جامعة الملك فهد للبترول والمعادن
King Fahd University of Petroleum & Minerals

King Fahd University of Petroleum & Minerals

RESEARCH & INNOVATION

2022 Annual Report

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2022 IN NUMBERS

TRANSFORMATION JOURNEY

RESEARCH HIGHLIGHTS

A Message from the Vice President of Research & Innovation

Dr. Ali Al-Shaihki

"Our achievements show KFUPM determination to enhance its research and innovation environment to be more interdisciplinary, flexible, and strong."

As one of Saudi Arabia's leading research-intensive universities, King Fahd University of Petroleum & Minerals (KFUPM) plays an essential role in building research capabilities to serve the Kingdom, the region, and the world. From the world-leading research programs in various science and engineering fields in which KFUPM has taken leadership role at the national level, our researchers pursue innovation that has the potential to enhance quality of life and support students and post-doc fellows.

Success in research and innovation requires the support of many, including the government and industry partners. Credit goes to our excellent researchers, innovative faculty and strong external collaboration, KFUPM has conducted large volume at total expenditure of more than SAR 157 million on in the year 2022. As we move forward in the transformation journey, continuous and diligent work has been undertaken to advance research activities and respond to national and international needs. This in line with achieving the goals of the Kingdom's Vision 2030 programs, national priorities, and the United Nations' goals for sustainable development.

Our achievements show KFUPM determination to enhance its research and innovation environment to be more interdisciplinary, flexible, and strong. In 2022, we continued to build and refine our approach to innovation, technology transfer, and collaboration with industry by emphasizing interaction. More than 2,700 scientific papers were published and 233 patents were granted.

The contribution of the industrial sector to research cannot be underestimated. The industrial sector contributes significantly and effectively towards science and technology advancements. In line with this, KFUPM launched two research consortia that will provide an effective platform to foster cooperation between academia, industry, and government agencies to accomplish high-quality research and solve critical scientific and technical problems.

I take this opportunity to extend my thanks and appreciation to all those involved in developing the research and innovation system at KFUPM. Special thanks go to the President of the University for his leadership and continued support of all research activities, and to all Deans, Directors of Research Centers, Chairmen of Departments, Faculty, Researchers, and Research Management Staff for their active contribution.t

2022 In Numbers
RESEARCH DASHBOARD

DECADES OF EXCELLENCE AND RESEARCH GROWTH

World University Ranking

#3rd IN ARAB WORLD

KFUPM is third among Arab countries - 2022 QS World University Rankings Arab Region

Emerging Economies

KFUPM is **ranked 40th** in the Emerging Economies University Ranking of 2022

160th IN THE WORLD
QS 2022

200-251 IN THE WORLD
ARWU 2021

Program Rankings

17th
The New Master of Supply Chain Management

70th
Executive MBA

134th
Regular MBA

Subject Rankings

Seven engineering programs are in the Top 100-2021 QS World Subject Rankings

TOP 10

6th IN THE WORLD
Petroleum Engineering

TOP 20

16th IN THE WORLD
Mineral Engineering

TOP 100

54th IN THE WORLD
Chemical Engineering

62nd IN THE WORLD
Civil Engineering

70th IN THE WORLD
Electrical Engineering

81st IN THE WORLD
Mechanical & Aeronautical Engineering

87th IN THE WORLD
Engineering & Technology

Constant Growth in Research

KFUPM has improved quantitatively and qualitatively continuously over the years with ongoing attention to scholarly publications, quality.

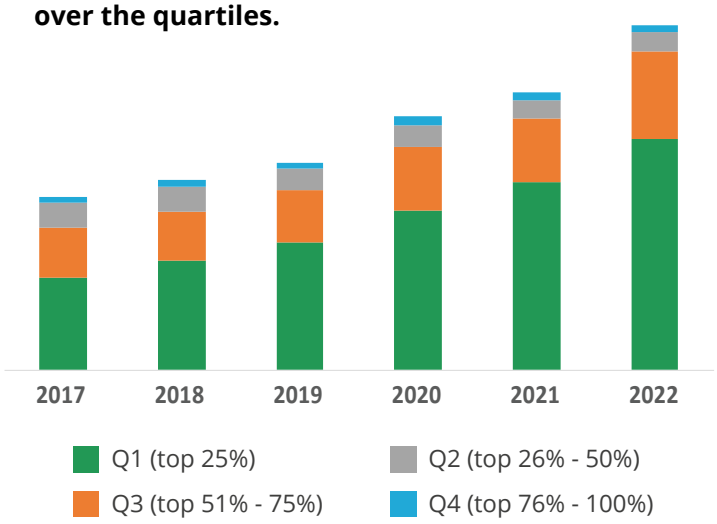
30K+
ISI Publications

136
Number of Books

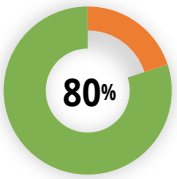
544K+
Citations

22K
Number of Journal Articles

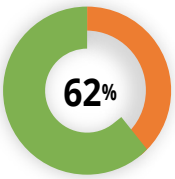
Distribution of KFUPM publications over the quartiles.



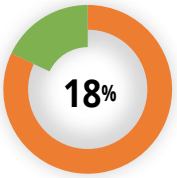
In 2022, KFUPM's scholars published 2,700+ scientific papers



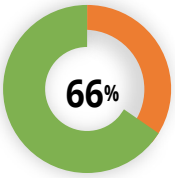
2,150
Papers published in reputable journals



1,685
Papers published in the first quartile (Q1)

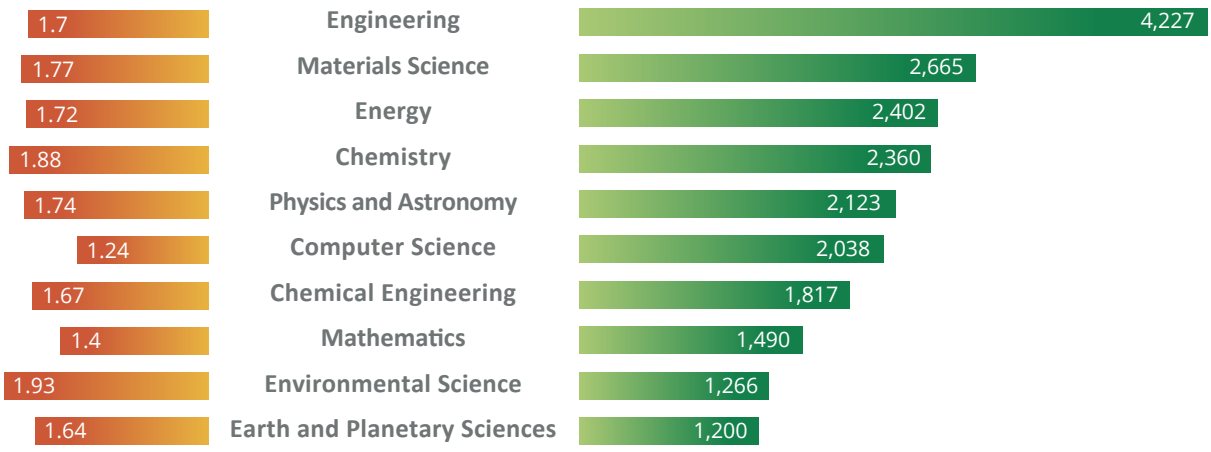


480
Papers published in the top 10% most cited publications worldwide



1,800
Papers published with international collaboration

Distribution of publications over the top ten research areas at KFUPM (2017-2022)

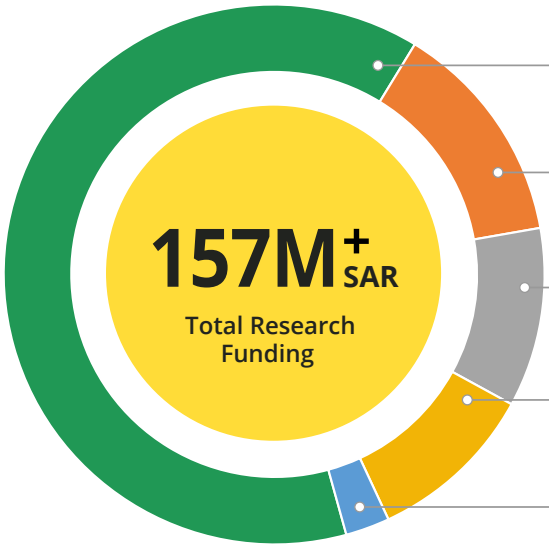


Field-weighted Citation Impact

Scholarly Output

**Source: Scopus Database*

KFUPM Research Funding



99+ Million SAR
Externally Funded Projects

21+ Million SAR
Interdisciplinary Research Centers Baseline

16+ Million SAR
Core Research Facilities

15+ Million SAR
KFUPM Funded Projects

4+ Million SAR
Research Support

237
New research projects were launched during 2022

In 2022, KFUPM generated over SAR **157 million** in research funding. External research funding comes from a variety of sources, including the government, industry partners, and non-profit organizations. Research support includes the conference attendance support, publication charges, and editing services.

Through Deanship of Research Oversight & Coordination (DROC), KFUPM offers faculty and researchers different kinds Research Grants and Support. The grants including but not limited to:

- Internal IRC Grants
- External Grants
- Early Career Research Grant
- Dhahran Techno Valley Collaborative Grant
- Proof-of-Concept Grant
- Exploratory Research Grant
- Outbound International Summer Visiting Grant
- Inbound international Visiting Program
- Sabbatical Leave Research open
- Industrial Sabbatical open
- All research support including conference attendance, publication charges, and editing services.

Recently, KFUPM Research & Innovation sector launched two main platforms to offer more information about KFUPM scholars, projects, activities and scholarly outcomes.

R&I implemented the **PURE platform** as a research information management system to handle research-related data including profiles, publications, projects, and awards of all KFUPM researchers.

CLICK HERE TO READ THE ARTICLE

R&I launched the newt **website for Research & Innovation** that elevates the reputation of KFUPM to an institution that conducts excellent research and highlights its industry links, legacy, and research approach.

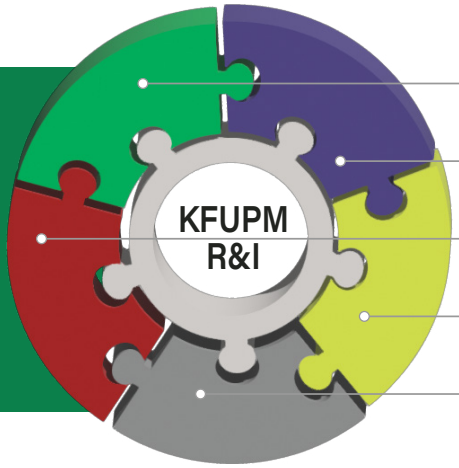
CLICK HERE TO READ THE ARTICLE

KFUPM Research Themes

KFUPM's top 5 Research Themes

KFUPM identified 12 mega-research trends and clustered them into 5 themes that are relevant for the KFUPM content

Transformation at KFUPM is to help achieve a research and innovation based economy in line with fulfilling Saudi Arabia's Vision 2030 objectives and Sustainable Development Goals.



- Energy, Utilities & Sustainability
- Business, Finance & Economics
- Biotech, Bionics & Health-tech
- Industrials & Infrastructure
- Digitization & Technology

Energy of the Future
Conducting research on oil and gas, power generation, renewables, decentralized generation, biofuels, transmission, storage, petrochemicals, and energy digitization/robotics.

Industry 4.0/5.0
Automating conventional manufacturing and industrial practices, using modern devices, smart technologies, and robotics.

Environment and Circular Economy
Conducting research on the impact of environmental and climate change, including impact on the effects of rising temperature and the development of decarbonization and carbon-efficient technology.

Future of Defense Technology
Development of innovative, smart and secure technologies for ground, air, and maritime defense.

Future of Mobility
Conducting research on methods and technologies leading to more sustainable, automated and efficient travel and mobility.

Infrastructure/Cities of the Future
Making construction more affordable, efficient, sustainable, safe, and healthier through smart infrastructure and sustainable materials.

Water Systems Evolution
Development of water management, water supply, desalination, and wastewater treatment technologies.

Developing Advanced Materials
Development of new materials and improving existing materials and composites with multiple applications across industries and products.

Development of Biotechnology, Bionics, and Health-tech Digital Services
Development of novel solutions for healthcare, including biotechnology, bionics and health-tech digital services.

AI and Data Economy
Leveraging combined power of data and technologies through areas such as augmented reality/virtual fragment reassembly, AI, machine learning, quantum technologies, cybersecurity, blockchain etc.

Future of Business and Financial Systems
Conducting research on economics and financial policies/regulations with a focus on the financial and banking systems and tapping into trends of business analytics.

