

KAUST IMPACT

Winter 2022/23



Core
Labs
Pages 33-48

جامعة الملك عبد الله
للعلوم والتقنية
King Abdullah University of
Science and Technology



Impactful
Partnerships
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From the President

Dr. Tony F. Chan, President of KAUST

Welcome to the sixth edition of *KAUST Impact*, which celebrates some of the latest fruits that have translated from KAUST research, education and innovation to society, government and industry. We are pleased to be “graduating” with this issue beyond mail and stand circulation to distribution by the national airline SAUDIA, our partner in more ways than one (pg. 5).

KAUST is ever eager to tell its story. The university is featured in a four-episode National Geographic series “Chasing Answers” that first aired in June 2022 throughout the Gulf on the Disney Channel. Scan the QR code above for a YouTube repository of the full episodes and some faculty shorts. Over the course of the series, which has garnered more than 15 million visits, over two dozen KAUST faculty are featured, telling their impactful stories in their own words (pg. 8).

KAUST Impact has two sister publications: *KAUST Discovery* and *KAUST Insight*. Whereas *KAUST Impact* reports on the impact of downstream application of a scientific discovery or engineering design produced by the university, *KAUST Discovery* describes the discovery and its scientific context, usually by digesting a professional scientific publication in terms an educated layperson can appreciate. The primary audience of *KAUST Discovery* is the community of peers in scientific and engineering communities and the academic community more generally. *KAUST Insight* tells the “story behind the story,” often relating the human drama, the inspiration or the serendipity behind the discovery. The audience for *KAUST Insight* includes all who are curious about how science advances as a human endeavor. Each magazine is available online and in print, and we hope that readers drawn to one will be drawn, in turn, to the others. Beyond its own publications, KAUST is extensively covered by national and international media. It also has official channels on the major digital social media, including in Chinese.

Besides presenting ripe stories from the preceding semester, each issue of *KAUST Impact* features a cluster of articles around a timely theme representing a major emphasis of the university. This issue turns the spotlight on KAUST’s Core Labs, a cluster of 12 expertly staffed and extraordinarily equipped facilities common to many research endeavors at KAUST and dozens of collaborators throughout the Kingdom (pgs. 33–48). Many of them represent expertise in performing measurements or computations, taking images or fabricating experimental equipment that cannot be found anywhere else within thousands of kilometers. KAUST has Center of Excellence partnerships with four international vendors – Thermo Fisher Scientific, Bruker, Leica Microsystems and Fugro – and is establishing two more with Hewlett-Packard Enterprise and NVIDIA in conjunction with the acquisition of Shaheen-3 (pgs. 47–48), which will be the most powerful computer between Bologna, Italy and Guangzhou, China – more than 100 degrees of longitude. These centers not only allow KAUST-affiliated researchers to push the limits of the technology, they also give vendors insight into the demands they should meet with their next-generation offerings. Among the Core Labs’ major accomplishments is the accreditation of its Animal Resources Core Lab by the Association for Assessment and Accreditation of Laboratory Animal Care. KAUST becomes the second institute in Saudi Arabia to hold this status (pg. 38). Achieving this standard for research quality, accountability and scientific validity improves KAUST’s ability to attract biological and medical research talent.

Feature articles in *KAUST Impact* are empowered by an external stakeholder quote called out from the text in green angle brackets. If you have only 10 minutes to spend with this issue, read the praise that 33 non-KAUST stakeholders have given for our efforts – all made possible by the dynamism of a Kingdom in pursuit of Vision 2030 and a university catalyst that has become a global destination.

President Tony Chan

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Links to KAUST publications:

KAUST Impact: kaust.link/kaust-impact
 KAUST Discovery: discovery.kaust.edu.sa
 KAUST Insight: insight.kaust.edu.sa

Articles in this issue feature activities aligned with one (or more) of the 17 Sustainable Development Goals of the United Nations – codified in 2015 and aimed at reducing poverty and hunger; improving health and education; and addressing climate change, environmental degradation and various social challenges – and are marked with an icon representing the most closely associated goal.



Also marked are articles that are applicable to Vision 2030 goals. KAUST’s mission is deeply intertwined with the development objectives of Vision 2030, such as diversifying the economy well beyond petroleum, embracing innovation, localizing advanced technology and expanding opportunities for Saudi citizens.

yahoo!
finance

 INDEPENDENT

AP
Associated Press

The New York Times

 **ALJAZEERA**

WOS SPA
وكالة الأنباء
السعودية
SAUDI PRESS
AGENCY

GULF NEWS 

nature

The National

العربية

 **THE HINDU**

KAUST
in the
news

 **Hia**
المجلة العربية الأولى

البكان

 **CHANNEL NEWSASIA**

ARAB NEWS

ASHARQ  **AL-AWSAT**

Khaleej Times

Daily Mail

la Repubblica

**SCIENTIFIC
AMERICAN**

THE IRISH TIMES

**FRANCE
24**

The Boston Globe

sky news **عربية**

**The
Guardian**

Saudi Gazette

KAUST Core Labs and Research Infrastructure

With state-of-the-art laboratories and specialized equipment, and more than 250 highly trained staff and subject experts, the 12 KAUST Core Labs offer world-class services and training to KAUST researchers and Saudi partners to support complex research projects from concept to design to application for outstanding science outcomes.



Infrastructure and Equipment

2000+
Research Instruments

43,000 m²
of Lab Space

12
Laboratories

45
Functional Units
(a service area within a lab representing
a different field of expertise)



Users

1,774
Internal Users

220
External Users
(the number of users who used the Core Labs in the last
fiscal year, from July 2021 to June 2022)

168
Service Agreements
(signed with various external organizations from
industry, academia and the government)



Services

650
Services Offered
(examples include training in a particular instrument,
a Core Labs scientist running samples in a machine, a
scientific cruise on KAUST's research vessel, etc.)

700
People Trained Per Year



Personnel

270
Staff

47
Nationalities



Supercomputing

5,330,510
Runs on
Shaheen (2021)

154
Papers in journal and
conference proceedings
acknowledging Shaheen (2021)

PROVIDING LOCALLY GROWN FOOD TO NATIONAL AIRLINES



KAUST startups help boost sustainability for national carrier SAUDIA



SIMON ROOPCHAND
CEO, RedSea Middle East

“ IF ALL THE TOMATOES
CONSUMED EACH
YEAR IN SAUDI ARABIA
WERE GROWN WITH
REDSEA'S COOLING
TECHNOLOGY, 80,500
TONS OF CO₂ EMISSIONS
WOULD BE SAVED – THE
EQUIVALENT OF OVER
3,000 FLIGHTS FROM
RIYADH TO DUBAI. ”

SAUDIA

“The Kingdom's Vision 2030 will see 100 million visits to Saudi Arabia by the end of the decade. A cornerstone of that vision is for the Kingdom to be a leader in sustainable and even eco-friendly tourism.”

Ibrahim Koshy, CEO, SAUDIA

Climate change impacts all sectors of the global economy, necessitating the use of innovation and collaboration to manage related challenges. This includes finding new ways to produce food. More than 80% of fresh food in Saudi Arabia is currently imported, as the Kingdom's arid climate makes growing crops a challenge. This reliance comes with a heavy carbon footprint due to air transport requirements.

The announcement in September 2022 of a collaboration between Saudi Arabia's flag carrier SAUDIA and RedSea (formerly Red Sea Farms) is a sign of progress toward achieving the Kingdom's Vision 2030 goals of environmental sustainability, and its longer-term aim to reach net-zero carbon emissions by 2060. RedSea, a KAUST spinout global agritech business, works to minimize the use of water in agriculture and facilitate sustainability throughout the agricultural value chain. The company uses unique technologies to enable sustainable, commercial-scale farming in desert climates, and it offers salt-tolerant vegetables that can be grown in greenhouses. The company's proprietary technologies utilize artificial intelligence to combine cooling, light and energy management.

For SAUDIA, the chance to source vegetables locally is helpful in multiple ways. The national carrier can lower its carbon emissions and cut costs by swapping out imported food for local options. As a part of the international airline alliance SkyTeam, SAUDIA participates in the group's Sustainable Flight Challenge, which includes sourcing local, sustainable produce in catering operations. The carrier was recently recognized by SkyTeam for its efforts, winning the group's Best Customer Engagement award, and was a finalist for the Greatest CO₂ Reduction award, attributed in part to its collaboration with RedSea. “Our partnership with SAUDIA is another step to introduce our unrivalled fresh produce to a wider and discerning public, while significantly scaling up our business,” said Simon Roopchand, CEO of RedSea Middle East.

RedSea was co-founded in 2018 by Ryan Lefers, who is now the company's CEO, and KAUST Professor Mark Tester, who is also associate director of the KAUST Center for Desert Agriculture. The company has scaled up quickly since its pilot saltwater greenhouse project successfully delivered tomatoes to local supermarkets, having attracted \$35 million in two rounds of venture capital funding since 2021. The two fundraising rounds were led by Wa'ed, the venture capital arm of Aramco, and the Savola Group, a MENA food and retail conglomerate. RedSea recently finished building a research and development facility at KAUST, and is expanding its business throughout the Gulf Cooperation Council (GCC) and North America.



EMPOWERING ENTREPRENEURIAL WOMEN IN SAUDI ARABIA

KAUST partners with the University of Texas at Austin to deliver a unique business program



HATTAT AHMED
Director, KAUST Entrepreneurship Center

“ KAUST IS COMMITTED
TO SUPPORTING THE
ADVANCEMENT OF FEMALE
ENTREPRENEURS IN SAUDI
ARABIA. WE ARE EXCITED
TO SEE THE OUTCOMES OF
THIS PARTNERSHIP AND
THE REAL IMPACT THAT
PARTICIPANTS WILL HAVE
IN THE KINGDOM. ”

UNIVERSITY OF TEXAS AT AUSTIN

“Texas Global is delighted to have partnered with KAUST and the US Consulate General in Jeddah to deliver a program that supports Saudi women entrepreneurs as they scale up successful businesses.”

Sonia Feigenbaum, Senior Vice Provost of Global Engagement and Chief International Officer, University of Texas at Austin

KAUST recently collaborated with the University of Texas at Austin (UT Austin) to deliver a new program called Empowering Saudi Women Through Entrepreneurship, with the support of the United States Consulate General in Jeddah. The program focuses on building capacity for emerging women entrepreneurs in the Kingdom, and its first workshops took place in both Austin, Texas, and on the KAUST campus.

By supporting this important initiative, KAUST hopes to spur the growth and diversification of the economy while encouraging the expansion of a vibrant entrepreneurial ecosystem – two vital pillars of Vision 2030. The women selected to participate in the program are developing innovative technologies and products with global export and growth potential to help solve pressing social and economic challenges.

The program was created by UT Austin's Global Innovation Lab (GIL), part of Texas Global. Texas Global is a wing of UT Austin that advances the university's international engagement and strategic partnerships. It utilizes UT Austin's Innovation Readiness Training curriculum, a combination of self-paced training and online exercises with immersive in-person learning. Participants acquire the tools needed to grow long-term sustainable businesses, and learn methods for crafting unique business models.

A grant from the US Consulate General in Jeddah enabled Texas Global to offer workshops in both countries, making this one of the first initiatives to include independent travel for Saudi women. In May and June 2022, KAUST hosted GIL's training on campus; in July 2022, Texas Global hosted the inaugural cohort of 11 entrepreneurs during Austin Ecosystem Week. Participants who went to the US benefitted from a unique opportunity to immerse themselves in a US business environment and learn from mentors who are well established in the local entrepreneurial community. Activities included visits to area business incubators and the delivery of presentation pitches to representatives of US investors.

“The program has been a turning point not only for my startup, but also for me as a person,” said participant Haneen Alnajjar, CEO and founder of Sicilena Jewelry. The program's evaluations on pitches informed her perspective on the elements that investors value, Alnajjar said, and she immediately implemented techniques from the design thinking and customer development courses in her startup's operations.

ADVANCING SCIENTIFIC COOPERATION WITH GLOBAL PARTNERS



A new agreement with the Uzbekistan government underscores KAUST's role in global scientific cooperation

KAUST's ambitions to become an elite global university for science and technology have led to initiatives aimed at forging international partnerships with universities and other organisations, as well as being open to cooperation with the widest possible range of stakeholders. Such collaboration is a key part of the university's role in helping Saudi Arabia meet its Vision 2030 goals of developing an innovative society.

The university took one of many steps toward that objective in August 2022, when it hosted a ministerial delegation from Uzbekistan's Ministry of Innovative Development (MoID), including Minister of Innovative Development Ibrokhim Abdurakhmonov, which culminated in the signing of a Memorandum of Cooperation (MoC) with the ministry. The visit was a part of the President of Uzbekistan Shavkat Mirziyoyev's visit to Saudi Arabia, hosted by His Royal Highness Crown Prince Mohammed bin Salman Al Saud.

The MoC establishes a mutual recognition of the value of leveraging the two parties' scientific, technological and innovative strengths, given that KAUST is Saudi Arabia's premier institution for scientific and technological education, and Uzbekistan's MoID is responsible for policy development in those same areas for the Central Asian country. One of the main goals of the MoC is to unlock the intellectual and technological potential of both countries.

"Uzbekistan and Saudi Arabia share many common aspirations, particularly in innovating in areas including sustainability, food security, artificial intelligence, computational bioscience and climate change," said KAUST President Tony Chan.

MINISTRY OF INNOVATIVE DEVELOPMENT OF UZBEKISTAN

"The agreement opens the door for our scientists to broad opportunities for joint projects and an exchange of experience."

Ibrokhim Abdurakhmonov, Minister of Innovative Development of Uzbekistan



TONY CHAN
President of KAUST

“ THE MEMORANDUM OF COOPERATION REFLECTS KAUST'S COMMITMENT TO GLOBAL PARTNERSHIP, AND WE JOIN HANDS WITH UZBEKISTAN'S MINISTRY OF INNOVATIVE DEVELOPMENT IN ADDRESSING OUR SHARED CHALLENGES. ”

Possible areas for collaboration cited by the two sides include information sharing, personnel exchange, project support and internship assistance. They agreed to create a joint working group to coordinate activities under the MoC, to be comprised of representatives from relevant organizations in both countries.

Uzbekistan's MoID was formed by presidential decree in November 2017 and charged with accelerating the innovation-driven growth of all sectors of the country's economy and social sphere; acting as a coordinator with public offices, scientific institutions and other relevant organizations; and creating proposals to boost innovation within government bodies. Specific sectors of interest include developing systems and approaches to healthcare, education, environmental protection and management, and agriculture.

Minister Abdurakhmonov received a master's degree in plant breeding from Texas A&M University in College Station, Texas, as well as a PhD in molecular genetics from the Academy of Sciences of Uzbekistan. He is the founder and director of the Center of Genomics and Bioinformatics of Uzbekistan, and his international recognitions and awards include a fellowship in The World Academy of Sciences in 2014 and an appointment as an Ambassador of Silk Road Friendship by the China International Cultural Exchange Center in 2022.



PROMOTING SUSTAINABILITY THROUGH SCIENCE DOCUMENTARIES

National Geographic series spotlights KAUST as a global scientific research hub

KAUST is featured in a news documentary television series by National Geographic, the well-known multimedia science publisher based in Washington, DC. Chasing Answers aired weekly during primetime hours through the month of June 2022. The series explores the university's ambitions and accomplishments, in recognition of the institution's emergence as a globally recognized source for high-quality scientific scholarship, education and innovation. Thanks to a robust social media campaign, the successful four-part series reached around 5.9 million people across the region and beyond, with more than 15 million impressions – the number of times the content was displayed, according to National Geographic. Because of this, the international channel saw an 87% increase in terms of average views, and a 100% increase on National Geographic Abu Dhabi, as well as 80,000 unique views on YouTube.



