel. (+966 13) 860 2200

<https://ri.kfupm.edu.sa>

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