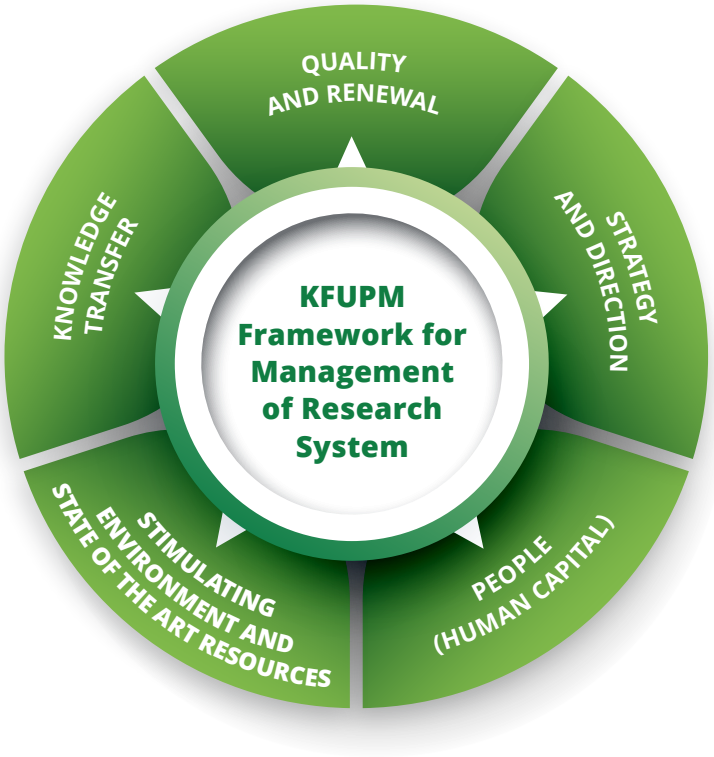
Future of IoT and Connectivity
Development of innovative network technologies, network security systems, and communication and routing protocols to improve efficiency and cybersecurity.

Towards Research Excellence

KFUPM, NATIONAL AND GLOBAL PRIORITIES ARE ALIGNED

Under the supervision of the university presidency and the Research and Development leaders, KFUPM research centers worked on deepening their understanding of national and global research priorities. This has helped to foster their strategic research objectives and formulate the grand challenges. Currently, KFUPM has identified grand research challenges and aligned KFUPM research projects with the national Research, Development, and Innovation (RDI) priorities and a line of sight to societal impact.

KFUPM Framework for Management of Research System was created by the Research and Development Leadership with an overarching goal to identify gaps and provide timely interventions to enable the attainment of a quantum leap in impactful outcomes. Also, the R&D leadership launched a new initiative "**Research Excellence AmPlification (REAP)"**. REAP will manage and evaluate the KFUPM Research Strategy alignment with the national RDI priorities.



Aligning KFUPM Research with Saudi National Research, Development, and Innovation (RDI) Priorities as well as Sustainable Development Goals (SDGs)

The National RDI Priorities

The Kingdom has announced national priorities for Research, Development and Innovation. The RDI national priorities will focus on four research areas as shown below. These essential focus areas will be a compass to guide the future research and initiatives at KFUPM.

Health and Wellness

Sustainable Environment & Supply of Essential Needs

Energy and Industrial Leadership

Economies of the Future

Responsible Research

GLOBAL SUSTAINABLE DEVELOPMENT GOALS

KFUPM aims to find solutions to the world's pressing problems in line with the United Nations' Sustainable Development Goals (SDGs) which are the most comprehensive shared objectives ever set by the international community. KFUPM uses SDGs as a roadmap to guide its research to make a positive impact and all research centers advance SDGs to make a meaningful impact on our future. In this report, we classify project highlights using the SDG icons shown above.

More information on KFUPM efforts for SDGs can be reached at link: (https://sustainability.kfupm.edu.sa/)

KFUPM publications (between 2017-2022) contributing to the SDGs

Source: Scopus Database

Research Centers

WHERE RESEARCH AND KNOWLEDGE ARE BLENDED

Research at KFUPM have now undergone a paradigm shift from a model focusing largely on research productivity to impactful and beneficial R&I

Our mission is solving grand challenges of our nation and it requires interdisciplinary research that spans disciplines

INTERDISCIPLINARY RESEARCH CENTERS

- Advanced Materials (IRC-AM)
- Intelligent Manufacturing & Robotics (IRC-IMR)
- Membranes & Water Security (IRC-MWS)
- Intelligent Secure Systems (IRC-ISS)
- Smart Mobility & Logistics (IRC-SML)
- Refining & Advanced Chemicals (RAC)
- Hydrogen & Energy Storage (IRC-HES)
- Construction & Building Materials (IRC-CBM)
- Communication Systems & Sensors (IRC-CSS)
- Finance & Digital Economy (IRC-FDE)
- Renewable Energy & Power Systems (IRC-REPS)
- Integrative Petroleum Research (CIPR)
- Aviation & Space Exploration (IRC-ASE) *Launched in 2022*

JOINT RESEARCH CENTERS

- Artificial Intelligence (JRC-AI)
- KACST Center of Excellence in Energy Efficiency (JRC-EEE)
- KACARE Center for Energy Research (JRC-ER)

APPLIED RESEARCH CENTERS

- Environment & Marine Studies (ARC-EMS)
- Strategic Studies & Planning (ARC-SSP)
- Metrology, Standards & Testing (ARC-MST)

Research Programs and Services

To promote high-quality research and innovation, KFUPM offers various programs and services through the Deanship of Research Oversight & Coordination (DROC). These programs aims to support KFUPM researchers to generate impactful outcomes.

International Visiting Scholars Program

The program aims to facilitate the direct interaction of KFUPM researchers with scholars in reputable academic and industrial institutions. Each year, KFUPM sponsors up to ten visits under the outbound component of the program and 30 visits under the inbound component for affiliates of its Interdisciplinary Research Centers (IRCs). Additionally, KFUPM supports up to three visits per year for applicants who are not affiliated with IRCs, as well as visits from international graduate students.

Conference Attendance Program

KFUPM supports attendance at reputable flagship conferences to help researchers to exchange ideas in person with their international counterparts. In collaboration with the academic departments, DROC has compiled a dynamic list of these conferences which is updated periodically.

Postdoctoral Fellowship Program

With its confidence in the abilities of postdoctoral fellows to contribute to its research and innovation journey, KFUPM leverages its efforts to attract high-caliber candidates from around the world. Undoubtedly, having postdoctoral fellows will support KFUPM's research mission by bringing new knowledge and innovative techniques and creating a dynamic collaborative environment.

Editorial Services

DROC established the editorial services to help researchers to improve their esearch publications in peer-reviewed journals and conferences by ensuring that their manuscripts are evaluated based on their scientific and technical value and not on their linguistic presentation. The editorial services are provided through the world-class editorial company Cactus-Editage. In particular, KFUPM covers the editing fees of one journal article per year, for each researcher. Additionally, as long as the edited article is accepted for publication in a top-quartile journal, the free-article counter will be reset. DROC also organizes webinars and workshops enabling researchers to improve their authorship skills.

Graduate Student Conference Attendance Program

As part of this program, travel grants are provided to graduate students to enable them to present their work at leading conferences. The program is sponsored by the KFUPM Fund and managed by DROC, in coordination with the Deanship of Graduate Studies.

Publication Support

To encourage publication in reputable journals, DROC provides KFUPM researchers with financial support to pay mandatory page fees and open access fees.

Enabling Research & Innovation

In addition to the research programs and services provided to the research community, KFUPM invest in promoting the research environment and attracting research talents. KFUPM's research infrastructure grew in significant ways.

Facilities and Infrastructure

Core Research Facilities (CRF) provides research support to academic departments and interdisciplinary research centers at the university. CRF is an enabling center that promotes programs geared towards empowering faculty members and researchers to help realize their research objectives.

- To centralize and facilitate the efficient use of research infrastructure
- To undertake strategic planning and improve sustainability of infrastructure investments
- To increase efficiency of research operations
- To enhance utilization of state-of-the-art high-tech research equipment
- To centralize the maintenance of scientific equipment
- To attract qualified research support talent

Functions/Activities

- Provision of analytical lab services
- Development and management of Core labs
- Maintenance of lab equipment
- Support for research equipment maintenance
- Entering into annual maintenance contracts for major equipment
- Purchase of spares
- Purchase and supply of lab chemicals and gases
- Facilitation of waste chemical disposal
- Addressing of safety issues in the research sector
- Management of chemical and glassware storehouses

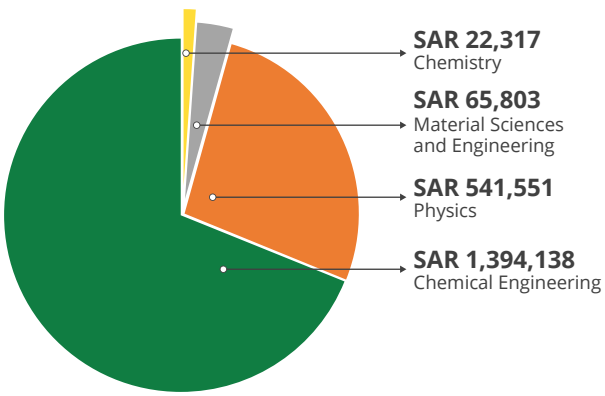
CRF Lab Resources

- X-ray diffractometer (XRD)
- ED X-ray fluorescence analyzer
- WD X-ray fluorescence analyzer
- Micro X-ray fluorescence analyzer
- Scanning electron microscope (SEM)
- Transmission electron microscope (TEM)
- Atomic force microscope (AFM)
- Optical Microscopes

CRF provides lab services to different research centers and academic departments. During 2022, CRF served 17 departments/centers. The total number of the completed requests was around 607, and the total number of analyzed samples was 2,500+.

LAB SERVICES

Year	No. of Service Requests Completed	Samples Analyzed	Depts/Centers Served
2022	607	2,568	17



Core Lab Development

- Nuclear magnetic resonance (NMR) spectroscopy
- Field emission transmission electron microscopy (FETEM)
- X-ray photoelectron spectroscopy (XPS)
- X-ray diffraction (XRD)
- Focused ion beam-field emission scanning electron microscopy (FIB-FESEM)
- High-performance computing cluster (HPC Cluster)
- Workstation lab
- Cloud based subscription
- Thin film core lab

CHEMICALS/GAS/SAFETY/DISPOSAL SERVICES

	Total	Cost (SAR)
Chemicals for teaching labs	1,027	907,327
Chemicals for research sector	1,592	1,588,202
Gas cylinders supplied	1,592	517,581
Ventilation of cylinders in storage	400	29,000
Purchase of PPEs	8,494	660,719
Chemical waste disposal	9,914 kg/Ltr	83,317
Disposal of unused chemicals	4,923 kg/Ltr	56,350
Safety inspections conducted	110 RI labs	-

Research Talent Attraction

A university at a high international level requires a strong research environment. Focus on recruiting, retaining, and developing talented researchers is crucial to deliver on the KFUPM's vision to be among the world's best universities.

400 Affiliated Faculty

150 Research Scientists

~80 Postdocs

STAR Faculty Initiative

KFUPM has launlaunched a new Faculty search campaign called STAR (Science, Technology, and Academic/Research) to invite high-quality applicants from the academic community worldwide to engage in its research and graduate-level teaching. This initiative targets distinguished stablished faculty and graduates with exceptional research profiles from highly ranked reputable universities.

Postdoctoral Researchers

KFUPM attracts high caliber postdocs to raise the quality of research to a higher level Postdocs at KFUPM will learn new skills, gain new knowledge, and refine their personality through he many development opportunities. At the same time, spending time at KFUPM will have its influence on the postdoctoral fellows and positively impact their career.

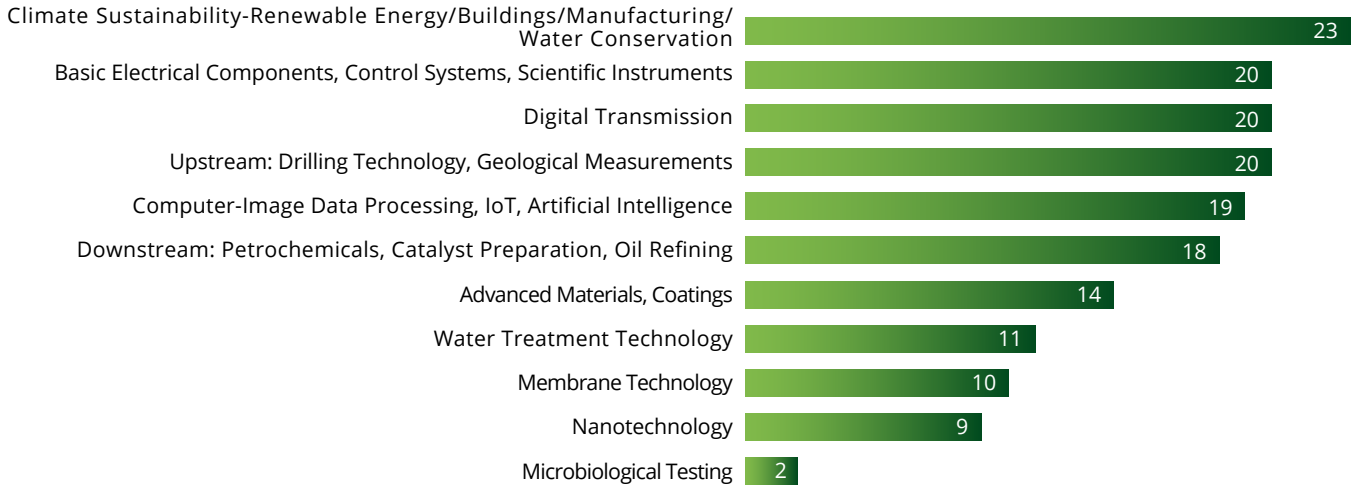
Graduate Students

KFUPM offers 83 programs to more than 10,000 students in eight academic colleges. The University provides four types of graduate programs; Doctor of Philosophy, Master of Science, Master of Engineering, and Master of Business.