DAVID KEYES
Professor of Applied Mathematics and Computational Science, and Narrator of Chasing Answers

“ OUR RESEARCHERS ENJOYED WORKING WITH THE SEASONED PRODUCERS OF NATIONAL GEOGRAPHIC TO IMPROVE THEIR OWN POPULAR SCIENCE EXPOSITION. NATGEO IS HIGHLY PROTECTIVE OF THEIR GLOBALLY RESPECTED BRAND, MAKING IT AN HONOR THAT OUR RESEARCH IS DISTRIBUTED UNDER THEIR LABEL. ”

NATIONAL GEOGRAPHIC

"An elite group of scientists from around the globe look for answers to the world's most urgent demands. In this science and technology-focused series, scientists tackle energy solutions and climate change."

The first episode, Powering The Future, featured professors Derya Baran, Mani Sarathy and Mohamed Eddaoudi. National Geographic's film crew shadowed faculty members and their teams as they focus on climate change and energy solutions for a sustainable future.

The second episode, Red Sea Explored, centered on the Red Sea, and featured various KAUST faculty members who study this body of water. Professor Manuel Aranda highlighted his work on coral spawning, and Professor Boon Ooi discussed his efforts to create an underwater Internet solution faster than WiFi.

The third episode, The 10 Billion Challenge, focused on world hunger, in anticipation of a global population reaching that threshold. The challenge goes beyond growing more food, emphasizing the need for innovative tools and processes that enable sustainable development. The episode highlighted RedSea, a global agritech business and KAUST startup founded by Professor Mark Tester and Ryan Lefers, now CEO, that aims to reduce agriculture's water footprint. The series also featured Professor Peiyong Hong's work on wastewater reuse.

The final episode, We Are Doers, addressed the substantial pressure scientists feel to deliver solutions, and the passion they bring to the challenge. The series returned to the Red Sea, highlighting Professor Zhiping Lai's work on mining lithium from seawater. It then spotlighted Professor Xiaohang Li's quest to solve the global chip shortage. Finally, attention turned to Professor Jürgen Schmidhuber and his role as the director of KAUST's Artificial Intelligence Initiative.

EXPANDING PRECISION AND PERSONALIZED MEDICINE IN THE KINGDOM



PIERRE MAGISTRETTI

*KAUST Vice President for Research and
Director of the KAUST Smart-Health Initiative*

“**TRANSLATIONAL HEALTH RESEARCH PROGRAMS ARE FUNDAMENTAL TO PROVIDING AND ATTRACTING TECHNOLOGY PLATFORMS, HUMAN CAPITAL, TRAINING PROGRAMS AND A CLINICAL TRIAL COORDINATION CENTER, AS WELL AS THE NETWORK OF STAKEHOLDERS — ACADEMIA, HOSPITALS, INDUSTRY AND STARTUPS — NEEDED TO ADDRESS THE CURRENT GAPS IN CLINICAL CARE AND BIOMEDICAL R&D.**



KAUST's Smart-Health Initiative is delivering novel healthcare approaches for the Kingdom

The KAUST Smart-Health Initiative (KSHI) is bridging the gap between advanced research conducted at KAUST and clinical care delivered in the Kingdom's hospitals. Launched in 2021, the Initiative is expanding and moving toward its goal of fostering knowledge and technology development that can improve public health and safety infrastructure, as well as patient outcomes.

In November 2022, KSHI held its annual two-day forum under the title, Impacting the Future of Healthcare in the Kingdom of Saudi Arabia. Professors affiliated with the initiative came together with local and international partners to showcase current research projects and exchange ideas on novel healthcare strategies relevant to the Kingdom and broader MENA region.

Central to this event was the presentation of several research projects involving collaborations between KAUST and in-Kingdom partners in the scientific community, including King Faisal Specialist Hospital & Research Center, King Abdullah International Medical Research Center, Alfaisal University and King Abdulaziz City for Science and Technology.

A poster session led by KAUST students and faculty presented more than 40 research projects that are underway in KAUST laboratories involving an array of technologies and applications, from devices that enable biomarker detection, to sensors used to diagnose cardiovascular disease, to 3D visualization of data, to genome sequencing and metagenomics for the analysis of patient data.



MINISTRY OF INVESTMENT

"KAUST has not only been able to cultivate deep and meaningful partnerships with the Kingdom's healthcare and biotechnology ecosystem, but has also been remarkably efficient at building robust ties with international industry leaders."

*Sara F. Althari, Biotech and Pharma Managing Director and
Advisor to the Minister of Investment*

Since its inception, KSHI has been working as a gateway to create effective collaborations with researchers in academic institutions, physicians in healthcare institutions and the medical biotechnology industry. This hub provides an environment for innovative ideas that may solve long-standing problems in the healthcare delivery system using the vast advancement of "omics" technologies to better understand diseases as well as patients. Implementation of these concepts after testing and validation will aid in the transformation of the healthcare system in the Kingdom from traditional medicine approaches, to an era of precision and personalized medicine in alignment with Vision 2030 strategic objectives.

The mission of KSHI is to develop and use smart-health technologies and methods to support and promote translational health research programs that transform fundamental scientific discoveries into practical clinical tools and solutions for common diseases.

Several projects involving industry partners are expediting the adoption of research discoveries into clinical practice in areas spanning genetics and metabolic science, digitalization, artificial intelligence and host-pathogen interactions in infectious diseases. Biomedical industry representatives from the Saudi Ministry of Investment, Royal Commission for Riyadh City, Ministry of Industry and Mineral Resources, Merck, Johnson & Johnson and Ginkgo Bioworks participated in the forum.

"It is exciting to see connections between academia, government and industry. These relationships are vital for the realization of KSHI's mission to advance scientific breakthroughs to local impact," said Professor Imed Gallouzi, associate director and chief operations officer of KSHI.

A highlight of the event was the introduction of the first cohort of the first MD-PhD program in the Kingdom, developed between KAUST and Alfaisal University, to train future generations of physician-scientists.

KAUST President Dr. Tony Chan said, "The partnership with one of the top medical education institutions, Alfaisal University, will produce the next generation of leaders who will drive the implementation of smart health and precision medicine in the Kingdom's healthcare delivery system."

Building on the success of its engagement with physicians and biomedical industry leaders to improve disease prevention, diagnosis and treatment, KSHI is planning several programs to advance its mission, including human biobanking for precision medicine, and a center of excellence for human monogenic diseases to help prevent and cure conditions such as thalassemia, a life-threatening, inherited blood disorder prevalent among Saudis.



LEADING THE CONVERSATION AMONG INDUSTRY STAKEHOLDERS

KAUST leads discussions on the future of education and hydrogen energy at the Future Investment Initiative

In October 2022, KAUST participated in a range of thought leadership events at the sixth edition of the Future Investment Initiative (FII) conference held in Riyadh. The theme of this year's conference was "Investing in Humanity: Enabling a New Global Order." KAUST representatives participated in lectures, seminars and panel discussions focused on the future of education and clean energy technologies.

The FII is one of Saudi Arabia's most important annual gatherings, bringing together well-known institutions and thought leaders from around the world, including CEOs, policymakers, investors and entrepreneurs. Launched by the Public Investment Fund – Saudi Arabia's sovereign wealth fund – FII provides leadership on the future of global investment in key areas that aim to improve the way people live and work. It does this through featured conversations with global leaders, executive roundtables, panel discussions and networking events.

As a Knowledge Partner of the FII, KAUST introduces conference participants and global investors to sustainable technology innovations from its leading

FII INSTITUTE

"Our partners come from a range of different industries and countries, helping us to shape a vision that is all-encompassing and inclusive."

Richard Attias, CEO, FII Institute



TONY CHAN
President of KAUST

“OUR MISSION IS TO PUT RESEARCH TO USE. THROUGH OUR COLLABORATIONS WITH INDUSTRY, GOVERNMENT AND STARTUPS, WE ARE GROWING A DEEP-TECH ECOSYSTEM IN SAUDI ARABIA AND PROVIDING A SUSTAINABLE FUTURE FOR ALL.”

experts that offer demonstrable solutions for strategic sectors of humanity. The KAUST pavilion showcased this research alongside university startups that are focused on issues of national and intelligence impact such as smart health care, artificial intelligence, food and water security, marine conservation and climate change, among others.

During the conference, KAUST President Tony Chan and KAUST PhD candidate Eman Alhajji led a conversation on the future of education. President Chan described how the education system needs to adapt rapidly to identify potential solutions that meet the needs of modern-day society. Alhajji stressed the importance of education as a bridge between decision-makers and the socially active youth of today. President Chan also moderated a panel on the role of capital in education and job creation.

Associate Director of KAUST's Clean Combustion Research Center Mani Sarathy chaired a panel on the emergence of hydrogen energy. KAUST is advancing efforts to develop hydrogen as a clean energy source as part of efforts to facilitate the transition to net-zero emissions. In late October 2022, the university hosted a four-day conference of delegates from academia, government laboratories and industry to explore the feasibility and value of hydrogen energy and ammonia.



8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

JOINING AI INNOVATORS FROM AROUND THE WORLD



JÜRGEN SCHMIDHUBER
Director, KAUST AI Initiative

KAUST showcases its tech initiatives as a catalyst for national goals at the 2022 Global AI Summit

The increasing use of artificial intelligence (AI) in everyday life has raised a number of important issues. These include the role of technology in driving social progress, the ability of machine learning to help fight climate change, and how to ensure the ethical application of AI. These questions and others were the focus of the Global AI Summit.

KAUST leaders featured at the event showcased the university's pioneering AI initiatives. Professor Jürgen Schmidhuber, informally known as the father of modern AI and the director of the KAUST AI Initiative, addressed the conference at its opening, detailing how AI innovations have made the world safer, healthier and easier for people. KAUST President Tony Chan addressed the untapped synergies between AI and science frontiers.

A panel led by KAUST Provost Lawrence Carin, a researcher of AI and professor of electrical engineering, and Deputy Director of the KAUST AI Initiative Bernard Ghanem, also professor of computer science, discussed KAUST's role in the development of domestic AI talent. Panelists included Vice President for Talent Development at the National Center for AI Abdulrahman Habib.

Other leaders at the event included CEO of Saudi Aramco Amin Nasser; Chief Medical Scientist at Microsoft Research Junaid Bajwa; and Sebastian Thrun, CEO of the Silicon Valley-based air-taxi startup Kitty Hawk. KAUST has ensured that AI extends beyond thought leaders and other experts in the field. Programs to boost AI skills and talent across the country include KAUST Academy, which aims to prepare the growing Saudi workforce to thrive in the fast-moving, tech-driven workplace through a series of training sessions and classes open to citizens on topics such as cybersecurity, bioinformatics, materials science, applied and computational mathematics, business analysis, the internet of things and robotics. The courses address specific goals in the country's Vision 2030 plan, and can be custom designed

“OUR AI INITIATIVE IS HELPING TO MAKE HUMAN LIVES LONGER, HEALTHIER AND EASIER. OUR DEEP-LEARNING TECHNOLOGY WAS THE FIRST TO WIN A MEDICAL IMAGING CONTEST FOR CANCER DETECTION, AND OUR NEURAL NETWORKS ARE BEING USED IN THOUSANDS OF OTHER HEALTH-RELATED APPLICATIONS.”

for KAUST partners, such as the course AI for Chemists, designed to help young Saudis acquire skills needed at Aramco.

During the summit KAUST and SDAIA announced a new partnership that will see the formation of the SDAIA-KAUST Center of Excellence in Data Science and AI. The center will focus on educational development and upskilling the new generation in AI to offer innovative solutions in a data-driven world. Alongside Saudi Aramco and SDAIA, KAUST Academy partners also include the Saudi National Cybersecurity Authority, Saudi Industrial Development Fund, King Faisal Specialist Hospital, Saudi Basic Industries Corporation and Saudi government ministries, among others.

NATIONAL CENTER FOR ARTIFICIAL INTELLIGENCE

"The SDAIA-KAUST Center of Excellence will be the hub for innovative solutions and talent development by leveraging artificial intelligence to position the Kingdom as a leader in the new data-driven era."

Majed Altwaijri, CEO, National Center for Artificial Intelligence



SPARKING CHANGE FOR SUSTAINABILITY

KAUST students and other young leaders work together at next-generation summit, Camp 2030, to address global issues



NAJAH ASHRY

Vice President for Strategic National Advancement

“KAUST IS THRILLED THAT OUR STUDENTS WERE CHOSEN TO JOIN 250 OF THE WORLD'S MOST BRILLIANT YOUNG PEOPLE. WE ARE PROUD THAT THEY COULD FURTHER THEIR CAREER INTERESTS AND BRING THE BEST PRACTICES BACK TO THE KINGDOM.”

In September 2022, a group of KAUST students traveled to the United States to join 250 young leaders for Camp 2030, a six-day innovation laboratory in New York oriented around the UN's Sustainable Development Goals (SDGs). This inaugural summit was organized to inspire solutions to some of the most critical global issues, while encouraging participants to establish deeper connections with their peers from other countries.

Set in and around the state of New York, Camp 2030 was run by UNITE 2030, a US-based non-profit organization that helps young people work towards achieving the SDGs. The camp took place during the 2022 edition of Global Goals Week, a UN initiative that includes an annual week of action, awareness and accountability oriented around the SDGs.

Eight students from KAUST participated in the event: Sarah AlHarbi, Afnan AlBatati, Rund Tawfiq, Indah Putri, Omar Abed, Natalia Odnoletkova, Michael Oyinyole and Eman AlHajji.

Ranging in age from 18 to 30, the students worked in teams of five to develop innovative solutions to the world's most pressing challenges within the framework of the UN's SDGs, covering critical topics such as poverty, health and well-being, education, gender equality, clean water and sanitation, and climate action.

The event took place in Adirondack Park in Upstate New York. On the sixth day, the campers returned to New York City for the first day of the UN's Global Goals Week, where they pitched their solutions to a panel before concluding the camp with a closing ceremony.

KAUST's eight representatives demonstrated their passion for pioneering sustainable ideas during the week, focusing on a number of critical challenges such as gender equality (SDG 5), good health and well-being (SDG 3), and decent work and economic growth (SDG 8).

The camp provided younger generations with an important platform to showcase their ingenuity and forge relationships that could prove fruitful in the decades to come, as students like those from KAUST will be responsible for the achievement of the UN's SDGs and other sustainability initiatives.

Sending representatives to events that aid in the development of future leaders like Camp 2030 is in line with the university's vision of being a global model for resource circularity, and nurturing the people and solutions that are playing a role in solving the most critical issues facing our planet.

UNITE 2030

“Our team loved having students from KAUST at Camp 2030! Not only did they bring their own culture to the camp, but they also conveyed so much passion and energy in bringing their ideas to the table.”

Alyssa Chasman, Founder, UNITE 2030



PROMOTING SCIENCE ACROSS THE COUNTRY

KAUST and the Saudi Press Agency are collaborating on a new science-oriented education portal

KAUST has entered into a media partnership with the Saudi Press Agency (SPA) in support of a new online science-oriented education portal that aims to promote the subject to a nationwide audience. In September 2022, the SPA launched a news and education website dedicated to scientific research studies and news content, and KAUST was selected as the SPA's first partner for the portal.

This follows the signing of a Memorandum of Collaboration between the two parties in August 2022 to enhance and expand scientific communication at the regional and global level. Under the agreement, KAUST is officially the SPA's strategic science partner, while the SPA is officially KAUST's media partner.

