

Summer 2024

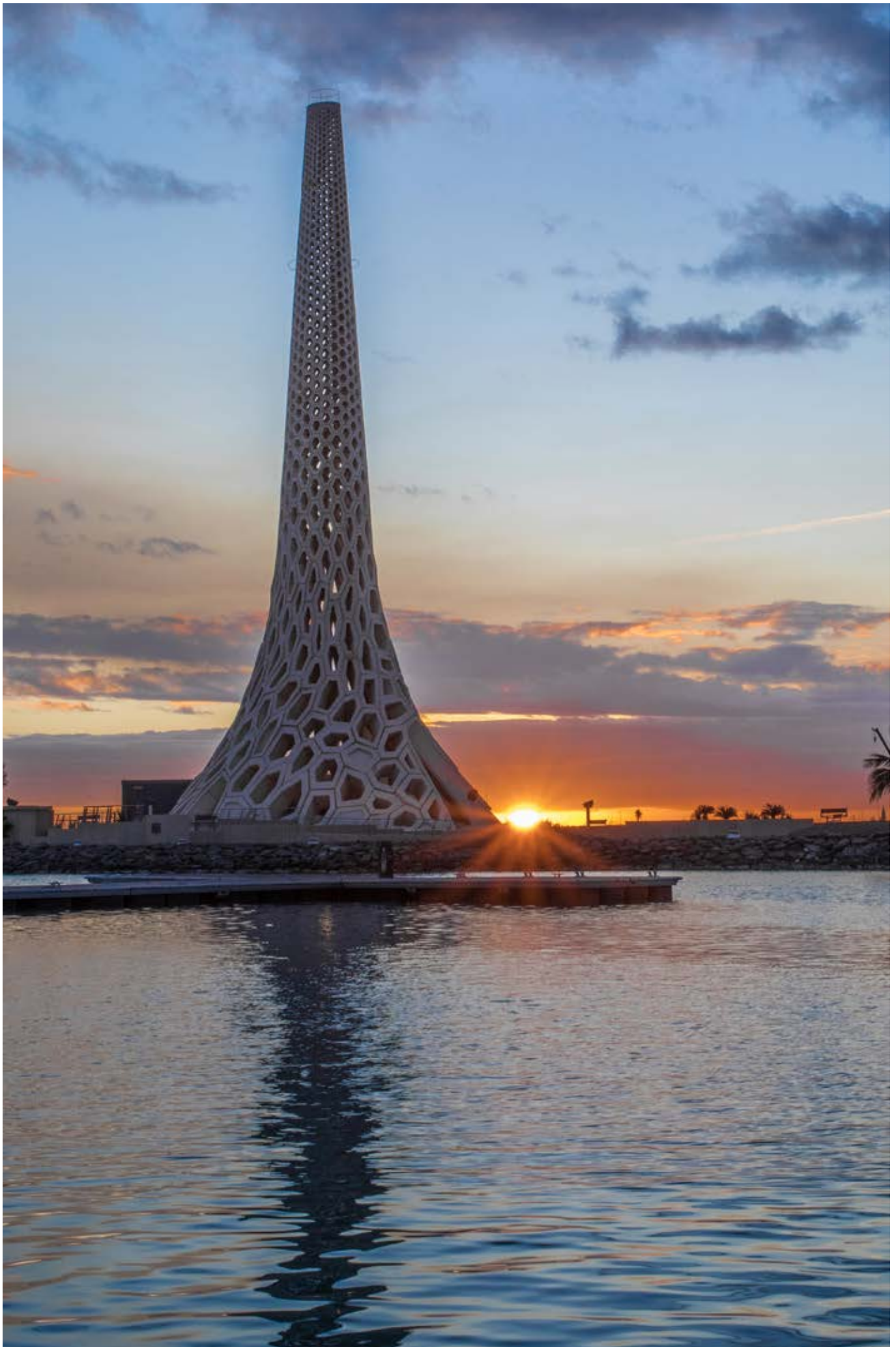
KAUST IMPACT

Pioneering Solutions for the Kingdom and the World



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





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FROM THE President

Welcome to the eighth edition of KAUST Impact. KAUST Impact was created during my presidency to provide readers with a regular snapshot of some of the great work the University is accomplishing. I am tremendously proud of all that we have achieved over the past six years and am excited to see how the University will grow in response to the new strategy that we announced last year.