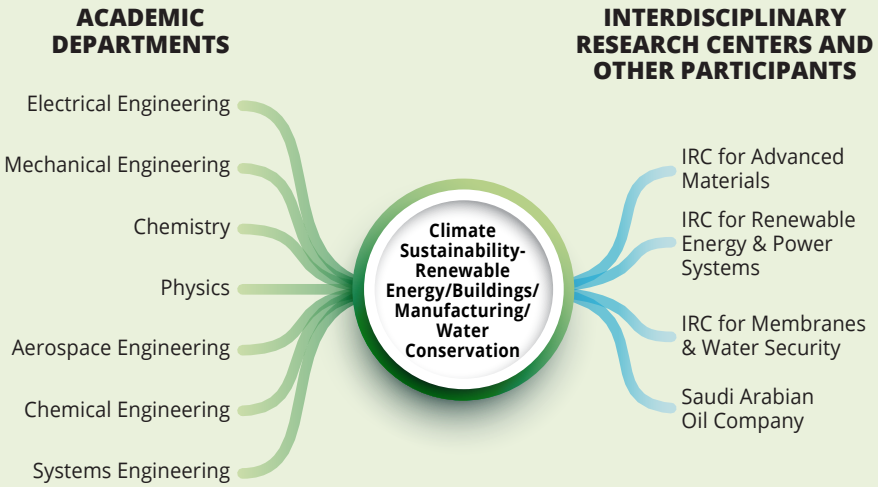
Innovation & Technology Transfer Highlights

212 invention disclosures in a wide range of technical disciplines were received by Innovation & Technology Transfer (ITT) in 2022

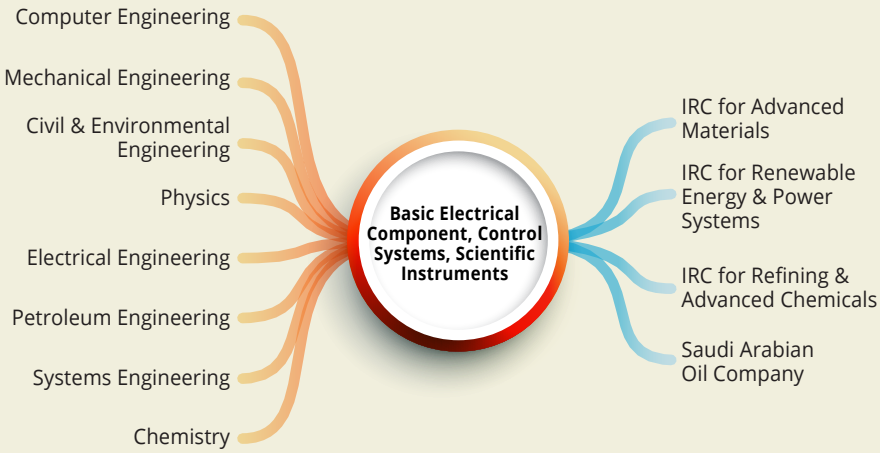
Top Technical Disciplines Filing Invention Disclosures



Inventors from academic departments and Interdisciplinary Research Centers (IRCs) at KFUPM collaborate to conduct research in the technical discipline of Climate Sustainability. As per the invention disclosure data, researchers from IRC for Renewable Energy & Power Systems were active in conducting research and they have submitted the highest number of disclosures in this domain.



Inventors from academic departments and Interdisciplinary Research Centers (IRCs) at KFUPM collaborated to conduct research in the technical discipline of Basic Electrical Components, Control Systems, and Scientific Instruments and file invention disclosures in 2022.



KFUPM Innovation in Numbers

233
Total U.S. patents granted in 2022

The ranking for 2022 will be released in the middle of 2023, KFUPM is expected to be among the top 10.

25th
Among global universities for number of U.S. patents (2022)

1,906
Total patents granted

1,655
Total U.S. patents granted

2,643
Total invention disclosures filed

3,004
Total patent applications filed

526
Total patents pending

2
IP license agreements

15
Total number of proof of concept projects

158
Total number of inventions in commercialization

4
Total number of licenses to startups

ITT's Growth as a Center for Excellence of Knowledge Transfer on Intellectual Property Management and Technology Licensing

With over 14 years of experience, Innovation & Technology Transfer (ITT) is now acknowledged regionally for its expertise in providing capacity building services to academic and industrial organizations in intellectual property management and technology transfer training programs. During 2022, KFUPM concluded such programs with regional universities and Saudi companies. Also, KFUPM and the Saudi Authority for Intellectual Property (SAIP) signed an agreement to provide training to 30 organizations annually.

Technology Licenses

During the year 2022, ITT explored, negotiated and signed licensing and option to license agreements to allow KFUPM Intellectual Property to be commercialized by companies.

IP Management

In 2022, ITT continued to effectively manage all the issues related to KFUPM intellectual property including the following: (i) Protecting potential intellectual property resulting from research activities, evaluating their economic and social benefits and prosecuting their registration; (ii) Reviewing and negotiating intellectual property sharing arrangements of KFUPM with other organizations; and (iii) Handling the administration of intellectual property resulting from collaboration with other organizations including drafting and negotiating Joint Invention Administration Agreements (JIAAs).

Innovation & Technology Transfer Highlights

Proof-of-Concept (PoC) Grant program

The program supports pre-commercialization of state-of-the-art research emerging from the University. As part of the program, a mechanism to shortlist potential patents/patent applications has been introduced. During primary market research, individual case managers and inventors who identify PoC needs for cases are invited to submit proposals.

IRC for Renewable Energy & Power Systems collaborates with ITT and has launched a special PoC Grant focusing on renewable energy related technologies. The program currently includes five projects.

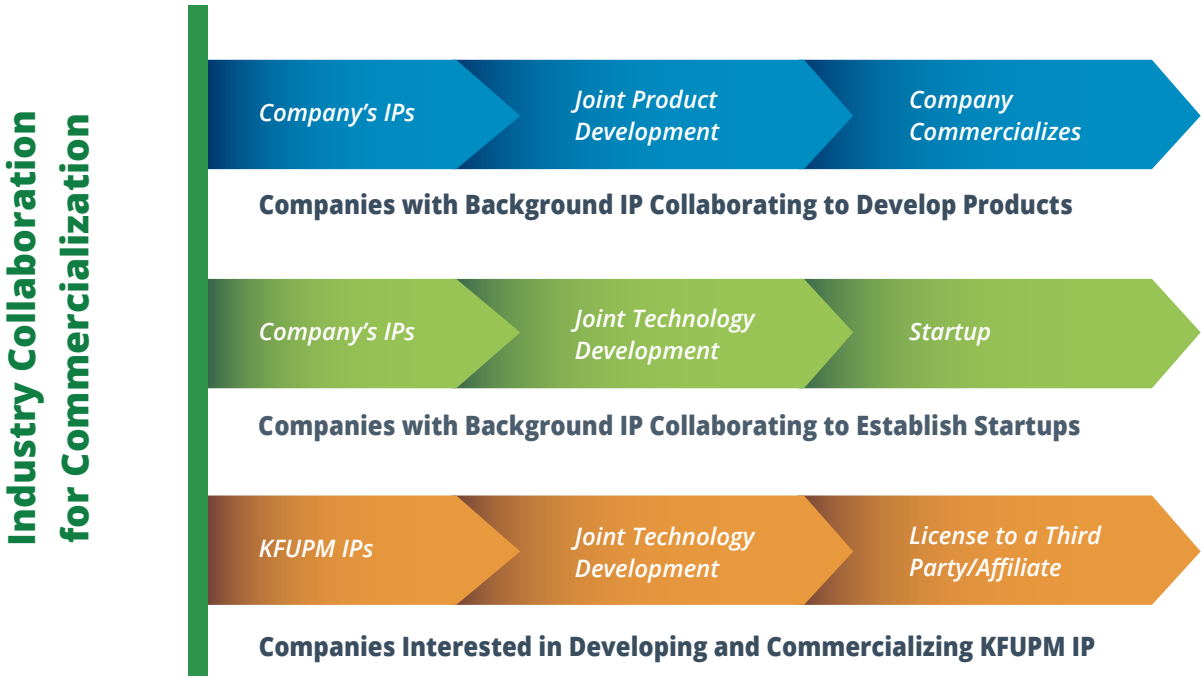
KFUPM Fund has agreed to support the PoC Grant program with an additional funding of SAR 1 million for 2 years including incentives for researchers.

PROJECTS IN PROGRESS FROM PREVIOUS YEAR	
Progress Reports Evaluated	3
Final Reports Evaluated	5

CURRENT YEAR PROPOSALS	
Received	7 (5 under Renewable Energy Technical Incubator (RETI)
Evaluated	5
Approved	4

ITT's Support for Industry Collaboration in Technology Commercialization

ITT supports endeavors of KFUPM faculty and researchers to maximize the potential of their inventions by commercialization of new products and services for the benefit of industry and society. During the year 2022, ITT used several IP models.



Growing Research Through Commercialization of Innovations

Market Research

ITT regularly screens KFUPM's patent portfolio to select inventions which deal with industrial problems and offer competitive solutions

- Network Architecture for Integrating Microgrids and Electric Vehicles
- Efficient Antimicrobial Textile to Combat Infections
- Corrosion Risk Assessment using Machine Learning
- Detecting Trace NO_2 Pollutant in Air
- Economical Corrosion Inhibitor
- Image Super-Resolution Loss for Seismic Interpretation Tasks
- Material Implants with Green and Sustainable Reinforcement
- Automatic Determination of Bioturbation Index Using Artificial Intelligence
- Device for The Removal of Environmental Pollutants from Water
- The Development of Bentonite Locally for Drilling Application
- Low-Cost Green Technology for Water Purification
- Crumb Rubber Concrete with Superior Qualities
- A New Enhanced Oil Recovery Method
- Modified Sonic Logging Tool for Low Resistivity Beds
- Oil Based Drilling Fluid with Hydrogen Sulfide Scavengers
- Advanced Membranes for Oil-Water Separation from Produced Water

Startups

ITT assessed and provided recommendations to faculty and researchers who were interested in establish startups based on their patented inventions

- Startup interest - Lightweight Concrete
- Startup interest - Covid-19 Biosensor
- Startup interest - NDT Palm Tree Pest Check
- Entrepreneurs for Deep-Tech Startups
- Venture Fund Support
- Legal framework for Startup Formation by Employees/Expat Students

Rapid Prototyping Enhances Technological Advancement

Technology Advancement & Prototyping Center (TAPC) offered a total of 36 services to activities and projects in 2021-2022.

TAPC continues to provide support and services for different aspects of the innovation process of KFUPM and Dhahran Techno-Valley (DTV) ecosystem. TAPC caters to different activities of the ecosystem associated with innovation needs including:

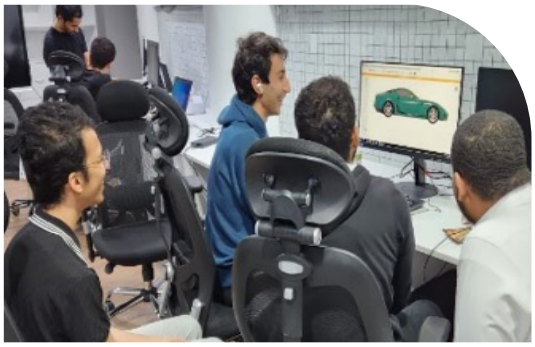
- Education (research in senior projects and by graduate students)
- Research/development (basic, applied, and proof-of-concept)
- Entrepreneurship (pre-startups and startups)
- Other external clients including DTV tenants (on commercial basis).

TAPC hosted the education activities of the graduate course for Additive Manufacturing Engineering (ME587), including providing training and mentorship for 7 students.

TAPC established the following innovation partnerships during 2021-2022:

- The Formula 1 in Schools Program with Ithra-Saudi Aramco. Students from different schools participated to learn about design, manufacture, test, and racing of Formula 1 cars for a period of three months.
- The KFUPM – Elite Innovator Program with KFUPM Students Innovation Club. A four-week program to educate and foster product innovation and problem-solving skills was conducted with the title **"KFUPM – Elite Innovator Program"**.