The SPA is Saudi Arabia's official news agency, collecting and publishing local and international news in the Kingdom and abroad. The new portal will offer content in both English and Arabic, providing a platform for publicizing scientific content relevant to improving Saudi Arabia's scientific literacy.

As part of the partnership, the SPA's new portal will showcase a range of KAUST's research and science, including the university's innovations; key research initiatives in the areas of energy, water, environment, the digital domain and food; the most recent developments in the circular economy; and partnerships between academia, businesses and entrepreneurs that will impact Saudi Arabia and the rest of the world.

The portal is part of an effort to promote science-oriented news and educational content in support of Vision 2030 by making scientific research a part of Saudi Arabia's transformation into a knowledge-based economy. The portal will act as a window into science in the Kingdom and help the general public stay informed about research advancements taking place, particularly projects being carried out by specialized research centers and universities such as KAUST.

As part of the collaboration, the SPA will help to attract online users to KAUST's various social media channels and improve users' access to KAUST's research. The collaboration will see the two parties hold a regular seminar to bring together members of the media, and the SPA will organize the participation of local and international media professionals in conferences and activities held on the KAUST campus.

SAUDI PRESS AGENCY

“SPA is excited to have KAUST as its first partner for this new portal, especially in light of the scientific role KAUST plays at the local and international levels and its distinguished research.”

Fahd bin Hassan Al Aqran, President, Saudi Press Agency



TONY CHAN

President of KAUST

“PARTNERSHIPS SUCH AS THIS ONE PROVIDE EVEN MORE OPPORTUNITIES AS WE DILIGENTLY WORK TO STRENGTHEN THE KINGDOM'S ACCESS TO THE LATEST DISCOVERIES IN SCIENCE AND SCIENTIFIC RESEARCH.”



PROVIDING EXPERTISE AT GLOBAL AND REGIONAL CLIMATE SUMMITS

KAUST engages with its global peers at the COP27 UN Climate Change Conference and the Saudi Green Initiative Forum to limit the effects of climate change

In November 2022, a team of KAUST representatives took part in a series of events at the COP27 UN Climate Change Conference and the 2022 Saudi Green Initiative (SGI) Forum, both of which were held in Sharm El Sheikh, Egypt, with the SGI Forum running concurrent to COP27.

KAUST faculty, students, staff and leaders took part in panels, meetings, interviews, exhibits and presentations during COP27 and the SGI Forum. Their presence at both events promoted the university's expertise, allowing KAUST to forge new collaborations and demonstrate sustainability at scale.

COP27, the world's largest annual gathering dedicated to climate action, took place in three designated areas across Sharm El Sheikh – the blue, green and climate action innovation zones. Each of the spaces offered different opportunities to network and share sustainable perspectives with people committed to climate action from around the world, including heads of state, industry and indigenous leaders, climate activists and academics. The SGI Forum is an annual event aimed at bringing together stakeholders

to help meet Saudi Arabia's various environmental and sustainability targets. These include the Kingdom's environmental protection, energy transition and sustainability programs, which are guided by the overarching goals of offsetting and reducing emissions, increasing the Kingdom's use of clean energy and addressing issues related to climate change. The November 2022 edition of the SGI Forum was the second following the inaugural event in 2021.

The Middle East Green Initiative (MGI), a Saudi-led regional initiative that accompanies the SGI Forum, also held its second annual summit on November 7, 2022. While COP27 brings the world's governments together to discuss climate change, the MGI pushes for greater regional coordination in the Middle East, which is crucial to meeting global climate targets.

KAUST's presence at both COP27 and the SGI Forum helped to establish new points of potential collaboration in areas such as carbon capture and storage, food security and desert agriculture, water conservation, blue carbon solutions and coral reef restoration.



NEW YORK UNIVERSITY ABU DHABI

"KAUST (...) has phenomenal research centers. Learning, aligning and working collaboratively (...) with KAUST and other regional universities is how we can solve local climate-related challenges."

Antonios Vouloudis, Director of Sustainability and Stewardship, NYU Abu Dhabi



RAQUEL PEIXOTO
Associate Professor of Marine Science

“ **BEING WITH KAUST AT COP27 AND BRINGING THE SCIENTIFIC PERSPECTIVE TO STAKEHOLDERS SUCH AS POLICYMAKERS IS CRUCIAL TO HELPING THEM UNDERSTAND THE URGENCY AND SEVERITY OF THE PROBLEMS THAT CORAL REEFS AND OTHER ECOSYSTEMS ARE FACING.** ”

KAUST subject experts who participated included Professor of Marine Science Michael Berumen, Distinguished Professor of Marine Science Carlos Duarte, Associate Professor of Energy Resources and Petroleum Engineering Hussein Hoteit, Senior Research Advisor Rory Jordan, Associate Professor of Marine Science Raquel Peixoto, Professor of Remote Sensing and Water Security Matthew McCabe, Associate Professor of Environmental Science and Engineering Himanshu Mishra, Professor of Mechanical Engineering William Roberts, Professor of Bioscience Alexandre Rosado, Professor of Plant Science Mark Tester and Professor of Plant Science Rod Wing.

The Blue Zone, COP27's official hub and plenary space, is where KAUST subject experts met with the press, world leaders and peers in one-on-one meetings, panels and presentations. KAUST had three research installations in the Saudi pavilion in the Blue Zone, each of which highlighted the technologies and approaches being used to advance clean energy solutions, supporting the Kingdom's climate action initiatives. The displays featured the use of ammonia as a carrier for hydrogen, 3D metal-organic frameworks to capture and store CO₂ and carbon sequestration using the carbonation of basalts and ultramafic rocks.

Multiple educational booths run by KAUST throughout the event served to inform the public of university-initiated, sustainable developments and engage KAUST with stakeholders. Among COP27's student-led events was the webinar Lessons from the Quran on Climate Change, which was organized by KAUST Students for Sustainability. Chief Environment Officer of NEOM Richard Bush also discussed NEOM and its relationship with KAUST. "We are working with KAUST on our climate modeling and carbon tracking in particular," he said. "This is something that is going to be very important in our mission to decarbonize our development."

KAUST President Tony Chan, faculty and students participated in numerous panels at the SGI Forum. In one discussion, How to Pave a Career Path in Protecting the Planet, Chan outlined career opportunities in the green energy sector and the options available for green professionals in the Middle East.

Duarte participated in more than 20 panels and presentations on behalf of both the university and the Coral Research and Development Accelerator Platform, a G20 initiative for which Duarte serves as the executive director.

CAPTURING CARBON USING CRYOGENIC TECHNOLOGY



KAUST, ENOWA and the Saudi Electricity Company launch a cryogenic carbon-capture pilot project

Cryogenic carbon-capture is an energy-efficient, low-cost process that has the potential to significantly reduce carbon dioxide (CO₂) emissions, and thus the Kingdom's carbon footprint. To help support the development of this technology, KAUST has signed agreements with ENOWA and the Saudi Electricity Company (SEC) to run a pilot project utilizing cryogenic carbon-capture technology that is expected to remove 30 tons of CO₂ per day from the SEC's Green Duba integrated solar combined-cycle power plant at NEOM.

The agreements were signed at an official ceremony overseen by His Royal Highness Minister of Energy Abdulaziz bin Salman al Saud during the second annual Saudi Green Initiative Forum in November 2022 at Sharm El Sheikh, Egypt, alongside the COP27 UN Climate Change Conference. The agreement marks the culmination of years of research and development that will now be put into practice. The new project underscores Saudi Arabia's commitment to fulfill its climate action targets, such as reaching net zero by 2060.

Once the carbon is captured at the pilot plant, it is transported as pure liquid CO₂ at room temperature, the majority of which is then used in the production of e-fuels for internal combustion engines to replace their fossil alternatives. The project's technology positions the facility as an example of environmental sustainability for others both in the region and around the

ENOWA

"We are delighted to be partnering with KAUST, as we both strive to advance science and technology through bold and collaborative research and education."

Peter Terium, CEO, ENOWA



WILLIAM ROBERTS
Director, Clean Combustion Research Center

" THIS PROJECT IS DUE TO THE COLLABORATION BETWEEN KAUST, SUSTAINABLE ENERGY SOLUTIONS, THE SAUDI ELECTRICITY COMPANY, NEOM, THE SAUDI MINISTRY OF ENERGY AND THE NATIONAL INDUSTRIAL DEVELOPMENT AND LOGISTICS PROGRAM. "

world. The project is receiving funding from KAUST and the National Industrial Development and Logistics Program.

"Together, we can bring fresh thinking and new energy solutions that are essential for the world as it transitions to sustainable energy sources," said Peter Terium, CEO of ENOWA, NEOM's energy, water and hydrogen subsidiary. ENOWA, which launched in March 2022, works to advance renewable energy and decarbonization efforts in the Kingdom.

The carbon-capture pilot project, led by KAUST Professor of Mechanical Engineering and Director of the Clean Combustion Research Center William Roberts, amplifies the call to action echoed at both COP27 and the Saudi Green Initiative forum for further collaboration between the private and public sectors to achieve sustainability goals, in this case between the government, industries and academia.

ACCELERATING SUSTAINABLE DEVELOPMENT THROUGH NATIONAL COLLABORATIONS

The partnership between KAUST and AEON drives sustainability initiatives at home and abroad

In October 2022, KAUST President Tony Chan signed a memorandum of understanding with co-founders Her Highness Princess Noura bint Turki Al-Saud and HH Princess Mashael bint Saud Al-Shalan of AEON Collective, a player in the Saudi sustainability sector, at the collective's headquarters in Riyadh to advance joint sustainability initiatives in the Kingdom and abroad.

AEON Collective is an interdisciplinary, non-profit endowment fund that is focused on promoting sustainability around the world and building the respective capacities through various activities and initiatives. The collective has also played a part in the Kingdom's efforts to achieve its net-zero targets.

The new agreement aligns KAUST and AEON's sustainability goals. Both parties are focused on developing educational sustainability capacities in support of the Vision 2030 framework and the UN's Sustainable Development Goals.

"We plan to build and strengthen collaborative frameworks that translate KAUST's research into strategic knowledge for policy development, youth empowerment and engagement initiatives around sustainability, both nationally and internationally," said Chan.

"Sustainability is not a foreign concept to us Saudis," said Al-Shalan. "Our forefathers lived a life that was sustainable by necessity. Their story is one of a resilient and resourceful community that occupied challenging and seemingly inhospitable lands. It is with that authentic Bedouin spirit that we further cement our collaboration with KAUST, leveraging advanced technical know-how and diverse global expertise to reclaim our homegrown path to sustainable and equitable development and drive the active pursuit of repairing our planet."

"We are steadfastly committed to advancing a Saudi narrative for social and economic development rooted in our history and rich culture," said Al-Saud. "Sustainability is inherent to our livelihoods and invaluable to our progress as a nation."



TONY CHAN
President of KAUST

" THIS MEMORANDUM OF UNDERSTANDING IS A TESTAMENT TO THE COMMITMENT THAT BOTH KAUST AND AEON COLLECTIVE HAVE MADE TO ADVANCE EDUCATION, AWARENESS AND RESEARCH ON SUSTAINABLE DEVELOPMENT. "

Areas of potential collaboration between the parties include joint research initiatives on emerging topics of sustainability in areas such as climate action, livability and health; food, water and energy security; ecosystem restoration and carbon management; and the strengthening of strategic engagement with key stakeholders to advance sustainability, including youth engagement. Other areas of potential development include policy advocacy and converting research into sustainable practices.

As a first step in this collaboration, KAUST Professors Carlos Duarte and Raquel Peixoto will be appointed members of AEON Collective, with which they plan to work on planetary repair, ecosystem restoration and resiliency.

AEON COLLECTIVE

"We are delighted to formalize our long-established engagement with KAUST, which will allow us to strengthen our action-oriented partnership and achieve long-lasting, positive impacts on the planet and societies around the globe."

HH Princess Noura bint Turki Al-Saud, Co-Founder, AEON Collective



INTERNATIONAL ASSOCIATION OF ADVANCED MATERIALS

"The upcycling of polymer waste and the exploitation of renewable resources for the fabrication of advanced separation materials are highly sought-after and pave the way towards a greener economy."

Ashutosh Tiwari, Director, International Association of Advanced Materials

pure polymer beads and membranes for use in separating petrochemicals, pharmaceuticals and other compounds. The oil refining industry in Saudi Arabia is a high-value example of where the technology could be useful.

"Sustainability is the main driver helping Saudi Aramco meet its carbon circularity and net-zero goals," said Sustainability Lead at Saudi Aramco Dr. Ameerah Bokhari. "We expect that [Szekely's] pioneering research will create environmentally benign ways to address our separation and upcycling challenges, and therefore directly contribute to the Saudi Green Initiative and Vision 2030."

Joyce Cavalcante, PhD student, estimates that this upcycling process could generate a profit of \$28.35 million from the sale of membranes, save \$441,000 on waste management, and eliminate about 560 tons of carbon emissions, the equivalent of planting 20,000 trees. Szekely's work won the Sustainability Award from the International Association of Advanced Materials (IAAM) during its Advanced Materials World Congress in October 2022. "The IAAM strives to utilize the sector of advanced materials to find solutions to the world's pressing issues," said IAAM Director Ashutosh Tiwari. "Professor Szekely has been honored with the IAAM Sustainability Award 2022 in recognition of his contribution to the development of greener polymer membranes."

CONVERTING FACE MASKS INTO NEW MATERIALS

KAUST professor develops sustainable method for separating and reusing valuable chemicals

Among the numerous challenges that public health systems faced during the COVID-19 pandemic was the significant amount of waste caused by discarded face masks. In 2021, 129 billion face masks were thrown away worldwide, creating a new source of environmental contamination. Through innovative chemical engineering processes, KAUST Assistant Professor of Chemical Engineering Gyorgy Szekely found a new way to reuse materials in face masks by using a method that has the potential to benefit a number of sectors through wider use.

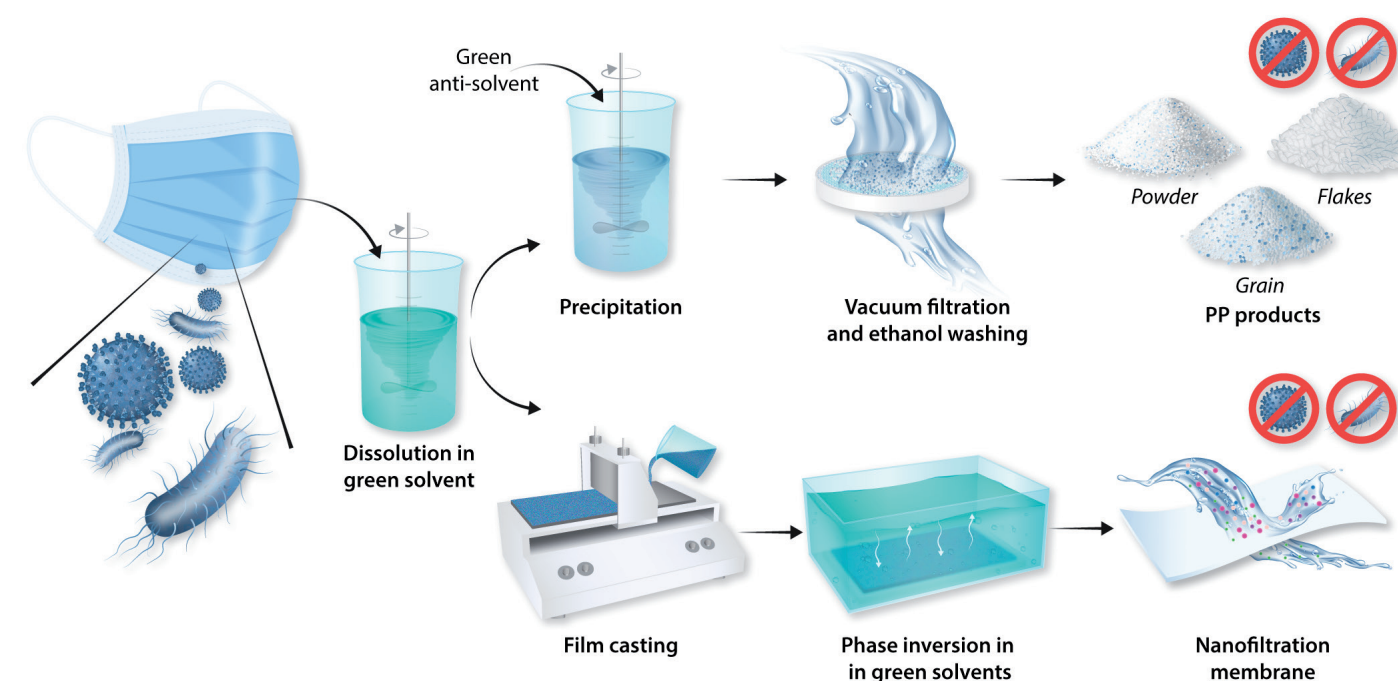
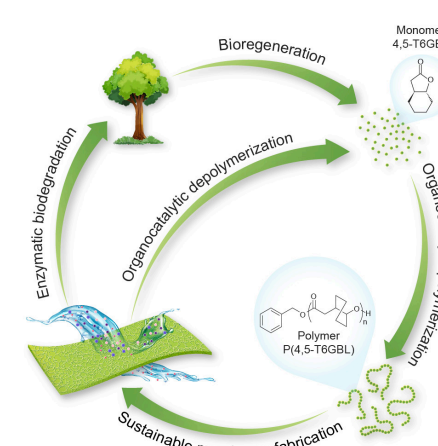
Szekely's research focused on finding ways to separate chemicals to make pure versions of the compounds by combining materials science and chemical engineering. The sustainable production of chemicals, pharmaceuticals and clean water is largely affected by the efficiency of separation processes in product supply chains, as conventional separation processes can account for as much as 80% of manufacturing costs and around 10% of global energy consumption. Szekely's team studied the potential of advanced membrane and imprinted materials when it comes to the efficient purification and sustainable processing of fine chemicals and water.

Chemicals are typically separated through heating, but these industrial processes are energy-intensive and result in significant carbon emissions. Replacing them by utilizing more sustainable solutions, such as porous membranes, could play a major role in reducing emissions and advancing sustainable practices. By realizing that discarded face masks have useful plastics in them, Szekely designed a process to convert them into



GYORGY SZEKELY
Assistant Professor of
Chemical Engineering

THIS SUSTAINABLE METHOD CAN BENEFIT SEVERAL INDUSTRIES – INCLUDING PHARMACEUTICALS, PAINT, AND FOOD AND BEVERAGE – IN RECOVERING SOLVENTS, AND SEPARATING PETROCHEMICALS AND HIGH-VALUE COMPOUNDS.





CREATING A ZERO-WASTE CAMPUS

KAUST, in collaboration with Averda, plans to be the Kingdom's first zero-waste institution

In November 2022, KAUST signed an agreement with the waste management and recycling company Averda to make its campus Saudi Arabia's first zero-waste facility. The project is set to be completed in 2025, and it will be an example for other institutions looking to implement sustainability practices.

Averda is an end-to-end waste management and recycling company that operates in emerging markets. The new agreement will provide sustainable waste-management solutions for the university, with Averda handling all aspects of solid and hazardous waste management, including recycling, sorting, waste transfer and disposal. Averda has worked with KAUST since 2015 to design and deliver an integrated waste-management service for its campus facilities and residential neighborhoods.

Averda's 10-year contract with KAUST will support the university's zero-waste-to-landfill target by recycling and recovering 100% of unavoidable municipal waste by-products in a one-stop, integrated materials recovery facility. It will also streamline processes for collecting, sorting and bundling waste. An all-electric fleet of Averda waste-collection vehicles that previously ran on diesel is also part of the agreement. In addition to energy savings, the use of electric vehicles will eliminate emissions, minimize noise and reduce maintenance costs, among other benefits.

Averda's specialized waste-collection services on the KAUST campus and in five residential areas will ensure the appropriate collection and handling of each type of waste. Recyclable materials will be sorted and sold to the market, while organic material will be composted by KAUST's respective

AVERDA

"We are delighted to help KAUST on the next stage of its sustainability journey as the university commits to reduce emissions and achieve zero waste to landfill."

Mazen Chebaklo, Chief Growth Officer, Averda



MATTHEW EARLY

Vice President of Facilities Management

“ THIS ENDEAVOR WILL ALLOW KAUST TO MEET ITS GOAL OF ZERO WASTE BY 2025 AND ELEVATE THE KINGDOM'S QUEST FOR ENVIRONMENTAL SUSTAINABILITY BY PRESERVING THE ENVIRONMENT AND CONTRIBUTING TO IMPROVING QUALITY OF LIFE. ”

facility. The more than 7,000 KAUST residents will play an important role in separating recyclables at the source. To this end, KAUST and Averda are developing an environmental awareness campaign for residents to ensure their total participation in the zero-waste effort.

The use of IT tools to record, monitor, analyze and report waste-management data will be a vital part of the program, ensuring that KAUST meets its sustainability goals. Technological provisions will be made to collect data at every level of the process, including bin management, a dynamic weighing system, fleet tracking and management. A sustainability plan for operations will track and measure their progress against targets to minimize emissions and keep KAUST informed of the environmental footprint of Averda's activities and services, both on and off campus.



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



ASSISTING THE G20'S EFFORTS TO RESTORE CORAL REEFS



14 LIFE BELOW WATER



The Coral Research and Development Accelerator Platform strengthens its global partnerships and research programs



CARLOS DUARTE

Distinguished Professor of Marine Science

“ A FUTURE OCEAN DEPLETED OF HEALTHY CORAL REEFS IS NOT ONE WE SHALL ACCEPT. WE MUST ACCELERATE THE NEXT GENERATION OF BEST SCIENCE AND TECHNOLOGY TO CONSERVE AND RESTORE CORAL REEFS. ”

With KAUST's support, the Coral Research and Development Accelerator Platform (CORDAP), a G20 initiative launched in 2020, has seen a year of expansion, with new partnerships and opportunities for research grants.

CORDAP aims to protect and restore coral reefs in an increasingly warming world. The initiative works to fast-track research and development (R&D) solutions that can save coral reefs, as well as invest in novel early-phase ideas through to their final proof-of-concept development and testing stages.

The Saudi government and KAUST are playing a central role in supporting CORDAP by deploying their coral resources and expertise in the field. KAUST serves as the central node of CORDAP, supporting its operations and covering its administrative costs as an in-kind contribution from the Kingdom, meaning that all of the international funding that CORDAP receives goes directly to R&D, as well as other projects. KAUST Distinguished Professor of Marine Science Carlos Duarte also serves as CORDAP's Executive Director.

During the 2022 UN Ocean Conference in Lisbon, Portugal, in June of that year, CORDAP announced an institutional partnership with the UN's Global Fund for Coral Reefs (GFCR) to advance and scale up research and the development and restoration of coral reefs across the planet. UN Special Envoy for the Ocean Peter Thomson said he was inspired by the solutions proposed during the event by participants. "It was said that coral reefs are the rainforests of the ocean, and just as we are planting trees to build up forests' capability to sequester carbon, we should be doing the same in the ocean by planting corals," said Thomson.

In August 2022, CORDAP co-organized a two-day G20 workshop with the GFCR in partnership with the Indonesia Coral Reef Garden called No Coral Reef Left Behind, during which participants delivered actionable policy recommendations on the conservation of coral reefs to G20 environment deputy ministers.

CORDAP's research grant program, the Coral Accelerator Program 2022, plans to give out \$18m to multinational collaborative teams for ideas that lead to significant discoveries, innovations and improvements in coral conservation and restoration. The ideas will be open-source to allow anyone to use the developed technologies.

In November 2022, CORDAP participated in the Blue Zone of the COP27 UN Climate Change Conference, and it plans to attend the next meeting of the annual UN Biodiversity Summit scheduled for December 2022.

GLOBAL FUND FOR CORAL REEFS

"The Global Fund for Coral Reefs is excited to partner with the Coral Research and Development Accelerator Platform to identify, implement and scale up approaches for coral reef conservation and restoration."

Chuck Cooper, Chair of the Executive Board, Global Fund for Coral Reefs



CARLOS DUARTE

Distinguished Professor of Marine Science

“ TIGER SHARKS SPEND ABOUT 72% OF THEIR TIME PATROLLING SEAGRASS BEDS, WHICH WE WERE ABLE TO OBSERVE FOR THE FIRST TIME WITH THE 360-DEGREE CAMERAS WE DEPLOYED ON THE SHARKS. ”

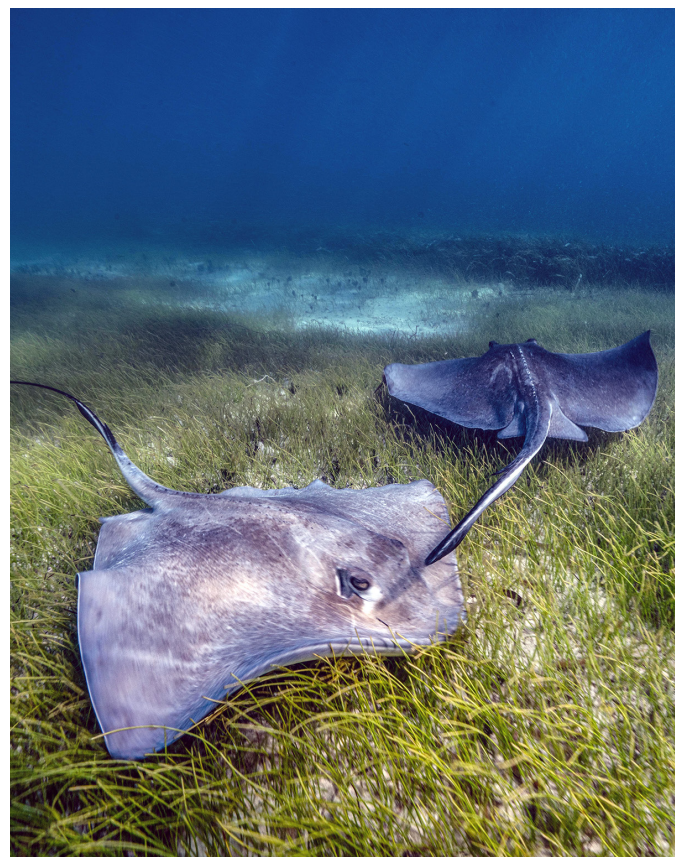
USING TIGER SHARKS TO MAP OCEAN ECOSYSTEMS

KAUST professor helps discover the world's largest seagrass meadow

Oceans are crucial to Earth's ecosystems as a source of food, transportation and oxygen. Scientists are helping the world understand oceans' importance in climate regulation – how they store carbon dioxide and transport heat from equatorial regions to the poles, creating a source of stability in weather patterns. But understanding how and why oceans and their specific ecosystems work is more difficult than understanding their overall value. Challenges include the difficulty of accessing remote depths and the limitations of satellite imagery, which often lacks the clarity required for detailed scientific insight.

KAUST Professor Carlos Duarte, a global leader in seagrass ecology, reported a breakthrough in November 2022. Working with Beneath the Waves, a US-based, non-governmental organization devoted to ocean research, the team was able to discover the world's largest seagrass ecosystem near the Bahamas, an archipelago country north of Cuba in the Atlantic Ocean. The meadow has an area of at least 66,000 square kilometers, according to findings published by the team, and perhaps up to 92,000 square kilometers. It may be as much as double the size of another seagrass system off the coast of Australia that was previously considered the world's largest.

Duarte knew that the seagrass ecosystem in the area was large, but measuring it had been difficult in the past. "We thought that the Bahamas likely had an extensive seagrass ecosystem, but the true spatial estimate had never been properly quantified because surveying this vast area remains challenging," he said. However, his extensive network of global contacts in the oceanography community provided a fortuitous opportunity. Dr. Austin Gallagher, lead scientist and CEO of Beneath the Waves, showed Duarte



THE BAHAMAS

"The innovative work (...) to map our country's vast seagrass meadows, represents extraordinary scientific progress, and will make a very significant contribution to our national development and security."

Philip "Brave" Davis, Prime Minister of the Bahamas

data from an experiment that positioned cameras on the dorsal fins of tiger sharks. The group had been studying the species of sharks because of concerns about the viability of their population. They are not only the largest marine predator in tropical seas, but also a protected species. They are especially important since the loss of an apex predator could produce destabilizing ripple effects throughout an entire ecosystem.

Although there could be multiple consequences, the scientists were focused on one in particular: the release of massive amounts of carbon, which seagrasses trap and store in their sediment. Indeed, seagrass captures carbon 35 times faster than tropical rainforests. Tiger sharks help seagrass by eating the animals that eat the grass, therefore preventing overgrazing. Those animals include sea turtles, dugongs and manatees. The seagrass meadow Duarte and his team discovered likely holds at least a quarter of all carbon trapped by seagrass.

"Rapid seagrass losses over previous decades have reduced the sequestering capacity of seagrass ecosystems, while also releasing large amounts of carbon to the atmosphere," Duarte, Gallagher and the rest of the team wrote in their paper on the topic, published in November 2022 in the journal *Nature Communications*. "The conservation of seagrass ecosystems is of critical global importance to manage greenhouse gas emissions, while safeguarding the many threatened species and seafood resources supported by seagrass habitat."

Gallagher's data and videos demonstrated how the sharks swim over large and dense seagrass meadows. They spend most of their time near the seagrass, swimming about 70 kilometers a day. Duarte and his team had this in mind when they hypothesized that they could use sharks to map the ecosystem. While it is possible for humans to dive to the ocean floor and measure the area themselves, such efforts would take a considerable amount of time. As sharks can swim much faster, the team suspected that the tracking data from devices attached to the sharks would aid their measurements. With front-facing cameras attached to six sharks and a seventh able to rotate 360 degrees, as well as another eight sharks with satellite tags, the scientists were able to track the sharks on their journey.



DISCOVERING MARINE LIFE IN THE RED SEA

JOURNAL OF FISH BIOLOGY

"There are potentially many additional undescribed species in the Red Sea remaining to be discovered. The [new] discovery [...] underscores the need for immediate conservation actions."

Lucia Pombo-Ayora et al

A fish caught from the sea is identified as a new species of sea bream

The Red Sea is a major area of focus for KAUST scholarship, especially as it is a body of water that is relatively understudied. Supporting these efforts, the KAUST Coastal and Marine Resources (CMR) Core Lab and the KAUST Red Sea Research Center (RSRC) are focused on learning more about the sea.

Scientific discoveries are not always planned – sometimes progress comes through fortuitous surprises. Such was the case earlier this year when a new species of fish was discovered by KAUST's former Vice President of Research (2019 to 2022) and current Senior Advisor for Education, Research and Innovation at NEOM Donal Bradley. As an avid fisherman, Bradley was familiar with the three species of sea bream found in the Red Sea. However, in 2021, he caught a fish that looked like a bream but had different marking and colors on its forehead, fins and body. He was not able to find record of such a fish in guidebooks or on the Internet.