Students Innovation Club (Elite Innovators Program)



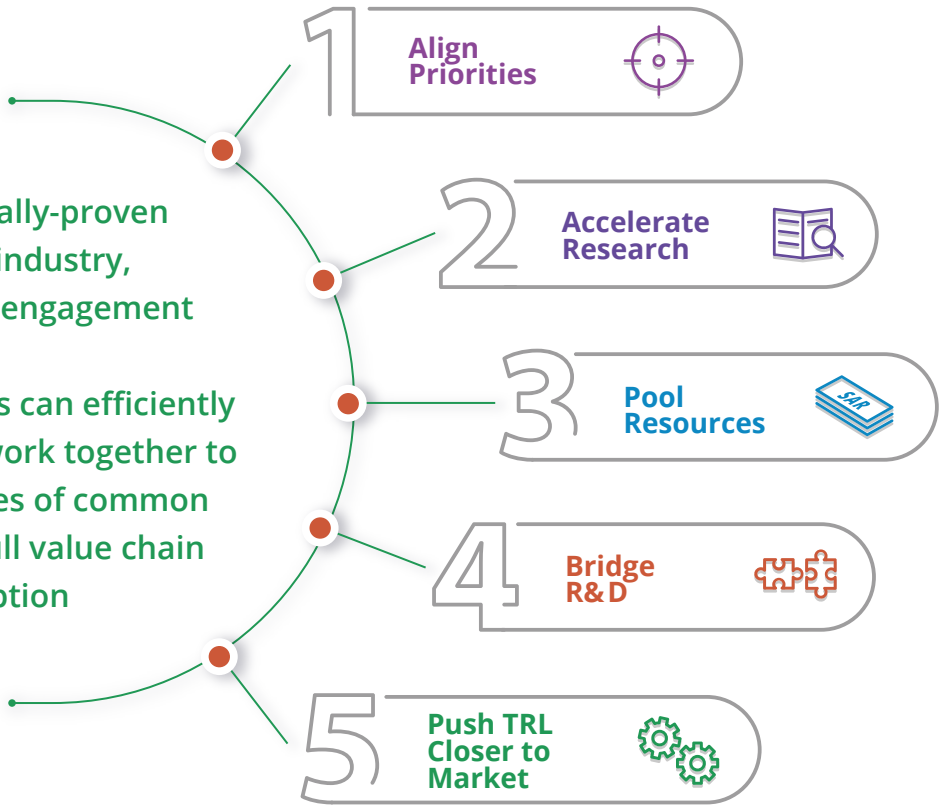
Bringing Research & Innovation
TOGETHER WITH INDUSTRY

KFUPM has launched research consortia as its primary external engagement and collaboration platform

To organize a multi-party research collaboration involving academic, industrial, and government members.

Consortia are a globally-proven model for academia-industry, multi-party research engagement

Multiple stakeholders can efficiently and collaboratively work together to solve grand challenges of common interest across the full value chain towards market adoption



Composition of Consortia: Bringing together key complementary stakeholders around one "collaboration table"

GOVERNMENT ENTITIES

Realizing national research goals by catalyzing partnerships and investing in national R&D infrastructure and capabilities

ACADEMIC & RESEARCH UNITS

Expanding own research relevance and capacity by accessing strategy, talent, capabilities and key market players

TECHNOLOGY PROVIDERS

Bringing prototyping, scaling up, commercialization, and marketing expertise, together while training and accessing talent

INDUSTRIES END-USERS

Defining key technology challenges, funding research projects and deploying resulting technologies

KFUPM Consortium
FOR A SUSTAINABLE FUTURE

As a pioneering initiative aligned with the National Strategy, the University launched its first global research consortium providing a platform that brings collaborations from academia, industry, and government together to tackle some of humanity's most pressing challenges in the field of advanced materials and others.

Launch of the University's Global research consortium named "KFUPM Consortium for a Sustainable Future"

This Consortium has been established under the leadership of Dr. Omar Yaghi, internationally renowned Chair Professor of Chemistry, Nobel Prize nominee, the recipient of several prestigious awards, and founder of the Berkeley Global Science Institute. He was recently granted Saudi citizenship by royal decree due to his distinguished accomplishments in the field of Chemistry.

Some Areas of Research

- Digital Materials
- Materials-to-Machines
- Air Economy

Mission: To define and articulate the complex, large problems facing the world, and to inspire researchers from academia and industry to develop solutions that ensure a sustainable future through discovery and utilization of materials.

KFUPM Consortium
FOR HYDROGEN FUTURE

KFUPM Offers Strong Foundations for a Powerful Hydrogen Research Program

H_2 Future

KFUPM Consortium for Hydrogen Future is a platform which produces innovation-based solutions and technologies that address a wide range of critical challenges in the production, transport, and use of H_2, along with key associated carbon management topics

01 Reducing cost of production of H_2 from all viable sources

02 Improving H_2 transport, distribution, and storage

03 Integrating H_2 into circular carbon economy by managing carbon associated with H_2 value chain

Improve H_2 production from natural gas	Improve pathways for H_2 production from liquid hydrocarbon (e.g., distributed production in station)	Explore H_2 production pathways that better enables C capture
Improve CO_2 capture and utilization pathways associated with H_2 production	Improve H_2 international transport, including options such as ammonia	Improve H_2 storage for mobility (improve compression requirement at H_2 filling stations, i.e., reduce cost of filling)
Explore other H_2 production opportunities (from H_2S)	In-situ H_2 production (in reservoir)	H_2 storage as large scale energy storage vector
Hydrocarbon pyrolysis (to produce H_2 and carbon)	Improve H_2 utilization (e.g., turbine and boiler burners)	Explore system-level integration opportunities of H_2 in hybrid energy systems (e.g., blue and green H_2)
Assess "waste-to-hydrogen" pathways for technical and economic feasibility	Address cross-cutting themes/objectives (e.g., techno-economics and life cycle assessment studies, safety and engineering standards of H_2 systems, CCS)	

KFUPM - Industry Collaboration

Partnership Drives Innovation

25 Joint Projects	**30** Agreements	**30** Seed CX Sponsorships
17+ Champions have been assigned	**5** Workshops with industry	**11** MoU

The Industry Collaboration (IC) office facilitated achieving major milestones. An enhanced and more progressive cooperation strategy with the industry was implemented in 2022.

- More than 25 joint projects
- 6 MoUs signed with government and private organizations
- More than 17 champions assigned to the industry
- 30 SEED (CX program sponsorships) agreements initiated
- 26 students on international training
- 5 workshops conducted with the industry

Engagements with Industry

Office of Industry Collaboration organized a high-level workshop to discuss the new era of collaboration between Saudi Aramco and KFUPM, led by the Chief Technology Officer (Saudi Aramco), Mr. Ahmad O. Al-Khowaiter and Vice President for Research & Innovation (KFUPM) Dr. Ali A. Al-Shaikhi.

An operational workshop with SABIC technical teams was conducted to overcome operational challenges and boost research and academic collaborations in certain research fields.
Also, the IC organized a workshop with Microsoft to discuss and plan a roadmap for Higher-Education Transformation and technology implementation.

1670 Students Locally

26 Students Internationally

Student Training

10 CX & MX programs **NESR**

5 CX & MX programs **Air Products**

20 SEED **GAMI/SAMI**

5 SEED **Baker Hughes**

Fueling Innovation Through Collaboration

An Initial Step for Long-term Engagement

KFUPM signed several agreements for cooperation with government agencies and major companies in vital sectors. These agreements aim to enhance the alignment of education and research outputs with the strategic needs of the Kingdom to strengthen national capabilities, invest in them and prepare them for the future in various fields. Some of these agreements include benefiting from the undergraduate concentrations programs (CX), early employment and student development programs (SEED), professional master's programs and professional courses held at KFUPM.

Agreements were signed with the following companies and organizations:

Governmental Organizations:
- General Authority for Military Industries
- Ministry of Energy
- KACST
- Ministry of Defense

Companies:
- MAADEN
- Saudi Aramco

Noteworthy Engagements

- KFUPM and Lockheed Martin (LM) agreed to collaborate and offer internship opportunities for students, and this is the first internship program LM is conducting in Saudi Arabia in its history.
- KFUPM and Huawei discussed the possibility of job offers for top KFUPM graduate students and enabling KFUPM graduates to connect to local Huawei partners.
- KFUPM arranged a site visit for electrical engineering (EE) students to Yokogawa's main facility in Bahrain to explore practical tasks.
- KFUPM EE students got accepted to do the rest of their training in the Yokogawa factory in King Salman City (Spark).
- KFUPM discussed with Wood PLC Recruitment Manager the Graduate Development Program, a long-term program where graduates will participate in tailored development plans in their engineering offices in Saudi Arabia with the option of overseas assignment to their center of excellence engineering offices in Reading, UK.

DTV Holding Company

DTVC
شركة وادي الظهران للتقنية القابضة
Dhahran Techno Valley Holding Company

Dhahran Techno Valley

"The World's Largest Energy Centric Research and Innovation Hub"

An Energy Centric Ecosystem at KFUPM

The DTV ecosystem is managed by Dhahran Techno Valley Company (DTVC), a wholly owned subsidiary of KFUPM created in 2010. The DTV ecosystem includes varied stakeholders - KFUPM, a globally renowned university, Saudi Aramco, the world's largest oil company, other national champions such as Saudi Arabian Basic Industries Corporation (SABIC), Saudi Electric Company (SEC), and Saudi Telecom Company (STC), and lastly the multinational technology companies in DTV Science Park. The company is mandated to support technology transfer for energy industry's current and future needs, create innovation-driven businesses, develop national talent, and accelerate the growth of entrepreneurship. With the unveiling of Vision 2030 in the year 2016, DTV was already on its path of developing as a dynamic energy centric ecosystem aligned with the Kingdom's Vision. The heart of DTV ecosystem is the DTV Science Park, which has a total of 18 multinational Research and Development Centers focused on developing innovative technologies in the energy sector. In addition to the 18 multinational companies, DTV Science Park has a world class R&D Center for the College of Petroleum Engineering & Geosciences (CPG) as well as the under-construction Petroleum Conversion Research Center (PCRC), both of which are owned by KFUPM.

Economical Impact of Dhahran Techno Valley

DTVC embarked on a journey to measure the economic impact of a world class asset under development in the form of DTV Science Park in the year 2014. Since then and as an outcome of the novel work being carried out in DTV, more than 200 collaborative/contract research projects with KFUPM have been completed or ongoing, 500 patents have been filed, and 700+ new technologies have been developed. Several of these technologies were developed in collaboration with KFUPM, more than 250 peer-reviewed articles were published in leading journals, and about 600 KFUPM students have undergone training as part of their academic requirements. In addition, 50 start-ups supported by the companies based in the DTV Science Park were launched through a variety of modes and numerous technologies as part of Vision 2030, saving multi-million dollars for companies as well as the Kingdom.

Bringing World Class Companies into DTV

Companies Signed

AIR PRODUCTS

A world leading Hydrogen producer signed an agreement with DTVHC in April 2022 to establish their 3rd facility namely Blue Hydrogen Innovation Center in Phase I of DTV Science Park.

TAQA

Signed a land lease agreement in March 2022 to establish a state of the art TAQA Innovation Center.

Companies based in DTV Science Park

slb, Baker Hughes, Halliburton, Weatherford, Sinopec, Honeywell, Yokogawa, Emerson, Schneider Electric, Air Products, Saudi Electricity Company, Sipchem, Amiantit, Sabic, Rosen, stc, TAQA, NESR

DTV Science Park Continues to Flourish with New R&D Centers

Centers opened recently

AIR PRODUCTS

- Air Products 2nd facility in DTV Science Park focusing on Process Intelligence, Process Safety, Turbo Machinery Root Cause Analysis and Hydrogen Production started its operations in January 2022

College of Petroleum Engineering & Geoscience

- KFUPM College of Petroleum Engineering & Geosciences facility in DTV commenced their operations in early 2022.

Economic Impact of Dhahran Techno Valley

All of these statistical parameters are expected to increase multi-fold by the year 2030 with a special focus on creating a wealth intensive platform for launching knowledge-based businesses, developing a world class technical work-force and lastly, making the Kingdom more sustainable and a better place to live for the coming generations.

Thus, the DTV ecosystem is well on the way to achieving its vision of fostering an environment in which KFUPM and drivers of innovation work together to deliver economic opportunities of national and global value in the energy sector.

2014

8 Operational companies
13 Collaborative research projects with KFUPM
10 KFUPM MS/PhD students working on their dissertations/theses in DTV
31 Patents filed
13 Patents granted
23 IP rights
12 Technologies licensed
17 Technology transfer outcomes
961 Full-time jobs created

2022

15 Operational companies
14 Contract research projects with KFUPM
34 Collaborative research projects with KFUPM
107 COOP/Summer trainings
25 KFUPM MS/PhD students working on their dissertations/theses in DTV
49 Part-time teaching/courses
125 Patents filed
110 Patents granted
83 IP rights
229 Research publications
24 Start-ups supported
51 Technologies licensed
169 Technology transfer outcomes
1659 Full-time jobs created

2030 (TARGETED)

30+ Operational companies
250+ Patents filed
200+ Patents granted
150+ IP rights
500+ Research publications
100+ Research initiatives
50+ Venture funding/investment projects
50+ Technology start-ups
400+ SMEs engaged
400+ Sponsorships
250+ Internal projects
100+ Technologies licensed
250+ Technology transfer outcomes
25+ Contract research projects (KFUPM)
50+ Collaborative research projects (KFUPM)
250+ COOP/Summer trainings
75+ MS/PhD students working on their dissertations/theses
100+ Part-time teaching/courses
1000+ Female employees
2500+ Full-time jobs
SAR 2.5 billion+ foreign direct investment

Impactful Projects

Highly Protective Multifunctional Anticorrosive Coatings for Steel

Novel hybrid sol-gel materials have been successfully synthesized by a research team at IRC-Advanced Materials. These materials showed promising activity as protective multifunctional coatings for steel surfaces in atmospheric and marine environments. Efficient corrosion protection coatings for metallic infrastructure of various industries is still in much need today. The excellent corrosion protection, mechanical, thermal, and adherence properties and long shelf life of the invented coatings make them very competitive with existing atmospheric and marine commercial protective coatings for steel substrates. Moreover, the developed coatings are cost-effective, easy to prepare, and a single application on the metal surface is adequate.