Bradley approached RSRC's Marine Science Director Mike Berumen to find out if he had identified a new species. Bradley gave Berumen a clipping of the fish's fin for comparison, and Berumen's team completed a genetic analysis and additional studies. To facilitate more extensive testing, Bradley returned to the Red Sea to try to catch more of the fish. With the help of Vice President of the KAUST Fishing Club and doctoral student Colin Williams, he eventually caught another specimen. Aiding these efforts, RSRC staff were enlisted to place a tidal trap on KAUST North Beach to catch more.

With the new samples tested in the lab, Berumen's team confirmed that the fish was indeed a new species. Its closest relative was not any of the other three bream species native to the Red Sea, but instead a version called the wandering sea bream, which is traditionally found along the Indian Ocean coastline in close proximity to South Africa and Mozambique.

Following the traditions of scientific nomenclature, Bradley was granted naming rights for the new species he discovered. The fish's formal name, *Acanthopagrus oconnorae*, is a nod to his mother's maiden name, O'Connor, while the fish's common name, Bev Bradley's bream, is named after his wife, Bev. Bradley and Berumen's team published their results in the *Journal of Fish Biology* in June 2022.

Looking to the future, the potential for discovering new species of fish and other marine life is high given the Red Sea's status as a biodiversity hotspot, as well as the fact that it remains a relatively understudied body of water. The discovery also underscores the need to focus on conservation efforts as the Kingdom continues to develop new coastal resorts to ensure that ecosystems can support and maintain their diversity.



MICHAEL BERUMEN
Director, the KAUST Red Sea
Research Center

“THE RED SEA IS A CONSTANT SOURCE OF DISCOVERY, INSPIRATION AND SURPRISE. THE BIODIVERSITY OF THE RED SEA IS ONE OF THE KINGDOM'S MOST VALUABLE NATURAL RESOURCES.”



DEPLOYING AUTONOMOUS UNDERWATER VEHICLES

KAUST announces partnership with underwater vehicle manufacturer Ocean Aero

KAUST's quest to expand the country's understanding of the Red Sea is a challenge, especially as the body of water brings extreme temperature conditions and unique biological and geophysical features. One way to address these challenges is through the use of ocean-going autonomous underwater and surface vehicles (AUSVs), seacraft that have the ability to sail on the water or sink below the surface in order to provide long-range ocean observation and data collection.

KAUST will deploy a fleet of specialized AUSVs for this purpose thanks to a new partnership with Ocean Aero, a marine craft company based in Gulfport, Mississippi, and Shelf Subsea, a marine industry service provider based in Perth, Australia. Shelf Subsea will handle training and offer general expertise in maritime operations to ensure the proper launch, recovery and maintenance of the university's AUSV fleet.

Ocean Aero's Triton Generation III AUSV has the ability to explore for period of times without human intervention or assistance. Equipped with solar panels and batteries, the vehicles can spend months unattended at sea. It is shaped like a small submarine, with a long, sleek 14-foot body covered in solar panels. It also has a tall wing mounted near the midpoint of its top surface that looks like the mast of a sailboat, only flatter and shorter. The wing can pivot and nest horizontally atop the vessel as well.

The Triton can move autonomously for three months and at speeds of five nautical miles per hour in autonomous sailing mode using solar and wind power. In submarine mode, it can remain submerged at up to 100 meters for five days and travel at two nautical miles per hour. It is the first and only vehicle of its kind with these capabilities. The on-board communications packages include iridium, WiFi and radio mesh networks.

For KAUST's Red Sea Research Center, the AUSV will collect new data to help faculty understand the special features of the Red Sea, including its unusual currents and biodiverse habitats and species. For the KAUST Coastal and Marine Resources Core Lab, the collaboration with Ocean Aero and Shelf Subsea will improve staff scientists' understanding of robotics design and operation, which is especially important as they seek to build their own autonomous underwater vehicles. The KAUST Computer, Electrical and Mathematical Science and Engineering Division will also play a central role in these efforts, developing features to integrate artificial intelligence and internet of things into the vehicles and their sensors.

OCEAN AERO

"We could not be happier to work alongside the oceanographers, researchers and marine scientists at KAUST."

Kevin Decker, CEO, Ocean Aero



DANIEL ACEVEDO-FELIZ
Director, KAUST Core Labs

“WE ARE EXCITED TO HAVE OCEAN AERO AS PARTNERS, AS NOT ONLY THEIR VEHICLES BUT ALSO THEIR SHARED EXPERTISE WILL SIGNIFICANTLY ADVANCE KAUST'S RED SEA RESEARCH.”



TOM MOORE

Director, KAUST Reefscape Restoration
Initiative at Shushah Island

“ THIS IS AN OPPORTUNITY TO
IMPLEMENT WORLD-CLASS SCIENCE
COMING OUT OF KAUST, WITH
SUPERLATIVE RESOURCES AND THE
MECHANISMS NEEDED TO TAKE
RESTORATION TO SCALE. ”

maritechture approaches to growth and outplanting; innovate project delivery with fresh approaches to robotics and 3D-adaptive manufacturing; and boost resilience with new strategies to improve coral health.

Tom Moore, a veteran environmental policy and coral reef restoration expert, was brought aboard KAUST in 2021 as the director of the KAUST Reefscape Restoration Initiative at Shushah Island to help launch the project. He had previously worked for more than 23 years with the National Oceanic and Atmospheric Administration (NOAA) in the United States. “This project is unprecedented for having full government support, with the investment and willingness to take coral restoration to scale, and a team of experts who can make it happen,” said Moore.

The project launch comes at a time of unprecedented environmental change, especially for corals. Coral reefs are among the planet's most vulnerable ecosystems, impacted by rising ocean temperatures that trigger coral bleaching and mass mortality, acidification, sea level rise, and changing patterns of currents and precipitation. More than two-thirds of the world's coral reefs have been lost due to human activity, and 70-90% of the remaining coral reefs may disappear in the next 10-15, years according to the UN's Intergovernmental Panel on Climate Change.

However, there is a window of possibility for many of the world's tropical coral reefs to recover if conditions permit, and there are numerous reasons to invest in restoration. Corals bring a range of benefits; they directly support the livelihoods of millions of people around the world and are a big draw for tourism. They reduce expected storm damage and lower the impacts of flooding. Corals cover only 0.2% of the ocean floor, yet support approximately 32% of all named marine species. In economic terms, it is estimated that corals bring a total benefit of \$12.7 trillion per year – equivalent to more than 15% of global GDP.

The Reefscape project was launched at the Reef Futures conference in Florida in September 2022 – a global gathering of coral restoration experts. KAUST, NEOM, The Red Sea Development Company, and the Coral Research and Development Accelerator Platform were among the Saudi representatives.

PARTNERING WITH NEOM ON CORAL RESTORATION

The KAUST Reefscape Restoration Initiative at Shushah Island is expected to advance coral regeneration at significant scale

September 2022 saw the official launch of a joint initiative between KAUST and NEOM that will be one of the world's first large-scale coral reef regeneration projects. Titled the KAUST Reefscape Restoration Initiative at Shushah Island, the project will be administered and funded by KAUST and support marine conservation, restoration and enhancement efforts in the coastal areas near NEOM in northwest Saudi Arabia.

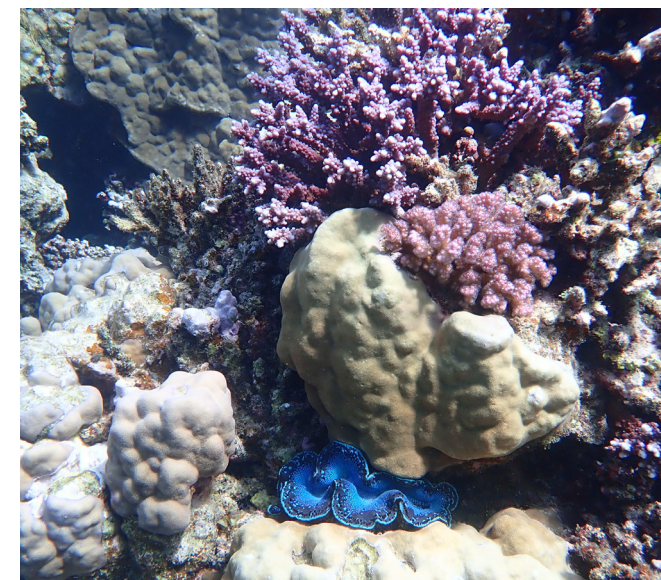
Using advanced restoration techniques, the project will begin by establishing a 100-hectare pilot site for coral reefs around Shushah Island, located approximately 20 kilometers off the coast of NEOM in the northern Red Sea. The project involves growing hundreds of thousands of corals in nurseries to be planted across the site and will deploy several KAUST-developed technologies. The effort will include a mix of coral conservation, protection, enhancement and restoration. The project is set to be completed by 2025, and it is anticipated that lessons learned from the initiative will support coral restoration throughout the region for decades to come.

Marine conservation is of particular importance for the Kingdom as it develops new sustainability-focused tourism initiatives, including NEOM and the Red Sea Project. The combined research expertise and technical infrastructure of KAUST and NEOM is expected to provide the traction needed to advance coral restoration at significant scale both regionally and globally.

The initiative will also include a research and ecotourism center where researchers, students and tourists can gain further knowledge about coral reef ecosystems and the biodiversity of species they support. NEOM CEO

Nadhmi Al Nasr said, “The program is key to our efforts to rewild, reforest and preserve NEOM and reflects our commitment to protecting our rich marine ecosystems and our efforts to pioneer the future of conservation.”

The genesis of the project began with KAUST's Coral Hub, a team of faculty and researchers working to develop new approaches to coral reef restoration. KAUST will contribute resources from across disciplines to deliver the project. This work will improve the supply chain using KAUST-developed



NEOM

“We are delighted to partner with KAUST on this pioneering coral reef restoration program off the coast of NEOM. NEOM's Red Sea coral reef ecosystem may hold the secret to the future of coral reefs around the world.”

Nadhmi Al Nasr, CEO, NEOM

RECEIVING AWARDS AND RECOGNITION ON THE GLOBAL STAGE

KAUST helps to raise the Kingdom's academic reputation through its distinguished faculty and alumni

As KAUST's faculty members continue to receive praise and accolades from the global scientific community for their research, Saudi Arabia's international research profile is growing. KAUST is conducting research on diverse topics, from nuclear proliferation to computational biology, supporting the country's efforts to reach the Kingdom's Vision 2030 goal of establishing a knowledge-based society. This is helping to transform the education sector and improve the efficiency of Saudi educational institutions.



Matthew McCabe
Professor of Environmental Science and Engineering, and Director of the KAUST Climate and Livability Initiative

McCabe, along with former team members Bruno Aragon and Rasmus Houborg, was awarded the 2022 Prince Sultan Bin Abdulaziz International Prize for Water in the Water Management and Protection category. McCabe's team won the accolade for their innovative use of satellites to account for and manage the use of water in agriculture. The award was announced on June 6, 2022 as part of the Space and Water Agenda of the 65th Session of the United Nations Committee on the Peaceful Uses of Outer Space.

PRINCE SULTAN BIN ABDULAZIZ INTERNATIONAL PRIZE FOR WATER

"The Prince Sultan Bin Abdulaziz International Prize for Water recognizes scientists, researchers and inventors around the world for pioneering work that addresses the problem of water scarcity in creative and effective ways."



Osman Bakr
Professor of Material Science and Engineering

Bakr and Mohammed were awarded the 2021 Kuwait Prize in the category of Condensed Matter Physics for their research into the use of perovskite material for solar-energy purposes and high-energy radiation sensors. The Kuwait Foundation for the Advancement of Sciences gives the prize annually in acknowledgement of its honorees' contributions to their fields, and it comes with a monetary prize of KD40,000.



Takashi Gojobori
Professor of Bioscience and Acting Director of the KAUST Computational Bioscience Research Center

Gojobori was elected a Fellow of the International Society for Computational Biology, the leading group of its kind for computational biology and bioinformatics. Gojobori said he was "incredibly honored" to receive one of the highest recognitions possible in the field.



Derya Baran
Associate Professor of Material Science and Engineering

Baran heads the Organic Materials for Energy Applications research group at KAUST. She has been recognized as a Fellow of the Royal Society of Chemistry, the UK's professional body for chemists, for her contribution to chemical sciences. Her research focuses on developing organic/hybrid soft materials for electronic devices, including flexible solar films.



Georgiy Stenchikov
Professor of Earth Science and Engineering

Stenchikov was awarded the 2022 Future of Life Award by the Future of Life Institute for his research on the consequences of nuclear war on the climate. His fellow winners in 2022 included planetary scientist Carl Sagan and Nobel Prize winner Paul Crutzen.



Omar F. Mohammed
Professor of Material Science and Engineering



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Strategic National Advancement



DEVELOPING AND RETAINING TALENT

KAUST hosts the inaugural Future Talent Conference during Saudi Arabia's largest career fair

In June 2022, KAUST brought together over 250 human resources executives and recruiters from more than 70 leading employers in Saudi Arabia at the inaugural Future Talent Conference, an event that took place on the sidelines of the In-Kingdom Career Launch (IKCL), the country's largest career fair.

The Future Talent Conference offered a venue for exchanging knowledge and ideas to help realize the Kingdom's vision of having a highly skilled workforce. The speakers and panelists included senior members of organizations such as Takamol, King Abdullah City for Atomic and Renewable Energy, NEOM, Saudi Technology Ventures, McKinsey, Bain & Company, PwC and KPMG.

Three panel discussions were held during the conference on the challenges of attracting, developing and retaining talent in Saudi Arabia. They touched on important issues, including how to upskill workers with future-ready expertise, as well as how to transform organizational processes and cultures to meet the next generation's changing needs and expectations.

"The technological and scientific transformation taking place in the Kingdom promises to create thousands of new jobs in the near future," said KAUST President Tony Chan. "The forum gave us an opportunity to align ourselves with industries and find common ground. We need to support companies to reskill and upskill, ensuring that people have the education, training and expertise to meet the demands of their changing jobs, and are prepared for the jobs of tomorrow, some of which might not exist yet."

KING ABDULLAH CITY FOR ATOMIC AND RENEWABLE ENERGY

"We are proud to collaborate with KAUST to strategically develop and connect talent in the Kingdom, creating pipelines for in-demand skills."

Kim Pringle Al Sahhaf, Director of Human Capability Development, K.A. CARE



NAJAH ASHRY

Vice President for Strategic National Advancement

“AS WE LOOK TO FULFILL THE VISION 2030 OBJECTIVE OF DEVELOPING HUMAN CAPITAL AND ENSURING EQUAL ACCESS TO OPPORTUNITIES, WE NEED TO FOCUS ON THE SKILLS THAT ARE NEEDED NOW AND WILL BE NEEDED IN THE FUTURE.”

The conference took place during KAUST's two-day IKCL event, which saw more than 1,000 job interviews organized for over 800 open positions in various industries operating within the Kingdom. Senior human resources and recruitment representatives from a wide group of companies, including Saudi Aramco, King Abdulaziz City for Science and Technology, King Fahd University of Petroleum and Minerals, SABIC, NEOM, The Red Sea Development Company, the Saudi Central Bank, Al Rajhi Bank, Amazon and Accenture, attended the event.

The university is helping to facilitate the growth of the Kingdom's labor market. KAUST programs such as the Future Talent Conference, along with employment-oriented events like IKCL, are important tools that can act as catalysts for the development of a skilled and knowledgeable workforce. Importantly, this event helped connect students with a number of leaders in industries, establishing relationships that led to job offers.

KAUST

ALUMNI CHANGE MAKERS AWARDS

جائزة صناع التغيير لخريجي كاوست

RECOGNIZING GLOBAL CHANGE MAKERS

The inaugural Alumni Change Makers Awards event honors KAUST graduates who are making a difference

As KAUST's alumni community grows and gains critical mass, an increasing number of graduates have gone on to play prominent roles in their professional lives as entrepreneurs and academics, and in other leadership positions. KAUST reached out to the community to nominate alumni demonstrating sustained impacts in their work, and more than 100 names were submitted for consideration. Ten were selected for recognition at a dinner gala on November 4, 2022.

The following alumni also earned accolades at the event:

- Abeer Al Doghaither, who earned a PhD in 2015, was recognized for her role as president of Dar Al-Hekma University, in Jeddah.
- Lina Eyouni, a PhD holder who graduated in 2021, is working as a physical-science environmental manager at The Red Sea Development Company, which is developing a tourism giga-project on the Red Sea.
- Yasmeen Nahm, holder of a PhD and master's degree from KAUST, is now the innovation lead for hydrogen and e-fuels at the NEOM smart city project, aiming to reduce greenhouse-gas emissions.
- Luca Passone, holder of a PhD and master's degree from KAUST, is the co-founder, chief technology officer and general manager of the local startup FalconViz, which focuses on surveys and maps.
- Aubrie O'Rourke, who earned a PhD in 2015, is now working as a project scientist at the National Aeronautics and Space Administration's Kennedy Space Center in the United States.

- Jian Pan, president of KAUST's Chinese Alumni Chapter, facilitated the group's donation of 2,000 surgical masks to the university's frontline workers early in the pandemic, when masks were in short supply.
- Yu Li, who holds a PhD and a master's degree, is employed as an assistant professor at the Chinese University of Hong Kong, and was honored for his research that helped to develop computational tools to identify antibiotic-resistant genes. He was recognized in Forbes Magazine's "30 Under 30 Asia" list in 2022 for his research.

KAUST ALUMNUS

"When the King announced KAUST, the dream came true for me. Receiving a world-class education from a reputable University while being next to my family is what I was looking for."

Ahmad Showail, Assistant Professor of Computer Engineering, Taibah University



Ahmad Showail

The Leadership and Impact Award was given to Ahmad Showail, who earned a PhD in 2016 and a master's degree in 2010. He has gone on to become an assistant professor of computer engineering at Taibah University, in Madinah, Saudi Arabia, and is currently working at the University of California-Irvine as a Fulbright Scholar in collaboration with another KAUST alumnus, Dr. Faisal Nawab. The pair are developing internet-of-things software solutions to securely help the country manage pilgrims in Madinah.



Luisa Javier

The Research, Innovation and Entrepreneurship Award winner went to Luisa Javier, who earned her PhD in 2011 and is now the CEO and co-founder of Wayakit, a Saudi Arabia-based startup offering biotech cleaning and disinfection solutions.



LEA SUBLETT
Manager, Alumni Affairs

“KAUST'S GLOBAL ALUMNI COMMUNITY OF 2,500 IS EXTRAORDINARY. OUR PHD AND MASTER'S OF SCIENCE GRADUATES ARE CREATING IMPACT IN SO MANY SPHERES OF LIFE – FROM CLIMATE CHANGE AND ENTREPRENEURSHIP, TO SAVING LIVES THROUGH CUTTING-EDGE RESEARCH. I AM TRULY PROUD OF THIS COMMUNITY.”



Grant Hill-Cawthorne

The Social Impact Award went to Grant Hill-Cawthorne, who graduated with a PhD in bioscience in 2015 and is now working in a prominent role in the Government of the United Kingdom as the managing director of Research and Information and House of Commons librarian. Hill-Cawthorne's background

in virology was crucial during the COVID-19 pandemic, allowing for rapid-response research for the Parliament and keeping the building and lawmakers safe from the virus.



Special Section: Core Labs



NEOM U

"KAUST Core Labs are world-class. They are among the best-resourced academic laboratories in the world. It is this excellence that excites me as I look forward to NEOM U and KAUST working together."

Andreas Cangellaris, President, NEOM U



THERMO FISHER SCIENTIFIC

"Thermo Fisher Scientific is delighted to continue our partnership with KAUST to drive Saudi Arabia's research output and innovation to combat global challenges."

Mourad Marcin Kouri, Senior Director of Africa & Middle East, Thermo Fisher Scientific



KFUPM

"KAUST Core labs are charting the future of how central research facilities at universities look like ... a role model for many to follow!"

Abdullah Saad Sultan, Dean of Research Oversight and Coordination, KFUPM



PROVIDING CUTTING-EDGE TOOLS FOR SCIENTISTS

KAUST's laboratories help Saudi Arabia showcase innovative technologies in scientific research

On its campus along the shores of the Red Sea, KAUST's Core Labs are home to some of the world's most advanced scientific equipment, enabling breakthrough discoveries for the Saudi and international academic world.

The Core Labs are a system of multidisciplinary, interconnected laboratories comprising state-of-the-art equipment that helps researchers fulfill their research objectives. They are available to faculty, students, researchers and external partners. The Core Labs' highly qualified scientists provide training programs to help users master complex research equipment and develop custom-made, unique methodologies for scientific exploration.

The university has 12 Core Labs – each supporting a specific area of KAUST's scientific research – that operate under a one-laboratory model overseen by a central operations team. Working together with the university's faculty members, the Core Labs identify the instruments and equipment that KAUST needs to conduct scientific research and hire the necessary staff to operate these tools. As it is often impractical for a single research group to purchase expensive equipment that it may only use a limited number of times, the instruments are shared across the university and used almost daily within the framework of the one-laboratory model, which helps the Core Labs' staff fully leverage the high-tech equipment. The Core Labs employ more than 250 professionals and they are regularly showcased as examples of the university's accomplishments in its fields of research.

Additionally, KAUST's more than one billion dollar investment in its Core Labs has helped to transform the research and development landscape in Saudi Arabia and contribute to the university's collaborations. Some of the equipment in the Core Labs is exclusive to KAUST and the region, placing the university among an elite group of institutions with the capacity to utilize these resources in innovative ways. The Core Labs are helping KAUST inspire the next generation of Saudis, as well as contributing to wider national goals of creating an innovative and knowledge-based society as part of the Kingdom's Vision 2030 framework.

BRUKER

"We are proud to be a strategic partner of KAUST and its Core Labs. Unravelling key scientific challenges by pushing technology beyond boundaries is key for KAUST."

Dr. Andreas Kamlowski, Division President, Bruker Optics GmbH & Co. KG

KAUST works with the world's leading innovators of scientific technologies to ensure the Core Labs are equipped with the most advanced tools and systems. To maintain these standards, KAUST has established four centers of excellence with the market-leading technology vendors Thermo Fisher Scientific, Bruker, Leica Microsystems and Fugro.

High-tech machinery can be found throughout the Core Labs. For example, the Imaging and Characterization Core Lab houses some of the most sophisticated spectroscopy, microscopy and X-ray instruments available. The Coastal and Marine Resources Core Lab deployed the first autonomous underwater surface vehicles in the Red Sea, allowing scientists to survey locations that were previously inaccessible. Additionally, the Supercomputing Core Lab will soon once again be home to the most powerful supercomputer in the Middle East as it has been throughout most of the past 14 years.

In many cases, the equipment in the Core Labs and the experts who operate them cannot be found anywhere else in the country or the region. For example, the Bioscience Core Lab is the only facility in Saudi Arabia to have gene-sequencing instruments from US-based PacBio to study rare genetic diseases. The Nanofabrication Core Lab is home to a Photonic Professional GT high-performance 3D printer, the only machine of its kind in Saudi Arabia, allowing researchers to print 3D objects that are only nanometers in size.

While each Core Lab has its own specialty, the one-laboratory model enables cross-disciplinary and collaborative research. This ease of access and transitioning between facilities offers a significant competitive advantage in the pursuit of innovative research.

In addition to servicing KAUST's research needs, the Core Labs support a range of Saudi Arabia's national institutions that require access to its laboratory facilities and expertise. This includes universities, government agencies and private companies. External users range from the government-owned energy firm Saudi Aramco, which has used the Core Labs' supercomputing facilities



DANIEL ACEVEDO-FELIZ
Director, KAUST Core Labs

“THE CORE LABS PROVIDE ACCESS TO SOME OF THE MOST SOPHISTICATED SCIENTIFIC EQUIPMENT IN THE WORLD. THEIR EXISTENCE ENABLES FASTER RESULTS, WIDER COLLABORATIONS AND MORE AMBITIOUS SCIENCE.”

to conduct oil reservoir simulations, to King Abdulaziz City for Science and Technology, which has been utilizing the Core Lab's expertise in nanofabrication to help facilitate the development of the Kingdom's semiconductor industry.

The Core Labs are doing their part to promote the scientific ambitions of not just KAUST but of the wider Kingdom as well, and their facilities can be held up as models for other universities around the world that wish to bolster their own capacities for conducting innovative research and science.

Analytical Chemistry



Animal Resources



Bioscience



Coastal and Marine Resources



Imaging and Characterization



Lab Equipment Maintenance



Nanofabrication



Plant Growth



Prototyping and Product Development



Radiation Labeling

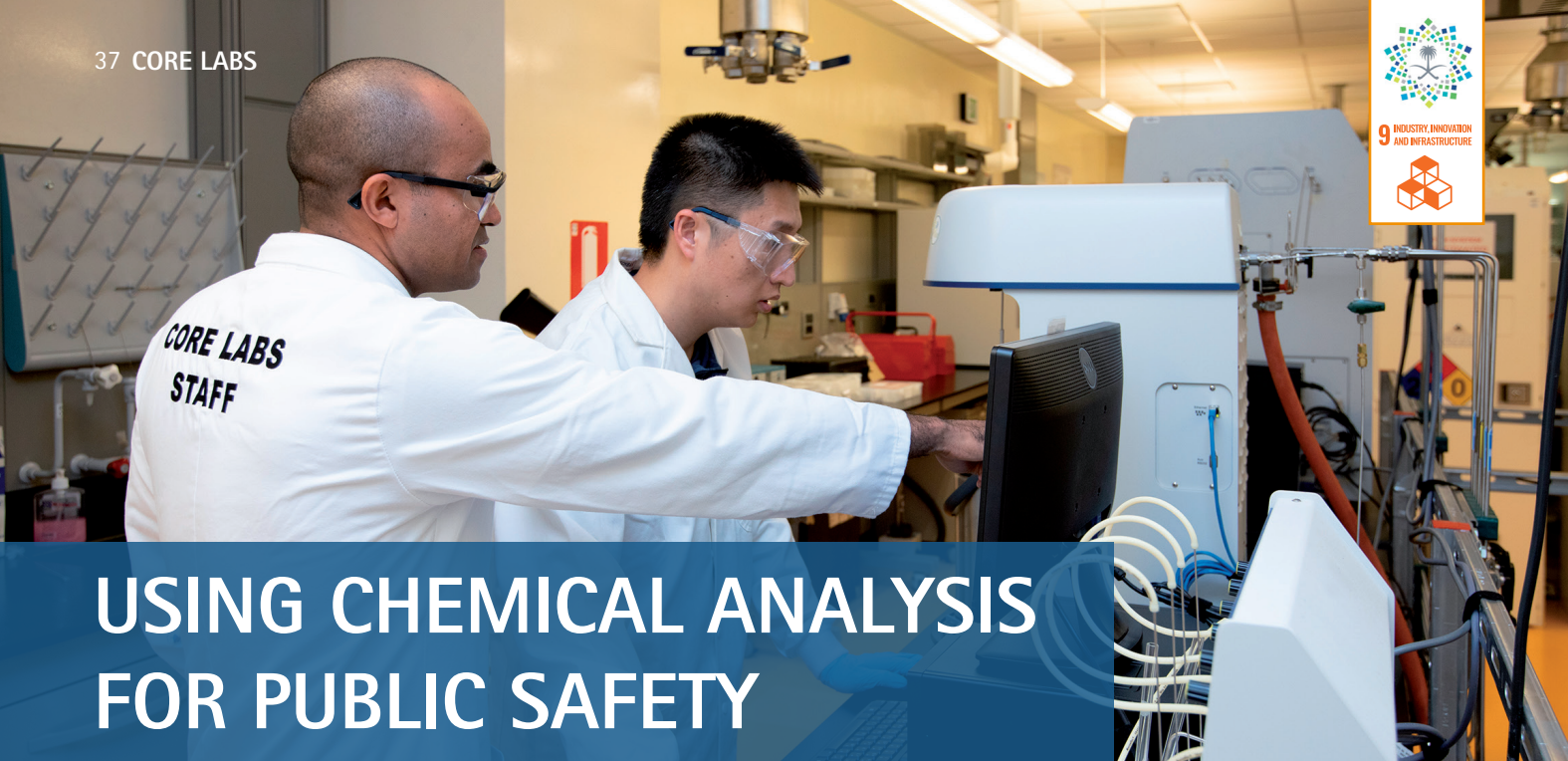


Supercomputing



Visualization





USING CHEMICAL ANALYSIS FOR PUBLIC SAFETY

KAUST's Analytical Chemistry Core Lab supports national food safety initiatives



EMAN BARRADAH
Senior Technical Specialist of
Inorganics, Analytical Chemistry
Core Lab

KAUST's Analytical Chemistry Core Lab houses a range of state-of-the-art instruments and tools to facilitate the analysis of organic and inorganic constituents in solids and liquids. In addition, its equipment helps scientists characterize the thermal, surface, optical and electrical properties of materials.

The 1,400-square-meter facility has the infrastructure to facilitate large-scale national projects. It was chosen by the Ministry of Environment, Water and Agriculture to assess the quality and safety of fish and sea life in the Red Sea by measuring the level of contaminants found in fish. The laboratory has also assisted in global food studies, identifying and quantifying compounds that affect the taste of quinoa.

The Saudi Food and Drug Authority (SFDA) chose the Analytical Chemistry Core Lab to support its food safety measures and eliminate health hazards. To that end, the laboratory developed and validated a method to help the SFDA with challenges related to analyzing arsenic speciation in rice to ensure public safety and food quality. As part of the program, the SFDA sent two of its researchers to attend a two-week workshop in the laboratory featuring high-performance liquid chromatography and inductively coupled plasma mass spectrometry. Led by Staff Scientists Dr. Klimentsi Cherviakouski and Dr. Jingyu Liu, and Senior Technical Specialist Eman Barradah, the workshop trained SFDA researchers on the developed method, which included sample extraction, instrument operation and data analysis. The group studied 30 rice species to detect arsenite, arsenate, monomethylarsonic acid and dimethylarsinic acid levels.

The laboratory offers services in four main areas. The inorganic analysis unit has the equipment needed for analytical chemistry, and staff are experienced in myriad techniques to determine the elemental composition of a variety of materials such as petroleum products, environmental samples, biological tissues and artificial polymers. The team can also quantify nutrients and organic carbon in fresh or saline water, and conduct thermal materials analysis. The metabolomics analysis unit uses mass spectrometry to identify small molecules, metabolites and lipids in biological matrices. Equipment includes ultra-high-performance liquid chromatography and gas chromatography instruments. The team can develop analytical methods for partners, as well as provide training and technical support to users. The organics unit is dedicated to the qualitative and quantitative analysis of a diverse range of organic molecules. Techniques include accurate mass determination, identification and quantitation of environmental contaminants, crude oil analysis and polymer molecular weight determination. The surface analysis unit, for its part, focuses on the characterization of powders and large solid particles, measuring properties such as their size, surface area, porosity, chemical adsorption and surface energy.

SAUDI FOOD AND DRUG AUTHORITY

"The well-established research infrastructure and the technical expertise at the KAUST Analytical Chemistry Core Lab have triggered us at the Saudi Food and Drug Authority to initiate mutual projects to strengthen food safety."