They are also environment-friendly compared to the currently used commercial coatings, which contain volatile organic compounds (VOC) or toxic additives in their formulations. Combination of all the above advantageous properties in a single coating makes the developed coatings superior to the currently used commercial coatings. These innovative coating formulations will help industries in the Kingdom to mitigate material degradation problems associate with metallic infrastructure due to corrosion. A patent (No. US11479692)describing the method of preparation and application of the coating formulations has been issued by the US Patent Office.

Showcase/MVP of Personal Protective Equipment (PPE) -Jointly with SDAIA

Workers' safety is a matter of great concern for the government of the Kingdom of Saudi Arabia (KSA). The government of KSA requires that all personnel, working in close proximity to hazardous sites, should wear proper personal protective equipment (PPE) to minimize the risk of being exposed to or injured due to hazards. Majority of injuries and fatalities at work sites are resulting from PPE non-compliance. Organizations have begun to penalize workers who fail to comply with PPE requirements to incentivize compliance. This procedure requires manual monitoring, which is not feasible and costly at large sites. In this project a monitoring system will be developed to ensure PPE compliance to automate this process. The proposed system will be employed in a real-time environment and will be equipped with a smart dashboard to facilitate system administration. The proposed system will be integrated into the safety workflow of an organization. The project outcome will be delivered in two phases. The deliverables in Phase 1 include a prototype that detects PPE compliance using CCTV cameras (helmet wearing compliance) and a dashboard for configuring and managing the PPE monitoring system. In the second phase of the project, the possibility of detecting other PPEs, including respiratory protectors, coveralls, and safety gloves will be explored. The proposed PPE detection system during this phase will utilize access point cameras installed at predefined site gates as the resolution of the CCTV cameras is not sufficient for detecting PPE compliance required during this phase.

Development of a Novel Air Gap Membrane Distillation Module for Water Desalination

The main aim of this project was to design and develop a novel membrane distillation desalination system with improved productivity, cost-effectiveness, and energy efficiency. The project, which commenced in late 2020, was funded by the Deanship of Research Oversight & Coordination (DROC), KFUPM. The target of the study was to re-design the distillate/condensation/gap chamber of an air-gap membrane distillation system, by inducing suction on the permeate side of the membrane sheet and promoting turbulence within the distillate compartment of the system through an installed rotating impeller/propeller inside the gap chamber of the system. The project was completed in 2022 with the development of a prototype and publications. The performance of the lab-scale prototype is better than that of conventional membrane distillation systems by more than 100% with the potential of scaling up the system towards commercial acceptance. This desalination technology is most appropriate to be deployed at remote locations within the Kingdom of Saudi Arabia for providing low-cost freshwater efficiently to the residents.

Archaeological Tourism and Economic Development in Saudi Arabia

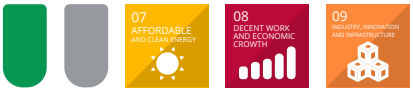
As Saudi Arabia opens up to the world and diversifies its economy away from oil, the Kingdom is banking on, among other things, the tourism industry, as well as education, infrastructure, etc. Archaeological findings are one of the major tourist attractions. Saudi government, for instance, revealed a 15 billion USD master plan to transform AlUla into a global cultural hub and international tourist destination for art, culture, and nature. As a result, it is the world's biggest archeological project. The ultimate goal of the AlUla Project is to bring in 2 million visitors annually and to create 38000 new jobs, boosting the nation's economy by 32 billion USD. Making it one of the world's archeological jewels, AlUla is home to over 2000 ancient cultural heritage sites, including the Site of Al-Hijr (Mada'in Saleh), which became the Kingdom's first UNESCO World Heritage Site in 2008. But AlUla is not the only archeological site in the Kingdom. There are other extraordinary ancient archeological, cultural, and historical places on Saudi soil.

Notwithstanding, these remarkable archeological discoveries in Saudi Arabia, so far they remain almost unknown globally even though it could be considered a cradle of ancient civilization. This research project is part of an effort to present the Kingdom's ancient archeological discoveries and riches to a global (and digital) society through academic research and scholarly publications. The project aims to shed light on contemporary major archeological discoveries in Saudi Arabia and their impact on and potential contributions to the Kingdom's tourism industry, economic sector, social/societal change, and national income.

A Multi-Objective Optimization Model Based on MILP for Sizing a Hybrid PV-Hydrogen Storage System

The use of fossil fuels for energy supply is associated with a large release of greenhouse gases, which causes global warming. On the other hand, renewable energy technologies and resources, particularly solar photovoltaic systems, can provide cost-effective and environmentally friendly solutions for meeting electricity demands., the Optimal design of solar and hydrogen storage systems is a key challenge with strategic implications in using renewable energy efficiently and economically. The design of photovoltaic systems has a significant impact on system expenses. In this regard, several researchers have addressed hybrid PV-hydrogen storage renewable energy systems. Even though the design of a hybrid PV-hydrogen storage system is naturally multifaceted, limited research suggests multi-objective models for system sizing. Heuristic techniques are employed to solve these models. The main drawback of these methods is obtaining suboptimal solutions. In addition, there is an evident lack of multi-objective studies to assess the economic feasibility and reliability of renewable energy systems. Consequently, the purpose of this study is to propose a multi-objective mixed integer linear programming model to design a hybrid PV-hydrogen storage renewable energy system in Saudi Arabia. The total life cost and loss power supply probability will be considered as objective functions.

Design and Schedule Optimization of a Fuel Cell-Driven Multigeneration Process for Combined Production of Power, Blue Hydrogen, and Ammonia



Due to the rapid increase in global energy consumption and the heavy reliance on fossil fuels, governments and stakeholders have acknowledged the importance of lowering carbon dioxide (CO_2) emissions to combat climate change. Hydrogen has proven to be essential for the successful decarbonization of the energy sector. Hydrogen is typically compressed at high pressure or liquefied for displacement and storage due to its low density. Even though there are a number of intriguing choices for delivery of hydrogen, ammonia has attracted the attention of numerous researchers in recent years. In this project, a revolutionary multigenerational process that generates electricity, hydrogen, and ammonia was used. Hydrogen was recovered by a catalytic membrane reactor, and all CO_2 was trapped using a membrane, while a solid oxide fuel cell at a high temperature was used to integrate heat and power. Determining the ideal profile for hydrogen, ammonia, and power production for several case studies necessitated the simplification of a comprehensive chemical model into a mixed integer linear program (MILP), a linear program (LP), and a stochastic program. In the first case study, the MILP model was utilized to address the optimization problem, and the results indicated that NH_3 sales are profitable at the present worldwide price level. In the second case study, linear programming was utilized to determine the ideal method for transferring H_2 to hydrogen fueling stations.

Molecular Kinetic Modeling of Catalytic Naphtha Reforming

IRC for Refining & Advanced Chemicals has completed a research project on molecular kinetic modeling of catalytic naphtha reforming. Naphtha reforming is deployed in refineries to increase the gasoline octane number and the experimental data required to develop the molecular kinetic model were generated via reliable pilot plant tests at a range of process conditions. A rational strategy based on process chemistry and literature review was adopted to define/select 37 chemical species and 181 reactions for incorporation in the kinetic model. A comprehensive program was developed that allows estimating kinetic parameters from experimental data using MATLAB® as a computational program/tool. The kinetic parameters were used for the estimation of product composition. The parity plots showed excellent matching of experimental and model-predicted data for the seven hydrocarbon types with an overall coefficient of discrimination (R2) of 0.9877. The molecular kinetic model was validated using a set of operational conditions different from that used in the development of the kinetic model. Owing to the sufficiently close fit between the calculated product composition and the corresponding experimental data, it can be concluded that the developed molecular-level kinetic model reliably describes the variation of hydrocarbon mixture composition during catalytic naphtha reforming.

Development and Utilization of Nano-Lubrication for Higher Machining Performance in High-Speed CNC Machining

In this research work, a novel nano-lubrication system based on carbon nanotubes (CNTs) has been used to develop a heavy-duty machining process (computer numeric control (CNC) milling) resulting in a high production rate and excellent product quality. Coolube® 2210, which is commonly used as a cutting fluid by metal machining companies, is used as the base lubricant oil. This oil is free of phenol, chlorine, and other additives. CNT nano-lubricant was prepared by adding functionalized CNT nanoparticles with an average size of 5–15 nm to the mineral oil followed by sonication (240 W, 40 kHz, 500 W) for 48 h to suspend the particles homogeneously in the mixture. MQL system is used to deliver the oil to the tool–chip interface area . The experiments were conducted using a thin-pulsed jet nozzle and controlled by a variable speed control drive. When a lubrication system with suspended nanoparticles is used, the nozzle is combined with an additional air nozzle to accelerate the introduction of the lubricant into the cutting zone and reduce oil consumption. The effects of the CNT nano-lubricant on machining performance (cutting temperature, surface roughness, cutting force, and chip thickness ratio) were investigated. Optimum CNT nano-lubricant parameters under different concentrations of nanoparticles, nozzle orientation, and air pressure were used to achieve the appropriate lubrication conditions at the lowest cutting force, cutting temperature, and surface roughness using the Taguchi optimization method. Furthermore, analyses of surface roughness and cutting forces were conducted using signal-to-noise (S/N) response analysis and the analysis of variance (Pareto ANOVA) to determine which process parameters are significant. Finally, the quality of CNT nano-lubricant in terms of the kinematic viscosity and colloidal stability was investigated.

Development of a Low-Cost Electrode for Hydrogen Production

Water electrolysis to generate hydrogen is technically viable and rapidly approaching economic competitiveness. In water electrolysis using a polymer electrolyte membrane (PEM), the cost of the stacks of the electrolyzer, which is the heart of the technology, remains high (~60-70%). The high cost is mainly due to the raw materials, namely platinum (Pt) and iridium (Ir), which are utilized as cathode and anode materials. The cost of these electrode materials is extremely high (~120,000 US$/kg for 40% Pt on carbon and ~490,000 US$/kg for 40% Ir on carbon), and these materials are kept under the category of "extremely rare earth metals". The cost of these materials is viewed as a significant barrier for the adoption of large-capacity electrolyzers and their wide-spread deployment.

During the past several years, we have been engaged in the development of low-cost electrodes, and we have achieved the technical targets in the laboratory. While the performance of the developed electrodes is comparable to that of commercial electrodes based on rare earth metals, they are produced using inexpensive metals – the cost of which is approximately 10-15 times less. The technology has been validated on laboratory scale, and the team aspires to take it to the next level through evaluation, validation, and demonstration in a pilot plant.

To achieve our goals, we are about to sign a joint project with UOP-Honeywell, and we are engaging with the Ministry of Energy (MoE). The MoE has short-listed our proposal for further consideration. In addition, we have established a potential collaboration with Catalonia Energy Research Institute, University of Barcelona, Spain.

Resource Allocation in UAV-Enabled Communication Systems

Communication enabled by unmanned aerial vehicles (UAVs), a promising technique based on B5G/6G, has received considerable attention due to its flexibility in deploying and low cost. UAVs can assist normal communication networks by acting as flying base stations (UAV-BSs) and managing traffic demand in exceptional situations, e.g., sports events, concerts, disasters, military situations, traffic congestion, etc. UAVs can also function as temporary hotspots or relay nodes for connections between safe areas and disaster areas. As UAVs hover above ground, UAV-enabled communication enjoys a relatively higher probability of line-of-sight (LoS) links than terrestrial communication. However, due to the broadcast nature of the wireless channel, the availability of LoS links makes air-to-ground communication more susceptible to being overheard by eavesdroppers (EVs). This emphasizes the importance of enabling security in UAV-enabled communication. This project aims to investigate secure uplink and downlink communications between UAVs and multiple user equipment (UEs) in the presence of multiple ground-based EVs and unfriendly jammers. Our objective is to maximize the average secrecy rate (ASR) by jointly optimizing the trajectory and the transmit power of the UAV, resource allocation of UEs, and scheduling of uplink and downlink transmissions. Although the formulated problem is nonconvex, we propose an efficient solution by jointly applying the techniques of block coordinate descent and successive convex approximation. Numerical results show that the proposed scheme achieves a better ASR compared to the benchmark schemes.

Assessment of the Possibility of Using Non-metallic Fibers and Polymers for Stabilization of Soil

Sand has to be stabilized for use in civil infrastructure, such as embankments for highways, dams, etc. This is achieved using mechanical and chemical methods or both. There is a recent trend to use fibers and polymers for soil stabilization. As such, the aim of this project is to assess the usefulness of existing methods (use of cement, lime, and indigenous industrial waste materials) and emerging technologies (use of fibers and polymers) for the stabilization of local soils, namely sand, sabkha, and marl.

Composite specimens using the selected local soils and stabilizers were prepared and tested to determine the unconfined compressive strength (UCS). Soil/stabilizer mixtures exhibiting maximum UCS were selected for detailed evaluation to determine their shear properties, California Bearing Ratio (CBR), and permeability.

The selected waste materials, along with 2% cement, improved the UCS of all selected soils. Cement kiln dust, due to its cementitious property, is the most efficient in improving the UCS of the selected soils. The selected fibers (polypropylene and polyvinyl acetate) and polymers (polymer emulsion and bitumen emulsion) were effective in improving the UCS, shear strength (angle of friction and cohesion), CBR, and impermeability. Fibers are efficient in improving the UCS of the investigated soils. The use of PVA or PP fibers along with 2% cement provided the UCS required for the stabilization of the sub-base for rigid/flexible pavements. Polymers appear to be more effective in improving the properties of sand.