Fahad Aldawsari, Reference Laboratory for Medicines and Cosmetics Director, SFDA

CREATING A SAFE, CLEAN ENVIRONMENT FOR ANIMAL EXPERIMENTS



KAUST's Animal Resources Core Lab receives international accreditation for its systems and standards

KAUST's Animal Resources Core Lab has worked to create the environment and processes necessary to successfully conduct animal experiments. To protect the integrity of KAUST research and the health of the animals it uses, the laboratory follows strict biosecurity procedures that ensure a pathogen-free environment. The facility is equipped with state-of-the-art equipment, including an IVIS Spectrum in vivo imaging system, an X-ray irradiation cabinet for the safe irradiation of in vitro and in vivo biological samples, a microwave brain fixation system and specialized instruments for behavioral assessment.

In November 2022, KAUST achieved full institutional accreditation from the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) for its animal care programs, which are hosted in the Animal Resources Core Lab and the Coastal Marine Resources Core Lab. AAALAC is a non-profit organization that promotes the humane treatment of animals in science through voluntary accreditation and assessment. KAUST's accreditation was achieved in light of the scientific standards, responsible stewardship, and community service roles embraced by the two core labs that work directly with animals.

Commenting on the approval of KAUST's accreditation, President of AAALAC's Council on Accreditation Linda Fulton said, "Especially noteworthy were the excellent institutional support, evidenced in part by investment in research buildings, personnel and infrastructure; the well-maintained, controlled, organized and clean facilities; and the committed and very knowledgeable staff with open communication, resulting in the appearance of healthy animals." The accreditation is an important achievement for both KAUST and Saudi Arabia, with the former becoming the second institute in the country to hold this status, the other being King Faisal Specialist Hospital & Research Center. The laboratory joins approximately 1,040 companies, universities, hospitals, government agencies and research institutions spread across some 50 countries that have earned this designation. Institutions pursue this particular accreditation since it is a marker of research quality, accountability and scientific validity. The AAALAC accreditation is also a signal to outsiders in a competitive global marketplace, and acts as a recruiting tool to attract scientific talent.

Members of the laboratory staff are available to assist with animal husbandry, research protocols, in vivo procedures and environmental maintenance, and they also conduct bi-annual training sessions on all equipment designated for independent use. These training sessions are open to the university community, as well as to external users that have an agreement in place with KAUST.



SIMONA SPINELLI
Director, Animal Resources Core Lab

“THE AAALAC ACCREDITATION IS A SIGNIFICANT DEVELOPMENT FOR OUR FACULTY AT KAUST AND FOR SAUDI ARABIA. WE CAN NOW BE PROUD OF ENABLING RESEARCH WITH THE HIGHEST ACCREDITED STANDARDS OF ANIMAL CARE.”

ASSOCIATION FOR ASSESSMENT AND ACCREDITATION OF LABORATORY ANIMAL CARE

"The council commends you and the staff for providing and maintaining a high-quality program of laboratory animal care and use."

Linda Fulton, President of the Council on Accreditation, AAALAC



IMPROVING HEALTH USING ADVANCED TECHNOLOGIES

The Bioscience Core Lab offers unique instruments for studying the composition of genes and proteins

KAUST's Bioscience Core Lab is a cutting-edge facility that supports advancements in genomics, proteomics and bioinformatics. While genomics is the study of genes, and proteomics is the study of proteins, bioinformatics is the computational analysis of these genes and proteins. Home to analytical equipment found nowhere else in Saudi Arabia, the Bioscience Core Lab is a unique facility for the quantitative and qualitative analysis of genes and proteins.

The laboratory has a number of mass spectrometry systems for proteomics that are unavailable elsewhere in the country. In addition to specialized instruments and processes, the experiments conducted by the laboratory typically require a great deal of customization depending on the characteristics of the sample.

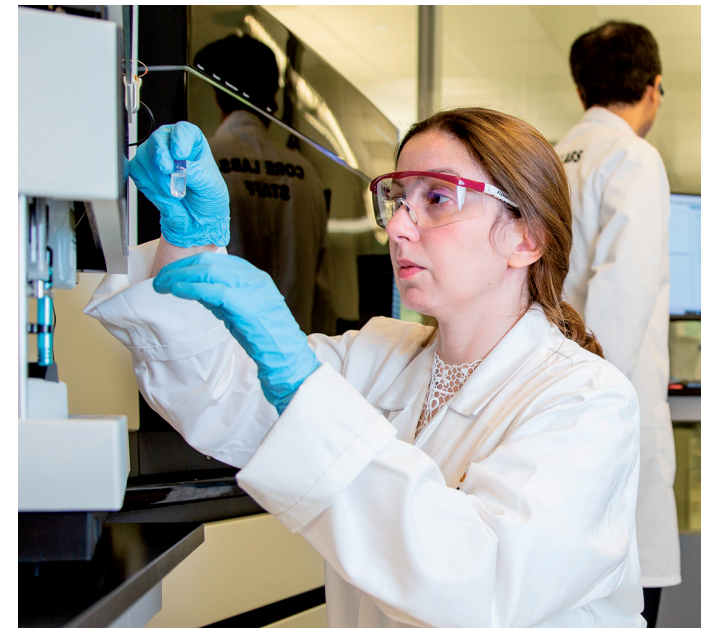
One such example is UHRF1, a protein that is abnormally abundant in cancer cells. Papita Mandal, a staff scientist in the Bioscience Core Lab, was interested in how she could control the conformation of this protein, which in turn determines its function. "This protein is very flexible and can acquire several 3D conformations," she said. "Because of this, there were few techniques that could be used for our experiments." As part of her research, she utilized hydrogen-deuterium exchange mass spectrometry, making KAUST's core lab the only facility in the Kingdom that is capable of studying the conformational changes of this cancer-related protein.



NICOLE CHEUNG
Director, Bioscience Core Lab

“THE BIOSCIENCE CORE LAB IS THE ONLY PLACE IN SAUDI ARABIA THAT HAS EXPERTISE IN PACBIO SEQUENCING, THE MOST ACCURATE LONG-READ GENE SEQUENCING TECHNOLOGY AVAILABLE ON THE MARKET.”

Genome sequencing involves cutting DNA into small strands, reading them with a sequencer and reassembling them computationally using bioinformatics. With this approach, scientists are able to identify mutations and other abnormalities that are responsible for the disease. The smaller the strands, the more difficult it is to reassemble them; however, third-generation sequencers like the ones used in the Bioscience Core Lab can



KING FAISAL SPECIALIST HOSPITAL & RESEARCH CENTER

"We were taken aback by the superior quality of the runs after we re-ran these samples at the Bioscience Core Lab, and this made all the difference in our subsequent analyses. From that moment on, this core lab became my trusted go-to partner."

*Fowzan Alkuraya, Professor of Human Genetics,
Principal Clinical Scientist and Senior Consultant, KFSH&RC*

do the analysis with longer reads, which results in more reliable data. For this purpose, the laboratory's PacBio third-generation sequencing technology, such as the Sequel IIe system, is considered the top in its field.

Such research is especially important in Saudi Arabia because of the combination of large families and homogeneity, which has resulted in the notable presence of autosomal recessive disorders with severe – if not fatal – symptoms. In collaboration with the Riyadh-based King Faisal Specialist Hospital & Research Center (KFSH&RC), the Bioscience Core Lab began sequencing patient samples in July 2022 to shed new light on these conditions. The laboratory plans to study the genomes of 34 pediatric patients who suffer from a range of rare genetic diseases.

The aim of the project, which will be the first to use PacBio instruments to study these kinds of diseases in Saudi Arabia, is to provide patients with diagnoses so that parents understand the risks when considering whether or not to have children.

"The lessons we learn from cracking tough cases inform our diagnostic pipeline for future cases. This can boost the diagnostic yield for all future patients," said KFSH&RC Professor of Human Genetics, Principal Clinical Scientist and Senior Consultant Dr. Fowzan Alkuraya. Alkuraya and his colleagues at KFSH&RC utilize the Bioscience Core Lab's technology, and there are several ongoing collaborations between the two entities.



DIVING DEEPER FOR ADVANCED MARINE RESEARCH

The Coastal and Marine Resources Core Lab offers the most comprehensive suite of equipment and services for research in the Red Sea

With an eye on becoming a leader in Red Sea exploration, the Coastal and Marine Resources Core Lab (CMR) is a complete marine station with expertise in marine operations, oceanographic instrumentation and wet lab experimentation. It was established in 2008 – before KAUST officially opened its doors – and in the years since has created a broad research network comprising both domestic and international partners.

CMR is leading an effort to establish a consortium of research vessel operators in the Kingdom that standardizes marine operations to increase the national capacity for ocean research.

The lab is home to KAUST's main research vessel, the R/V Thuwal, which has served KAUST since 2013 and has helped to scale up research on the largely unexplored Red Sea. Because of the consortium, other institutes keep their boats at the CMR, such as R/V Al Azizi from King Abdulaziz University, as well as international partners investigating the Red Sea.

In line with government efforts to increase knowledge of the Red Sea, KAUST is investing in a new research vessel. Slated for completion in 2026, the new vehicle will offer a greater range of operational capabilities and



ZENON BATANG

Lead Senior Staff Scientist, Coastal and Marine Resources Core Lab

“THE COASTAL AND MARINE RESOURCES CORE LAB IS UNIQUE FOR HAVING ALL ESSENTIAL MARINE RESEARCH FACILITIES IN A CENTRALIZED LOCATION BY THE RED SEA.”

will be uniquely built for research in the Red Sea, in both coastal and deepwater environments. The vessel includes a reconfigurable deck for multipurpose projects and equipment, and weather-hardy traits for managing the conditions of the Red Sea.

In addition to marine operations, the lab is a leader in engineering and calibration, remotely operated and autonomous vehicles, scientific diving and wet lab experimentation. Another important initiative managed by the lab is Seawater Laboratories for Aquatic Biosystem Simulations (SeaLABS), which aims to bring the Red Sea to researchers. From consulting on project design to the construction of bespoke aquarium set-ups, SeaLABS services help to tackle global challenges such as environmental protection.

For example, the lab is supporting a project on coral reef restoration that is aimed at developing strategies to help coral cope with climate change. It is also supporting the Aquaculture Development Program, a collaboration between KAUST and the government that aims to develop new technologies for aquaculture. “We want to share the knowledge and expertise that we have gained over the past decade with other players in the Kingdom so that the lab can have an exponential impact,” said CMR Director Dr. Lloyd Smith.



PARTNERING WITH PEERS TO PROVIDE IMAGE-BASED INSIGHTS

KAUST's Imaging and Characterization Core Lab uses sophisticated tools to provide detailed close-ups of innovative materials



SUZANA NUNES

Professor of Chemical and Environmental Science and Engineering

“THE CORE LABS SYSTEM IS STRONG IN SO MANY DIVERSE FIELDS. WE COULD CHARACTERIZE OUR SYNTHETIC PRODUCT WITH SUCH DETAIL TO CONVINCINGLY SHOW NOT ONLY THAT IT IS USEFUL FOR CRUDE OIL FRACTIONATION, BUT ALSO WHY.”

Enhancing knowledge about materials can help drive innovation and solve a variety of issues, including those related to climate change and sustainability. KAUST's Imaging and Characterization Core Lab is positioning itself as a leader in this sphere. The lab's team and technologies are focused on five main areas: electron microscopy, nuclear magnetic resonance, physical characterization, surface science and optical microscopy. It also features three of four centers of excellence within the Core Labs: the Thermo Fisher Scientific Center of Excellence for Electron Microscopy, the Bruker Center of Excellence for Magnetic Resonance, and the Leica Microsystems Center of Excellence for Optical Microscopy. These centers partner with companies that are leaders in their respective fields.

The lab recently played a key role in the synthesis of a new polymer membrane that could deliver cleaner crude oil at a lower cost by working with KAUST Professor Suzana Nunes and her team. Membranes are used to fractionate crude oil or distill it – the process by which an oil refinery separates the raw oil into different products such as naphtha, kerosene and diesel. Nunes' team believed that using their membrane would be a more sustainable and environmentally friendly method. However, it was necessary to design tests to understand more about the structure of the new material.

The lab's scanning and transmission electron microscopy capacities were used to provide close-up images, and a chemical analysis was performed using nuclear magnetic resonance and dynamic nuclear polarization. The Analytical Chemistry Core Lab confirmed that the membrane would hold up against extreme heat. This was done using spectrometry, including a Fourier transform ion cyclotron resonance mass spectrometer. The team's results were published in June 2022, in the journal *Science*. “I have been working with the Core Labs for many years. I know that the quality of my output improves when I collaborate with their team,” said Dr. Stefan Chisca, research scientist at KAUST and lead author of the study.

Improving the efficiency of the refining process is of paramount strategic importance to Saudi Arabia given that the Kingdom is expected to produce oil for decades to come. Efficient refining will be essential to lowering the country's carbon emissions, in line with its target to reach net zero by 2060 and maintain its position as one of the lowest carbon intensity oil producers in the world.

Another recent achievement encapsulates the collaborative nature of KAUST's Core Labs. In March 2022, the Imaging and Characterization Core Lab provided images of the catalysts of solar batteries as part of a global research collaboration. Partners on the project included Oxford University and Imperial College of London. The lab's main role was to characterize the nanoparticle photocatalysts at a high spatial resolution. The study was led by KAUST Professor Iain McCulloch, with assistance from the lab's director, Dr. Rachid Sougrat, and Electron Microscopy Staff Scientist Dr. Lingyun Zhao.

NEOM U

“I was particularly impressed by the sophistication and comprehensiveness of their characterization and imaging facilities, from bleeding-edge electron microscopy, to comprehensive nuclear magnetic resonance spectroscopy and cutting-edge optical microscopy.”

Andreas Cangellaris, President, NEOM U

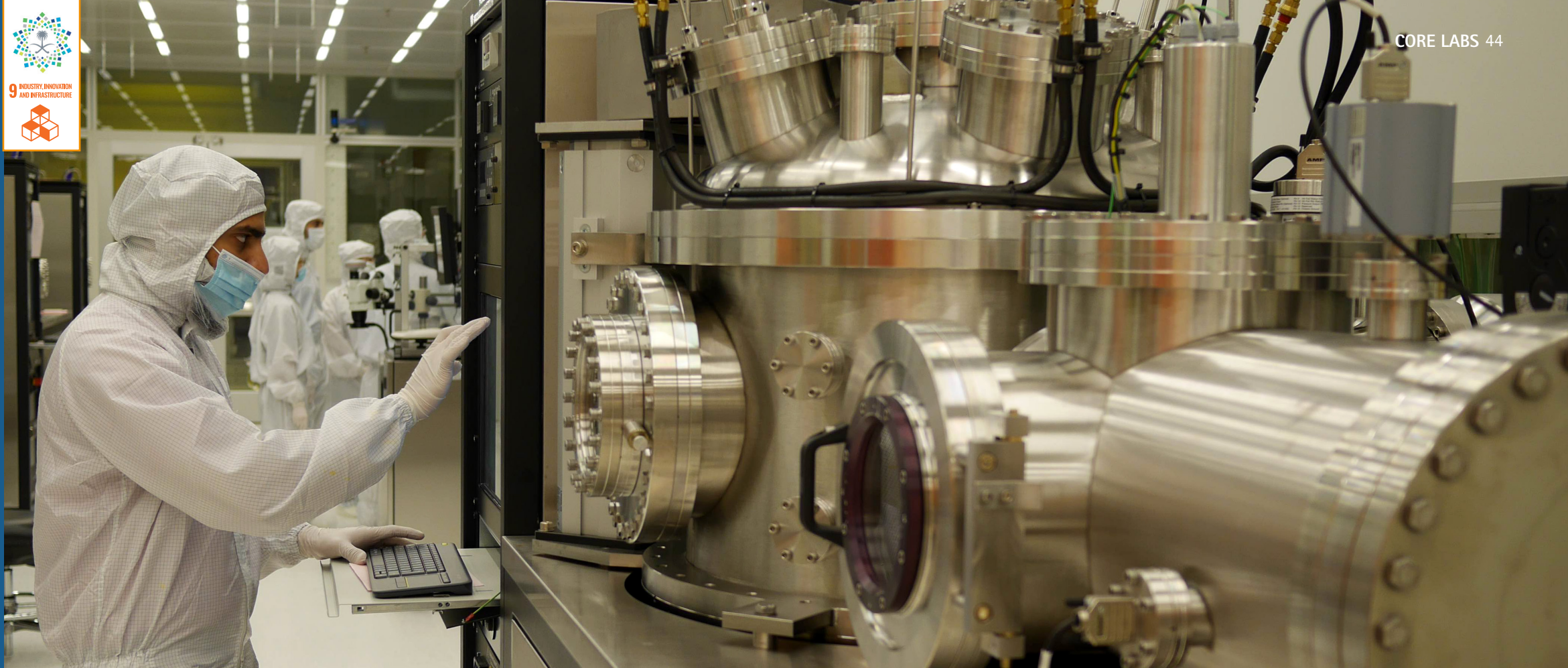
KING ABDULAZIZ UNIVERSITY

“One of our successes in operating KAU vessels is cooperating with KAUST's Coastal and Marine Resources Core Lab. We thank them for their support and team effort in helping us achieve our goals.”

Dr. Faisal Alsaqa, General Supervisor of KAU vessels



MAKING GREAT STRIDES WITH SMALL DEVICES



The Nanofabrication Core Lab specializes in innovations that are tiny solutions for big problems



KENNETH KENNEDY

Director, Nanofabrication Core Lab

Among world-class universities, an enabling nanotechnology and nanofabrication research environment can give an educational institution a strategic advantage. These facilities are oriented around the design and manufacture of devices small enough to be measured in nanometers, or 10 million times smaller than a centimeter.

KAUST is among the elite institutions successful in this area, according to *US News & World Report*, which publishes annual rankings of universities around the globe. KAUST was tied for 15th place out of the 250 institutions in the list for nanoscience and nanotechnology in the 2022/23 report, an achievement attributed in part to the success of KAUST's Nanofabrication Core Lab.

Higher-ranked laboratories in the United States include Georgia Institute of Technology and Stanford University; in China, the second-ranked University of Chinese Academy of Sciences in Beijing and third-ranked Tsinghua University; and in Singapore, the top-ranked Nanyang Technological University. In comparison, the Massachusetts Institute of Technology and Harvard University were 20th and 17th on the list, respectively.

Recent initiatives implemented by the lab include nanoscale patterning and etching to produce flat, pinhead-sized optics that are expected to become a core technology in next-generation wearable tech such as smart watches.

The Nanofabrication Core Lab features three areas: a microfluidics laboratory, a thin films laboratory and a class 100 cleanroom. Manufacturing devices at this scale sometimes requires a degree of cleanliness that is in accordance with the standards outlined in ISO 14644 to avoid contamination.

"The unique combination of world-class equipment and highly experienced staff means the Nanofabrication Core Lab can offer expert support and training," said Nanofabrication Core Lab Director Dr. Kenneth Kennedy.

KING ABDULAZIZ CITY OF SCIENCE AND TECHNOLOGY

"KAUST's Nanofabrication Core Lab has built and maintained a reputation in the scientific community both at home and abroad as a capable leader in many cutting-edge technologies, particularly in semiconductors."

Abdulrahman Albadri, Professor and Project Director, KACST

Hundreds of steps may be involved when building semiconductor devices, such as material deposition and thermal diffusion. The thin films involved can be created in the Nanofabrication Core Lab at a thickness of a few atomic layers. The laboratory supports fundamental and applied research in the properties of thin films, and in their applications in devices such as catalytic converters and magnetic sensors. Another area of expertise in the laboratory is photolithography, or the defining of microscopically small patterns and structures on wafers, the thin slices of semiconductor material used in the making of integrated circuits.

As a part of its objective to support the wider scientific community in Saudi Arabia, Core Labs recently signed a service agreement with King Abdulaziz City for Science and Technology (KACST). Under the arrangement, KACST scientists and engineers are allowed to work in KAUST's Core Labs, and several researchers from KACST now have access to the Nanofabrication Core Lab. This agreement, which was announced at the inaugural Future of Semiconductors Forum hosted in Riyadh in March 2022, is expected to enable future collaborations and encourage the development of a semiconductor ecosystem in Saudi Arabia and beyond. KACST is developing its own facility, and the agreement envisages a long-term reciprocal partnership between

the two institutions. The laboratory offers services to the university and external partners in multiple areas. Metrology, the science of measurement, is crucial to ensuring that devices such as microchips are made to the standards set by their designers. Etching, which is done in a cleanroom with plasma etching equipment, can be achieved on many types of materials to totally or partially remove layers from the surface of materials. The microfluidics laboratory allows researchers to try out various techniques to make microfluidic systems, which exploit the physical and chemical properties of liquids and gases.



THIS AREA OF SCIENCE COVERS ALMOST ENDLESS APPLICATIONS AND DEVICES, WITH POTENTIAL IMPACT ON EVERYDAY LIVES AND ECONOMIES. SEMICONDUCTORS ARE A SIGNIFICANT GLOBAL BUSINESS THAT CURRENTLY HAS A VERY HIGH PROFILE.



SECURING AND MAINTAINING EQUIPMENT FOR RESEARCH AND INNOVATION

The Laboratory Equipment Maintenance Core Lab ensures access to essential equipment



MOHAMMED SHAKIR
Director, Laboratory Equipment Maintenance Core Lab

“WE ARE A UNIQUE PART OF KAUST NOT FOUND AT OTHER UNIVERSITIES. WE ARE VALUE-DRIVEN AND ARE ALWAYS THINKING ABOUT MAXIMIZING OUR VALUE TO THE SCIENTISTS, WHEREAS AN EXTERNAL SERVICE PROVIDER IS REVENUE-DRIVEN.”

Scientific experiments depend on sophisticated and expensive equipment. When equipment breaks down, companies will typically send a representative to investigate. However, this service strategy can prove challenging in Saudi Arabia, where visa-processing delays can last weeks or even months, causing major setbacks in research when scientists need equipment repaired immediately. It is for this reason that KAUST established the Laboratory Equipment Maintenance Core Lab (LEM).

The laboratory consists of 27 professionals with experience in the maintenance of complex scientific instruments. Their task is to keep the machinery in all KAUST research labs working at optimal capacity while also training scientists to identify and correct routine problems. Importantly, all LEM staff are physically located at KAUST, which saves time and costs by ensuring that scientists can continue their experiments with minimal delay. LEM is also sharing its unique service model with other universities in the Kingdom so that they can apply best practices.

LEM's work is directly relevant to the Kingdom's wider goals. In 2019, director of the KAUST Catalysis Center Jorge Gascon worked with Aramco to discover a single-step method to convert petroleum to petrochemical products. Such a discovery is significant economically because petrochemical demand is predicted to increase even while fuel use drops as nations work to reduce greenhouse gas emissions. However, the refinery gas analyzers on campus that were required for the study needed a major upgrade.

Gascon looked to LEM for a solution, and the lab delivered. It maintains strategic relationships with private sector partners, including a preferred-vendor program through which manufacturers provide service-level training and parts, enabling LEM to act as a service team. For refinery gas analyzers, one preferred manufacturer and vendor is Thermo Fisher Scientific, based in Waltham, Massachusetts. The company had a model available that would help Gascon and his team acquire the data they needed. LEM's staff arranged for the necessary training to keep the machinery performing properly. In the end, Gascon and Aramco found a new method for converting petroleum to petrochemicals, and published the results in 2021 in the journal *Nature Catalysis*.

In a confirmation of LEM's work, in June 2022 the American Association for Laboratory Accreditation awarded KAUST an expansion of accreditation to perform calibrations for mass (balances) and volume (pipettes). LEM joined the Coastal and Marine Resources Core Lab as the second KAUST facility to have earned this status.

GEORGIA INSTITUTE OF TECHNOLOGY

“The laboratory is a unique resource that provides KAUST faculty and the Core Labs with a competitive advantage. Not only does it reduce repair and maintenance costs for scientific instruments, but it also reduces equipment downtime.”

Oliver Brand, Executive Director of the Institute for Electronics and Nanotechnology, Georgia Institute of Technology



BUILDING BESPOKE MACHINES TO DRIVE INNOVATION

The Prototyping and Product Development Core Lab is designed to build anything and everything innovators need



JASON SERIN
Director, Prototyping and Product Development Core Lab

“WE ARE PUSHING A NEW VISION AT THE LAB AND WANT TO SHOWCASE OURSELVES AS INTERNATIONALLY COMPETITIVE. BY PROVIDING COMPREHENSIVE EXPERTISE AND SERVICES IN-KINGDOM, KAUST CAN ACCELERATE SAUDI INNOVATION.”

Researchers, corporations and institutions in Saudi Arabia have historically had to turn to overseas vendors to build customized equipment for their products and operations. As the Kingdom evolves and the economy diversifies, off-the-shelf products may not meet the needs of scientists, entrepreneurs and industrial innovators who require specific expertise and facilities to create bespoke items. As such, developing domestic capacity for the creation of customized prototypes of equipment and other products will be crucial.

KAUST's Prototyping and Product Development Core Lab plays a key role in defining and inculcating these capacities, which fall into seven areas: reverse engineering, welding, electronics engineering, projects and engineering, scientific glassblowing, machining and rapid prototyping. KAUST has equipped the lab with state-of-the-art machinery such as laser cutters big enough to hold small cars, 3D printers that can manufacture products from resin or metal, and CNC mills and lathes that can machine any shape. It is ready to work with KAUST faculty and researchers, as well as outside organizations that require its expertise.

KAUST's first collaboration with an external partner began in October 2021, with Research Products Development Company (RPDC), a subsidiary of the Saudi Technology Development and Investment Company. RPDC specializes in deep-tech development and commercialization, and had partnered with another local university on an antimicrobial coating for textiles using a nanotechnology-based treatment process. The technology's potential was evident to scientists, especially in terms of its use in healthcare – having antimicrobial gowns, bedsheets and other linens would go far in limiting the spread of infections in hospitals and similar settings. However, there was no machine available to apply the coating to fabrics. Dr. Jason Serin, Director of KAUST's Prototyping and Product Development Core Lab, knew his facility would be a particularly good fit to meet RPDC's goals.

Serin's team worked with RPDC scientists to design a treatment process and prototype. The device allows for different chemicals and nanomaterials to be sprayed onto fabrics, which are then activated by ultraviolet light. Since some of the chemicals used could be toxic to humans, the final version of the prototype featured a fully enclosed, waterproof system with an intake method to pass the fabric through the device. The machine also has a vent for the chemical fumes produced by the process.

“The alternative would have been to separate the project into smaller tasks and approach different entities in Saudi Arabia and abroad to develop and create the different components of the system. We would then integrate the solution in-house,” said Ahmed Alfadhel, Chief Technologist at RPDC.

RESEARCH PRODUCTS DEVELOPMENT COMPANY

“We were very impressed by the outstanding capabilities of the Prototyping and Product Development Core Lab at KAUST. There are not many entities in the Kingdom that have similar capabilities.”

Ahmed Alfadhel, Chief Technologist, Research Products Development Company

INTRODUCING NEXT-GENERATION SUPERCOMPUTING

The Supercomputing Core Lab selects Hewlett Packard Enterprise to build a new supercomputer that will be the region's most powerful

Computing capacity is increasingly driving innovation and discovery in academic research. Supercomputers – physically larger and more powerful than desktops and laptops – are crucial in fighting pandemics, scaling up clean energy systems and discovering new artificial intelligence pathways.

KAUST has the Shaheen II supercomputer on campus, which is maintained and operated by the KAUST Supercomputing Core Lab. In September 2022, KAUST announced its plans for its next-generation supercomputer Shaheen III, which will be built by Hewlett Packard Enterprise (HPE). Shaheen III will be more than 20 times faster than Shaheen II, and it will be the most powerful supercomputer in the Middle East upon completion. The machine will process information at speeds of up to 125 petaFLOPS; a petaFLOP is one quintillion – a billion billion – calculations per second.

Their power allows supercomputers to model and simulate scientific problems far faster and with greater accuracy. More than half of KAUST's faculty uses Shaheen II for their work, and researchers from more than 20 external organizations have been granted access, helping KAUST to fulfill its Vision 2030 objectives of embracing innovation. Shaheen II plays a crucial role beyond the KAUST campus, such as in weather forecasting. The Supercomputing Core Lab has been collaborating with the Kingdom's National Center for Meteorology (NCM) since 2016 to improve the center's capacity to model and forecast weather, which is crucial for air travel,

HEWLETT PACKARD ENTERPRISE

"We are honored to help fuel Saudi Arabia's Vision 2030 for a new era of innovation by empowering KAUST with a state-of-the-art supercomputer."

Antonio Neri, President and CEO, Hewlett Packard Enterprise



agricultural yields and air-quality advisories, and other key issues of public health. Environmental models to track and predict weather conditions require supercomputer levels of computational power.

The staff at the Supercomputing Core Lab has helped NCM upgrade its own supercomputer; store and back up data; build capacity on operating supercomputers; and maintain and manage equipment. By 2021, five years into their partnership, NCM's computational capabilities increased from 10 trillion calculations per second to 380 trillion per second. The second phase of the project, which was recently completed, boosted this capability further to 1.8 quadrillion calculations per second.

These improvements help meteorologists improve forecasting; NCM now has the computational power to update its weather forecasts every hour, instead of four times a day.

Shaheen III, which is expected to be fully operational in 2023, is set to be built using HPE's Cray EX supercomputer platform, the company's most sophisticated supercomputing offering. HPE's technology has emerged as the preferred choice for scientists studying meteorology.

Shaheen III's initial workload is expected to include analyzing data on clean combustion, Red Sea ecosystems, climate modeling and the Arabian tectonic plate. It will also be enlisted to help design new materials for solar panels, envision new industrial catalysts to enhance energy efficiency and reduce waste, discover new medicines, improve the recovery of hydrocarbons and enhance the ability of plants to survive droughts in desert environments.



TONY CHAN

President of KAUST

“THE NEW HPE CRAY EX SYSTEM WILL ALLOW US TO CONDUCT RESEARCH ON A LARGER SCALE, RESULTING IN SIGNIFICANT SCIENTIFIC, ECONOMIC AND SOCIAL ADVANCES.”

Further bolstering its reputation in the global supercomputing community, a multidisciplinary team from KAUST, along with fellow researchers from the University of Tennessee, Knoxville, was selected as finalists for the 2022 Gordon Bell Prize at the 2022 International Conference for High Performance Computing, Networking, Storage and Analysis, also known as SC22. The award is given in recognition for achievement and innovation in the application of high-performance parallel computing to the field of science and technology.

On the success of SC22, Saudi Arabia's Assistant Minister for Human Resources and Social Development Mohammed bin Nasser Al-Jasser said, "Sincere thanks to KAUST for all its efforts to develop the future leaders of Saudi Arabia. SC22 is a very important event in the industry. Such exposure will help students gain real-world perspectives in addition to their academic experience."



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