The cost reduction due to the combined use of 2% cement plus 0.2% PVA/PP fibers, compared to the use of 7% cement alone, is in the range of 6 to 28%. The decrease in cost leads to economic benefits. Furthermore, the reduction in the quantity of cement, 2% in lieu of 7%, leads to a decrease in greenhouse gas emissions, resulting in environmental benefits.

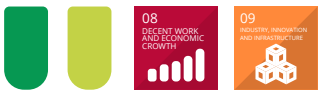
Petroleum Conversion to Chemicals over Medium-to-large Pore Zeolites

Synthesis of medium-to-large pore zeolites for the catalytic conversion of crude oil to petrochemicals is ongoing at IRCRAC. Zeolite pore dimensions and topology are crucial in the catalytic cracking of crude oil. In general, crude oil is composed of a wide range of hydrocarbons from low-molecular-weight volatile hydrocarbons to large-molecular-weight resins and asphaltenes. Cracking of these wide-range of hydrocarbons will certainly be challenging, considering the fact that most catalytic reactions are carried out at active sites of the catalyst, which are typically within the internal pores or cavities of the zeolites. Therefore, a cost-effective and environmentally benign approach for developing highly stable medium-to-large pore zeolites that can withstand the harsh conditions of the fluid catalytic cracking (FCC) process was developed by a top-down approach. The research was directed towards engineered pore size control by statistical (multi-variate) zeolite desilication. Desilication conditions were optimized for achieving desirable pore size and mesopore surface area using the Taguchi design of experiments. Interaction among the desilication parameters was used to identify the important factors that can be used to modulate the mesoporosity of the zeolite. The optimized mesopore zeolite was tested in a microactivity testing (MAT) unit available at IRCRAC, and the results showed improved activity in the direct conversion of crude oil to chemicals.

Assessment of Some Physical and Mechanical Properties of Natural and Stabilized Soils Using Laser-Induced Breakdown Spectroscopy (LIBS)

The design stage and construction process associated with a structural project are driven and based on the gathered soil data. As soil parameters are crucial for long-lasting building structures, both standardized laboratory and in-situ tests have to be developed. This project intends to develop an empirical model using laser-induced breakdown spectroscopy (LIBS) to assess some mechanical parameters of soils. The use of LIBS is due to its simplicity and instantaneity, and it is used in both laboratory and in-situ investigations. LIBS has many applications in the chemical analysis of soils, including the detection of contaminants, pH measurements, and the determination of metallic and non-metallic elements. However, LIBS has not been commonly used for the assessment of the physical and mechanical properties of soil. Therefore, this project will investigate the elemental composition of soil so as to be compared and correlated with its mechanical and physical properties. This will be accomplished by relating the elemental composition of soil obtained using LIBS with the results of standardized soil tests, such as the unconfined compression test and direct shear test, to assess the quality and strength of the soil. The mechanical parameters include unconfined compressive strength, bulk density, angle of friction, and cohesion. Furthermore, these parameters can be assessed for both natural soils and soils stabilized using cement and lime with varying dosages. Assessment relies on finding the dominant element(s) in each type of soil and correlating their concentrations with the standardized test values. Following the development of empirical correlations, the model is validated with the control specimens. Finally, a statistical analysis is carried out to determine the accuracy of the developed models to arrive at the most reliable models that can be used by practicing engineers.

Securing the Molecular Time Scale: Center for Integrated Petroleum Research Achieves Femtosecond Time Resolution



Atoms in molecules move very fast and a very fast camera with a shutter speed on the femtosecond (10^{-15} s) time scale is required to capture their motion in real time. As this cannot be achieved with electronic shutters, it is typically accomplished using lasers. A laser pulse is used to initiate the process of capturing images and a second pulse applied at a controlled number of femtoseconds later, probes the temporal evolution. As simple as it may sound, the device requires many optical components, lasers, and detectors to work together via a homegrown data acquisition system. This has now been accomplished in the femtosecond laser lab in the DTV center. An absorption signal is induced by combining two laser pulses applied to a sample at a specified time delay between the two pulses. The exact point of transition from high to low in the induced signal at different delays between the two pulses shows when the pulses are overlapping in time and space. This point is now established and forms the t = 0 for the experiments. The signal still needs refinement but establishing t = 0 is the bottleneck for the establishment of femtosecond time resolution.

Construction-phase Environmental Monitoring for the Dredging, Filling and Compaction Work of Sheybarah Island Development

The Red Sea Development Company (TRSDC), is developing a luxury tourism project at Umluj, known as The Red Sea Project (TRSP). TRSDC has awarded China Harbour Engineering Arabia Company Ltd (CHEAC) the contract to carry out the development activities at Ummahat and Sheybarah island (Figure on the right). These activities (dredging, landfilling, hotel building, etc.,) are likely to negatively impact the air, terrestrial, and marine environments. Therefore, it is required to conduct an environmental monitoring study during the construction period. CHEAC contracted the Applied Research Center for Environment & Marine Studies (ARCEMS) at KFUPM to conduct environmental compliance monitoring during construction to comply with the requirements and mitigation measures. The objective of this study was to protect the environment in the vicinity of the construction activities in accordance with the environmental rules, regulations, and standards of the Kingdom of Saudi Arabia and TRSDC environmental policies.

KFUPM conducted the monitoring study in accordance with the monitoring plan and CESMP recommended and approved by TRSDC. The dredging and backfilling activities commenced at these islands in January 2021 and were successfully completed in August 2022. The KFUPM environmental monitoring team carried out compliance monitoring in and around the Sheybarah island on a daily basis. The final monitoring surveys showed a healthy ecosystem including striving corals.

The final design of Sheybarah island

Interactive Arabic Reading Tutor

The objective of this project is to develop a platform to collect and store recordings of reading of carefully articulated paragraphs in Arabic by students. This platform will help Arabic teachers to identify issues and mistakes in students' readings. The recordings will be used to develop AI models for automatic rating of students' readings. The project will advance research on Arabic speech processing techniques that are suitable for recognizing children's speech problems. The project will also advance the development of reading assessment strategies using machine learning and deep learning techniques. We also hope that it will stir more interest in the research and development of techniques that assess reading comprehension skills. This project will have a positive impact on first-grade to fourth-grade students by enhancing their reading skills outside the classroom setting. This project is also expected to build a database that contains readings of different paragraphs of varying quality. The research team has collected a total of forty hours of recordings of various paragraphs in Arabic using the developed platform.

Development of Regional Baseline Standards and Conduction of Surveys for NEOM Environment

The project commenced in the first quarter of 2021 and was completed in the last quarter of 2022. The key elements of the first project KFUPM conducted for NEOM were: (i) physical landforms (including coastal morphology), (ii) terrestrial flora and vegetation, (iii) terrestrial fauna and habitats, (iv) marine sediment quality, (v) marine water conditions, (vi) benthic primary producer habitats, and (vii) marine fauna and biologically important areas.

Initially, comprehensive baseline surveys were conducted to support activities of many NEOM development projects commencing soon. These included numerous field surveys in the terrestrial and marine environment. This baseline information was used to develop the ESIA.

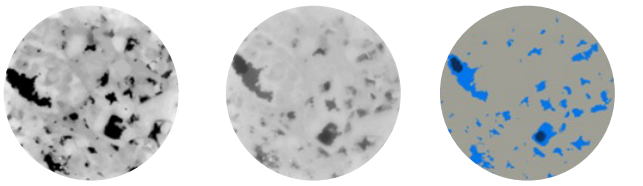
Reports were prepared according to the sites studied. Overall, the following items were submitted to the client: 18 separate reports for landform, terrestrial flora and fauna, 10 reports for seawater, sediments, and benthic primary productivity, and one report each for sea turtles, marine mammals, BRUV, and coral reefs.

On realizing the capabilities of ARCEMS, NEOM directly contracted KFUPM to carry out further baseline studies. The first one, titled Consultancy Services for NEOM in the Execution of Fast-track Environmental Technical Services commenced in September 2021 and the second one, titled Assessment and Characterization of Coastal and Inland Sabkhas in NEOM commenced in September 2022.

In-House Low Cost Mini Micro-CT Core Holder

In-situ micro-CT core flooding experiments were conducted in porous rock media and perform 2D and 3D image data acquisition of fluid saturation levels at high resolution (~ 4 microns) using new low-cost (< 100 SR) miniature core holders (6 mm × 20 mm rock core sample dimensions). In addition, the same spot in the rock can be captured both before and after flooding. The non-destructive micro-computed tomography (micro-CT) technique is used to visualize and measure geometrical features in three dimensions (3D) and characterize fluid amounts and their distributions within porous rocks. These also help monitor the change in porosity, permeability, and wettability dynamically.

The 2D images on the right were captured before and after the flooding of the carbonate rock with brine. In the raw images, grey is rock, black is air, and light grey is water. In the segmented image, black is air, blue is water, and grey is rock. All the scans were conducted using a HeliScan MicroCT by FEI-ThermoFisher company (spatial resolution = 4 microns). The PerGeos software (FEI-ThermoFisher) was used for analyzing the tomograms. Such experiments will enable a proper assessment of water saturations during and after water floods to access the efficiency of, e. g., EOR strategies in real time.



Raw image-dry (before flooding) | *Raw image (after flooding)* | *Segmented image (after flooding)*

Core plugs have a 6 mm diameter

Publications: Dissemination of Research Findings

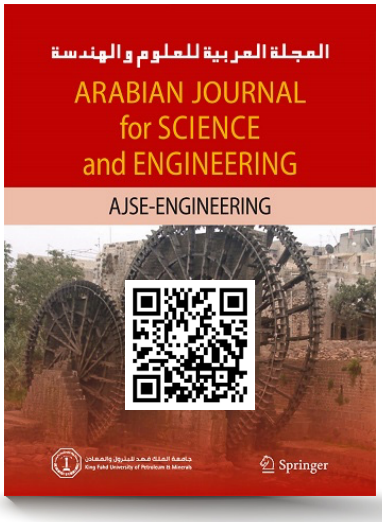
Impact factor: 2.807

KFUPM partnered with Springer to publish the Arabian Journal for Science and Engineering (AJSE) from 1975. AJSE is a recognized national, regional, and international journal that provides an excellent opportunity for the dissemination of research advances in the Kingdom of Saudi Arabia, MENA, and the world.

AJSE publishes twelve issues containing peer-reviewed original contributions in the Science disciplines of Biological Sciences, Chemistry, Earth Sciences, and Physics, and in the Engineering disciplines of Chemical, Civil, Computer Science and Engineering, Electrical, Mechanical, Petroleum, and Systems Engineering.

With its long history, AJSE reached another milestone whit the achievement of an Impact Factor of 2.807, announced in June 2022, and moved to the second quartile (Q2) of top journals in its area. AJSE achieved this impressive Impact Factor due to the high number of citations, large number of submissions, the high-quality papers published per year, and most importantly the exceptional efforts of the Editor-in-Chief and the subject editors.

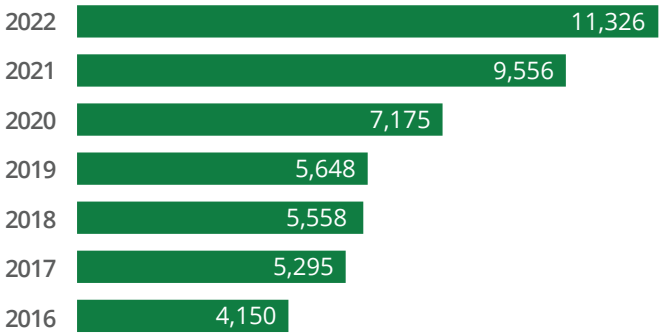
In 2022 a total of 11,326 manuscripts were received by AJSE, including 1,547 in science disciplines and 9,779 in engineering disciplines. These manuscripts were from 90 countries. AJSE is an important Springer-Nature journal recognized as a multidisciplinary international journal.



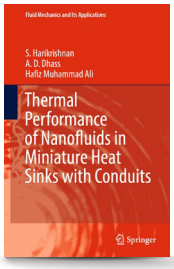
CLICK HERE TO READ THE ARTICLE

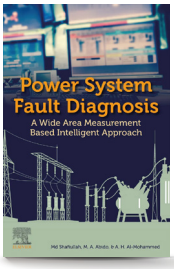
Manuscripts received during 2016-2022

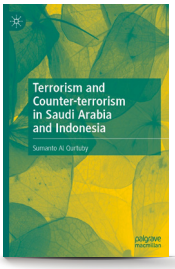
Total number of manuscripts received = **11,326**
Total number of papers published in 2022 = **1,080**
Acceptance rate = **12-14%**

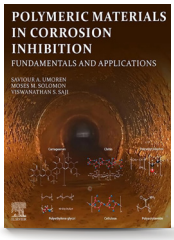


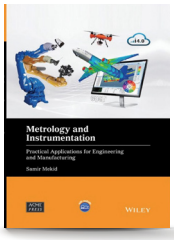
KFUPM Published Five Books in 2022











Impact of KFUPM on the Society

Even though the impact of a university on the society is historically determined mainly based on its academic contribution, the impact of research institutes and universities extends beyond the institutions in terms of changes in the society of the real world.
KFUPM impacts many different aspects of the society directly and indirectly,including those involving attitude, awareness, economy, social attributes, policy, cultural aspects, and health. Education, research, and innovation at the University impacts the society significantly. The indirect contribution of academic research extends to the economy, society, environment, and culture and beyond. In addition, KFUPM contributes to the society directly through various projects and programs.

NIDLP's Renewable Energy Research and Technology Incubator

The IRC for Renewable Energy & Power systems at KFUPM was recently awarded a fund from the National Industrial Development and Logistics Program (NIDLP) to establish a Renewable Energy Technical Incubator at KFUPM. The proposed initiative facilitates and expedites research, development, and innovation (RDI) projects in renewable energy, energy efficiency, and the fourth industrial revolution (IR 4.0) applications in the energy sector. The objectives of the initiative are the following:

(i) Establish a state-of-the-art incubator to inspire students, engineers, researchers, and local communities to realize the full potential of renewable energy, energy efficiency, and Industry 4.0 for relevant technology development in the Kingdom.
(ii) Build a state-of-the-art Renewable Energy Incubator at KFUPM to facilitate research, innovation and technology transfer, and implementation of proof-of-concept ideas in the renewable energy sectors that will serve to accomplish Vision 2030.

The Renewable Energy Incubator administers the following five programs to support research at different Technology Readiness Levels (TRL):

- Undergraduate students
- Graduate students
- 50 K Competition
- Proof of Concept
- Business start-ups

Edamah - Establishment of 290 Voluntary Work Units

Establishment of 290 Voluntary Work Units according to the National Standard of Voluntary Work Units (EDAMAH) in Non-profit and Government Organizations

The project aims to establish 290 voluntary work units in non-profit organizations and government agencies according to the Saudi National Standard of Voluntary Work Units (EDAMAH).
This project is supported by the Ministry of Human Resources and Social Development and other foundations as an initiative to contribute to achieve the goals of Vision 2030 goals of maximizing the impact of voluntary work and reaching one million volunteers annually.

- 250 organizations sponsored by the MHRSD
- 20 organizations sponsored by the Alsubaii Foundation
- 20 organizations sponsored by the Alrajhi Humanitarian Foundation

Nature of the established units:
- 25 government organizations
- 265 non-profit organizations

Contribution of the established units:
- Provided 24,965 volunteering opportunities
- Allowed 153,695 volunteers participated in the above opportunities
- Participating volunteers contributed a total of 1,751,147 volunteering hours

The economic impact of the contributed volunteering hours is worth SR 68,403,812

Alfozan Academy conducted 128 programs throughout the Kingdom in 2022 and educated 5,485 attendees from 1,875 nonprofit organizations in collaboration with the National Center for Nonprofit Sector and Nora Almilahi Foundation

RAED Program

RAED Program is to encourage youth leaders from higher education in various regions of the Kingdom mainly to enhance their community participation and engage them through leadership in volunteering and leading various community initiatives.

- A master's degree program in Nonprofit Management in partnership with Indiana University Lilly Family School of Philanthropy, IUPUI has been launched.
- A scholarship program for nonprofit leaders to pursue postgraduate studies in the nonprofit sector has been launched.

Rasheed Program

Rasheed Program is a new initiative of Alfozan Academy, which was launched as one of the programs derived from the National Standard for Volunteering (Edamah). The Program aims to organize and institutionalize school volunteer work according to the Rasheed standard to boost volunteer work in schools and involve them to strengthen and expand the impact of nonprofit sector to serve the community.

National Occupation Standards (NOS)

This initiative involves the development of a standard based on global best practices. NOS is the first to be developed in the non-profit sector of the Kingdom, the first to be adopted nationally by the Ministry of Human Resources and Social Development, and the first standard of Arab volunteering.

KFUPM Research Events

KFUPM Institute for Knowledge Exchange (KIKX) has been established to make KFUPM a hub for knowledge exchange by connecting the scientific community and the industry locally and globally to promote and share knowledge. KIKX is a single, centralized channel for all the science-related events and micro-nano-credential courses. All science-related events such as forums, symposia, and conferences which are conducted by the academic departments and research centers at KFUPM are managed by KIKX.

111 EVENTS in 2022

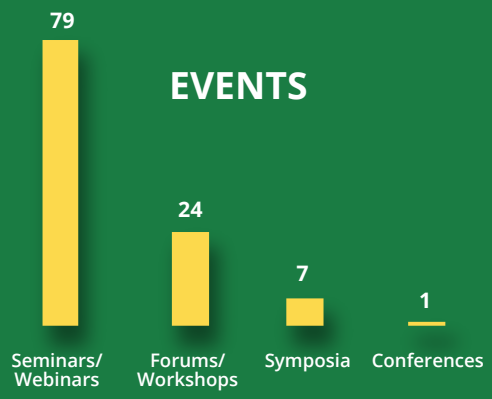
316 SPEAKERS in 2022

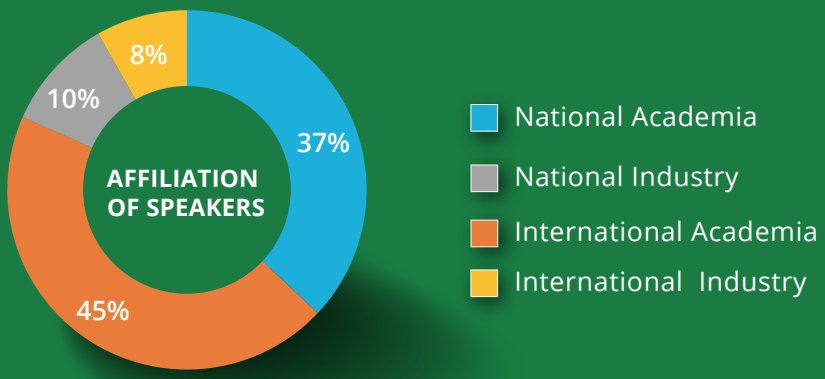
The Saudi Japan Symposium: Technology in Fuels & Petrochemicals

The 31st annual Saudi-Japan symposium "Technology in Fuels & Petrochemicals" was held during December 12-13, 2022. This event, jointly organized by KFUPM, Saudi Aramco, the Japan Petroleum Institute (JPI), and Japan Cooperation Center, Petroleum (JCCP), brings together researchers from industry and academia to discuss recent downstream technologies related to refining. The main theme of this symposium was "Innovative Catalyst Development" with the objective to partner with institutions in Japan to positively promote research collaboration in downstream areas. In this year's symposium, there were presentations featuring 21 papers and 10 posters. The topics included carbon neutrality, innovative catalysis, production of hydrogen and chemicals, and waste and CO_2 utilization. Distinguished speakers were from Saudi Aramco R&DC, KFUPM research centers/academic departments, International Center for Synchrotron Radiation, ENEOS, Japan Advanced Institute of Science & Technology, and University of Tokyo Shizuoka and Tohoku. The poster session was rich with high-quality presentations by young researchers from Saudi Aramco and graduate students from KFUPM. More than 150 participants from KFUPM, Saudi Aramco, Sabic, companies in DTV, and local private sector attended the symposium.

The Women in Data Science

Dr. Rabeah Al-Zaidy, Ambassador of Stanford's Women in Data Science (WiDS) at KFUPM led a team of students in organizing the 3rd annual WiDS-Dhahran workshop at KFUPM in hybrid mode. It was held on March 24, 2022 and featured prominent female data science experts as presenters. The event was held under the patronage of the university president Dr. Muhammad Al-Saggaf, and with the support of the KFUPM Fund, the KFUPM KIKX, the SDAIA-KFUPM Joint Research Center for Artificial Intelligence, the College of Computation and Mathematics at KFUPM, Thakaa Center, tWomen Techmakers, and the Google Developer Groups (GDG) in Saudi Arabia. The workshop agenda had a rich one-day program that included two themed sessions of talks, a poster session for students to demo their projects, two technical hands-on tutorials from the industry from Google developers and Fathom, a Saudi start-up.





The Menacis 2022

KFUPM Business School (KBS) and the Interdisciplinary Research Center for Finance & Digital Economy (IRC-FDE), and the KFUPM Institute for Knowledge Exchange (KIKX), hosted the 5th Middle East and North Africa Conference on Information Systems (MENACIS 2022) from November 16 to 19, 2022 under the theme "Socially Responsible Information Systems for Sustainable Societies".

MENACIS highlighted the role of information systems and technologies in achieving Sustainable Development Goals (SDGs). The event was attended by several leading international researchers, experts, academics, and students from more than 40 countries.

High-caliber senior international researchers from different countries around the world made presentations at the conference. The conference included keynote speeches, a knowledge exhibition, and a number of events highlighting the role of information systems in society.

KFUPM also received the "Golden Medal Award" from the Council of the Association for Information Systems in the MENA region.

The Annual Nonprofit Development Sector Forum

One of the major activities of the Center of Excellence in Development of Nonprofit Organizations is organizing the first-ever Annual Nonprofit Sector Development Forum in the Kingdom. The forum's objective is to foster the nonprofit sector's role in society and help Saudi Arabia achieve the goals of its Vision 2030 program by introducing international best practices in the non-profit sector. Almost 250 leaders in the non-profit sector, including presidents and CEOs, administrators, volunteers of NPOs and NGOs, some Saudi Government officials, top management officials of private companies and CSR executives participated in the 10th Forum held in March 2022. Internationally recognized speakers and recipients of prestigious awards from philanthropy bodies such as Skoll Foundation and Schwab Foundation from North America, Europe and Fareast were invited to deliver keynote addresses.

KFUPM Stimulates Gifted and Creative Minds

UNDERGRADUATE PROGRAMS

Undergraduate research is a learning activity that enriches a student's undergraduate experience.

207
Students applied for the **Uxplore** program

77
Students fulfilled **Uxplore** program requirements

67
Students completed **Uxplore** program

38
Advisors participated in **Uxplore** program

166
Students applied for the **SURE** program

88
Students fulfilled **SURE** program requirements

30
Students completed **SURE** training

11
Students completed the research experience

23
Advisors participated in **SURE** program

24
Students who attended the **Mawhiba** program

7
Advisors participated in **Mawhiba** program

Undergraduate Student Research Grant (Uxplore)

A research scholarship for undergraduate students to encourage their active engagement in research and scholarly activities.

The program assists students to develop critical thinking, creativity, problem-solving, intellectual independence, and leadership skills.

Summer Undergraduate Research Experience (SURE)

A research scholarship for undergraduate students to participate in scientific research for eight consecutive weeks (40 hours/week) during the Summer Semester.

The program aims to:

- Instill the culture of research and provide more opportunities to conduct research at the undergraduate level
- Furnish students with knowledge of advanced research techniques and tools
- Enhance research capabilities of students through early engagement
- Attract students to graduate programs at KFUPM
- Help students identify their passion to decide on their future career path

STUDENT COMPETITIONS

***50K** Challenge Competition and Competition for Renewable Energy*

The final round of the Center of Excellence in Energy Efficiency (CEEE) "50k Challenge Competition" and the "K.A.CARE Competition for Renewable Energy", were held on Thursday, May 12, 2022. This contest provided an opportunity for the participating students to showcase their projects to peers and a committee composed of expert panel of judges from faculty as well as the industry.

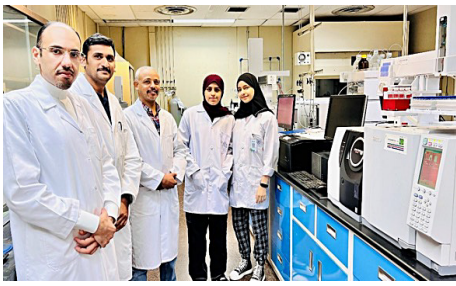
Both these contests were organized under the guidance of the Director of the CEEE, Dr. Fahad A. Al-Sulaiman, who also holds the position of the Director of K.A.CARE's office of cooperation at KFUPM.

KFUPM ACADEMY FOR RESEARCH EXPERIENCE

Attracting and retaining the next wave of world-class research and innovation leaders.

In partnership with the King Abdulaziz and His Companion Foundation for Giftedness and Creativity (Mawhiba), KFUPM promotes research in the fields of science, engineering, and computing.

A research scholarship for undergraduate students to encourage their active engagement in research and realize scholarly achievements. The program assists students to develop critical thinking, creativity, problem-solving ability, intellectual independence, and leadership skills.



The program has introduced a range of research enrichment units including the following:

- Gamification Techniques
- Removal of polycyclic aromatic hydrocarbons from polluted water using environmentally friendly material
- Artificial intelligence and machine learning
- Nanomaterials and their applications
- Development of electro-and photo-catalysts for energy applications and environmentally friendly fuel production
- Preparation of porous organometallic structures and study of their applications
- Reducing carbon dioxide to form safe and industrially useful materials

The top three winners of the 50k competition challenge shared a total of SAR 110,000 as the prize money. Mr. Syed Shaheen Shah won the first prize of SAR 50,000, while Mr. Asaad Abdulsalam Abdulrahman Al-Duais, Mr. Abdulrahman Basharat Javaid, and Mr. Miswar Akhtar Syed won the second prize of SAR 35,000. Mr. Yasser Saeed Alqahtani, Mr. Hosam Abdulrahman Alrefaie, Mr. Faisel Abdullah Ali Alhendi, and Mr. Ali Mohammad Abdullah Dakhnan Mahnashi won the third prize of SAR 25,000. All the awards were handed over by the guest of honor Dr. Muhammad M. Al-Saggaf, President of KFUPM.

Winning Projects

1

Development of High-performance Supercapacitor Based on Date Leaves Derived Carbon

2

Electrodynamic Screen (EDS) for Increased Solar Energy Efficiency and Sustainability

3

Solar Hydrogen Production

Recognizing Success and Impact

EXTERNAL RESEARCH AWARDS

Interdisciplinary Research Center for Renewable Energy & Power Systems (IRC-REPS) participated in the Fourth Cycle of the Emirates Energy Award-2019 which is organized by the Dubai Supreme Council of Energy annually, and won an award under the "Education & Capacity Building" category of the Energy Efficiency and Management Program. Dr. Ali A. Al-Shaikhi (VPRI) and Dr. Fahad A. Al-Sulaiman (Director, IRC-REPS) were invited to attend the Emirates Energy Award ceremony where they received the award at World Green Economy Summit, Dubai, UAE on September 28, 2022.
The Emirates Energy Award was organized under the patronage of His Highness Sheikh Mohammed bin Rashid Al Maktoum. It is a regional prize which encourages the sustainable energy and highlights the best practices and pioneering work in energy efficiency, alternative energy, sustainability and protecting the environment among the public and private sectors cross the region.

HIGHLY CITED RESEARCHERS

Highly Cited Researchers have published numerous highly cited articles during the past ten years, demonstrating a significant and wide-ranging impact. Clarivate has recognized professors from KFUPM as Highly Cited Researchers in a number of research categories for 2022.

ENGINEERING

Tawfik Saleh
Professor, Department of Chemistry
Interdisciplinary Research Center for Advanced Materials
Subject Categories: Chemistry, Engineering, Physics, Materials Science, and Environmental Sciences & Ecology

Hafiz Muhammad Ali
Visiting Associate Professor, Department of Mechanical Engineering
Interdisciplinary Research Center for Renewable Energy and Power Systems
Subject Categories: Thermodynamics, Engineering, Mechanics, Energy & Fuels, and Chemistry

ENVIRONMENT AND ECOLOGY

Tawfik Saleh
Professor, Department of Chemistry
Interdisciplinary Research Center for Advanced Materials
Subject Categories: Chemistry, Engineering, Physics, Materials Science, and Environmental Sciences & Ecology*

CROSS-FIELD

Ahmet Sari
Chair Professor, Mechanical Engineering Department
Interdisciplinary Research Center for Renewable Energy and Power Systems
Subject Categories: Energy & Fuels, Engineering, Environmental Sciences & Ecology, Materials Science, and Thermodynamics

Ali Riza Yildiz
Chair Professor, Mechanical Engineering Department
Subject Categories: Engineering, Materials Science, Computer Science, Transportation, and Mathematics

Eyup Dogan
Chair Professor, Department of Economics
Subject Categories: Environmental Sciences & Ecology, Energy & Fuels, Science & Technology - Other Topics, Business & Economics, and Engineering

Source: Clarivate.com/highly cited researchers in 2022

KFUPM Research Awards

DISTINGUISHED PROFESSOR AWARD

Muhammad Ashraf Gondal
Professor, Physics
Interdisciplinary Research Center for Hydrogen & Energy Storage
Research Interests: Solar Cells, Supercapacitors, Oil Water Separation, Laser Spectroscopy, Advanced Nano Materials, Hydrogen Production, and Photo Catalysis

Mohammed Habib
Professor, Mechanical Engineering
Interdisciplinary Research Center for Hydrogen & Energy Storage
Research Interest: Thermal Sciences, Combustion, Boilers, Erosion, Heat Exchangers, Thermodynamics, Oxygen Transport Membranes and Carbon Capture

Michael Anthony Kaminski
Professor, Geosciences
Research Interests: Historical Geology, Paleontology, Paleoceanography, Paleoclimatology. Biodiversity, Evolutionary Processes, and the History of Marine Microfossil Communities Classification

EARLY CAREER RESEARCH AWARD

Ihsanullah Obaidullah
Assistant Professor, Applied Research Center for Environment & Marine Studies
Research Interests: Water Treatment, Desalination, Membranes, Nanomaterials, and Environmental Impact Assessment

Abdullah Mohammed Alsharafi
Assistant Professor, Department of Mechanical Engineering
Interdisciplinary Research Center for Renewable Energy & Power Systems
Research Interests: Self Cleaning of Surfaces Hybrid Renewable Energy Systems Solar Energy Conversion, and Computational Fluid Dynamics

Nadeem Baig
Assistant Professor, Interdisciplinary Research Center for Membranes & Water Security
Research Interests: Membrane, Oil,Water Separation, Produced Water, Wastewater Treatment, and Advanced Nanomaterials

Umair Waheed
Assistant Professor, Department of Geosciences
Research Interests: Physics and Data-driven Machine Learning, Geophysical Modeling, Inverse Problems, Induced Seismicity, and Geothermal Exploration

RESEARCH EXCELLENCE AWARD

Fahad Al-Sulaiman
Professor, Mechanical Engineering
Interdisciplinary Research Center for Renewable Energy & Power Systems
Research interests: Thermodynamics, Heat Transfer, Solar Energy, Thermofluids, and Renewable Energy

Muhammad Sajid Tufail
Associate Professor, Applied Research Center for Environment & Marine Studies
Research interests: Chemical Analysis, Sample Preparation, Emerging Contaminants, Environmental Analysis, Selective Adsorbents

Muhammad Khalid
Associate Professor, Department of Electrical Engineering
Interdisciplinary Research Center for Renewable Energy & Power Systems
Research Interests: Renewable Energy Resources, Energy Storage Systems, Optimization and Control, Microgrids and Smart Grids

Amir Ahmed Ahammad Hossain
Associate Professor, Interdisciplinary Research Center for Renewable Energy & Power Systems
Research Interests: Thin Film, Plasmonics, Renewable Energy, Solar Cell, UV,Protective Layer, and Sensors

Nasr Aldeen Ali Tatar
Professor, Department of Mathematics
Interdisciplinary Research Center for Intelligent Manufacturing & Robotics
Research Interests: Theoretical Study of Partial Differential Equations in Viscoelasticity and Thermoelasticity (Timoshenko Beams)

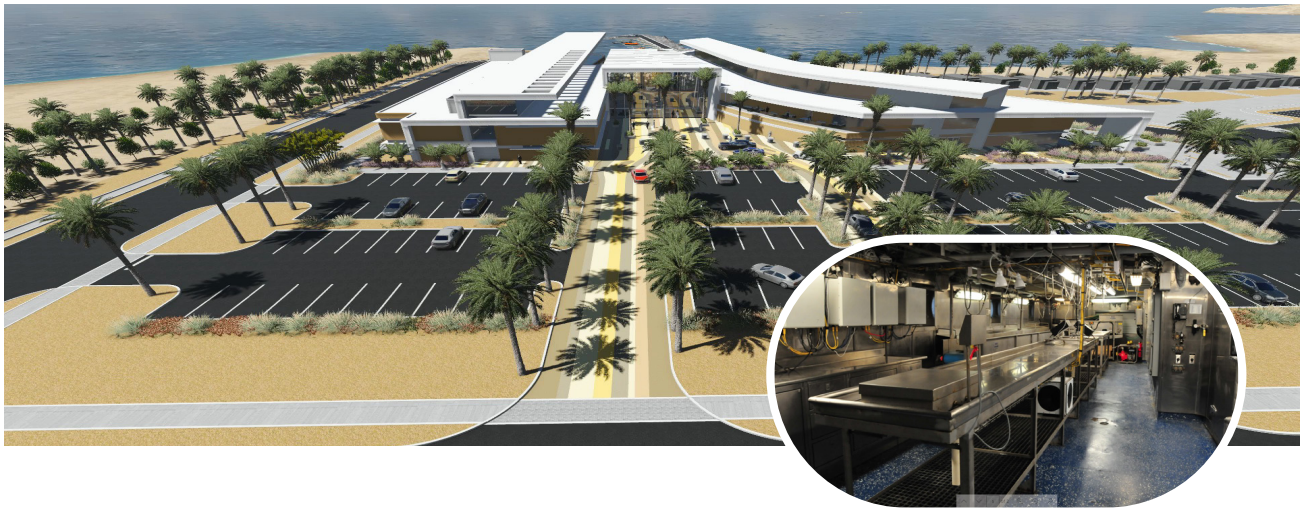
Medhat Nemitallah
Associate Professor, Interdisciplinary Research Center for Hydrogen & Energy Storage
Research interests: Clean and Renewable Energy, Hydrogen Production and Mobility, Alternative, Fuels, Circular Carbon Economy, CFD Modeling

Research & Innovation Future Initiatives

KFUPM is constantly working on establishing new centers for emerging areas of research. Biotech Center will be launched in 2023.

Arabian Gulf Marine Research Center (AGMRC)

Considering that a facility in close proximity to the ocean is a prime requirement for conducting Marine Environmental Research in a sustainable manner, establishment of AGMRC is a significant initiativet. By monitoring Saudi waters of Arabian Gulf, AGMRC will enable in developing its research in the areas of marine environmental protection. AGMRC will provide an opportunity to enhance the quality of teaching and attract researchers from elsewhere in the nation and region to carry out their research at the center.



Fluid Systems Laboratory (FSL)

The KFUPM fluid systems laboratory (FSL) is one of its kind in the Kingdom to solve the problems faced by the oil, gas and petrochemical industries. The objectives of the FSL is to conduct research and development of innovative multiphase flow devices used in the oil and gas industries and train personnel involved in operation of the multiphase flow systems. The Center has completed several client funded projects using the existing FSL facilities and is currently working on the Saudi Aramco project entitled "Experimental Study of Air-Oil Flow Behavior at the Inlet of an electric Submersible Pump at Different Slugging Flow Conditions".

Stainless steel 4" multiphase loop

Swing arm 6"/3" multiphase loop

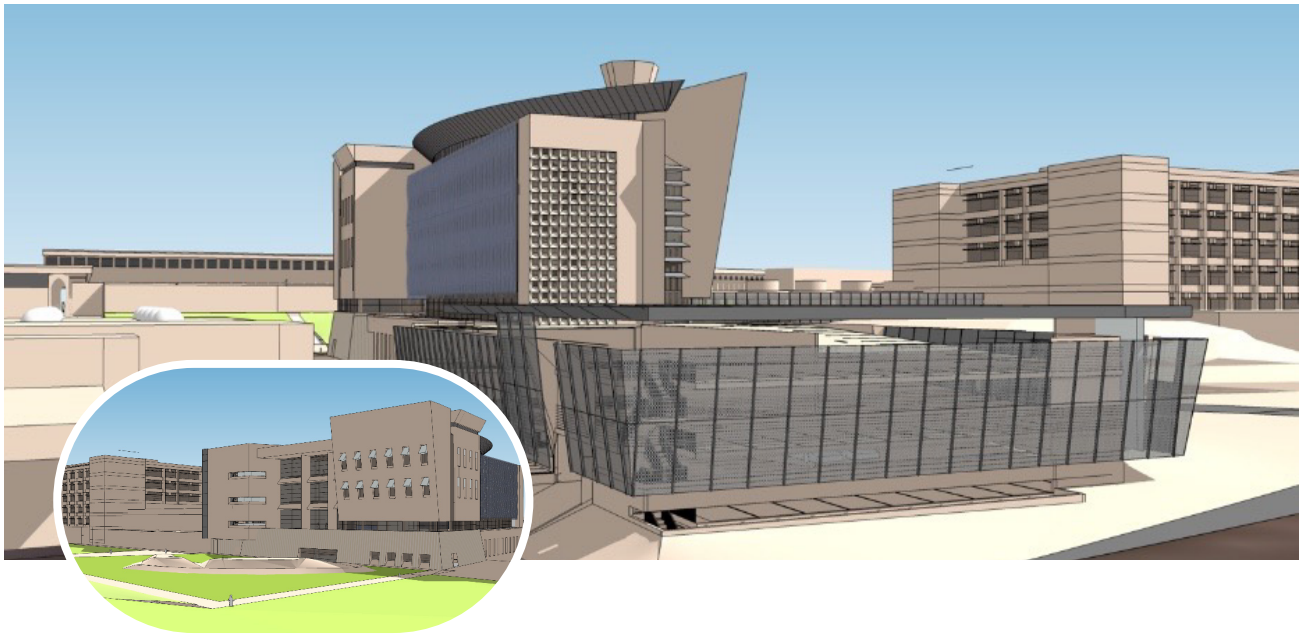
ESP artificial lift 3" loop

Petroleum Conversion Research Center (PCRC)

KFUPM is establishing PCRC in collaboration with Saudi Aramco R&DC at DTVC to be a platform for collaborative research that bridges the gap between bench- and industrial-scale units in the field of chemicals and fuels. The Center will serve faculty, researchers, graduate students and post docs in science and engineering who are conducting research in both heterogeneous and homogeneous catalysis. PCRC will be fully dedicated to convert petroleum products to value-added chemicals and provide technology solutions for local and global downstream industries. PCRC will facilitate scale-up of process technologies from “proof-of-concept” (Technology Readiness Level TRL 4) to “pilot scale” (TRL 6).

Central Lab Building

Central Lab, which is a highly innovative and sustainable facility, is being built to support the research activities of the faculty, researchers and students at KFUPM at large and other universities in the Kingdom and to provide advanced analytical services to the local industry.



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