Before I begin, though, I want to write that while it has always been a joy to share my thoughts on these pages, this issue leaves me with ambivalent feelings, as it is the last time I will do so since my time at KAUST draws to an end.

As with every issue, this one exemplifies the great work we are doing with a representative selection of stories. The new strategy has us aligning with the four national priorities of the Research, Development and Innovation Authority: (1) health and wellness, (2) sustainable environment and essential needs, (3) energy and industrial leadership and (4) economies of the future. By design and foresight, KAUST's original focus of Energy, Environment, Food and Water, plus the new pillars of Digital and Health that started after I came, align perfectly with these four areas. This issue shows how KAUST is making impact in all four by, for example, exploring new energy sources in the Kingdom (p.13), collaborating with leading Saudi hospitals and international companies for better healthcare (p.14), developing new bioengineering techniques to sustainably manufacture commercial products of high value to Saudi Arabia (p.25), and working with Saudi companies to combine our superior imaging technology with their own AI (p.32). We also reflect on a number of people that have brought great accolades to the University.

KAUST was founded to "serve the people of the Kingdom and benefit all the peoples of the world". All can see by the examples provided in this issue how we are accomplishing both through academic research, innovation and commercialization, and by educating young Saudis who we believe are destined to become global leaders. We publish this information so that the national population can appreciate the scientific status of our work and talented internationals are as attracted to this wonderful country as I was, so that they, too, can take part.

I came to the University as president in 2018, after having served on its Board since 2011, persuaded by the chance to lead the top research university in the region and to experience first-hand the great changes the Kingdom is experiencing. Monica and I have lived and worked in other wonderful countries where I have led universities and national agencies, but never have we witnessed such a rapid rise in scientific excellence. My role on numerous governing boards and advisory committees has allowed me to observe this excellence and the ambition that drives it not just at KAUST but across all of Saudi Arabia. My time at KAUST has been a privilege and honor. In my professional experience, nothing before or after will surpass my period here.

Finally, and sadly, during the time between this issue and the previous one, one of KAUST's greatest members and founders, Dr. Najah Ashry, passed away. Her contributions and commitment to the University are matched by few. This issue contains a memorial of her life and her fifteen years of labor over this institution with love, dedication and tremendous success.

Tony F. Chan
President of KAUST

KSA Impact

Saudi Arabia is undergoing rapid transformation that will position itself as a leader in health, energy, communications and just about every other major scientific industry. To realize this goal, the Kingdom depends on its best minds and institutes. KAUST has taken up the call through research and partnerships that have advanced many of the Kingdom's giga-projects as well as the daily lives of its people. It is also sharing its knowledge and infrastructure to help other entities in Saudi Arabia achieve their goals.

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Milestone in coral restoration



KAUST's new coral nursery off the coast of NEOM will produce 40,000 corals annually

As pioneers of sustainable development, reviving the vital sites of coral reefs is a natural step in our partnership with KAUST."

Nadhmi Al-Nasr
CEO, NEOM

Earlier this year, KAUST scientists began work on the first nursery at the KAUST Coral Restoration Initiative (KCRI), the largest coral restoration project in the world and a significant step towards restoring reefs globally.

KCRI's newly built nursery on the coast of NEOM in northwest Saudi Arabia is set to transform coral restoration efforts with a production capacity of 40,000 corals annually. Functioning as a pioneering pilot facility, researchers will leverage the nursery as the blueprint for large-scale coral restoration initiatives. Most importantly, this facility serves as a precursor to a more ambitious project: the world's largest and most advanced land-based coral nursery. Located at the

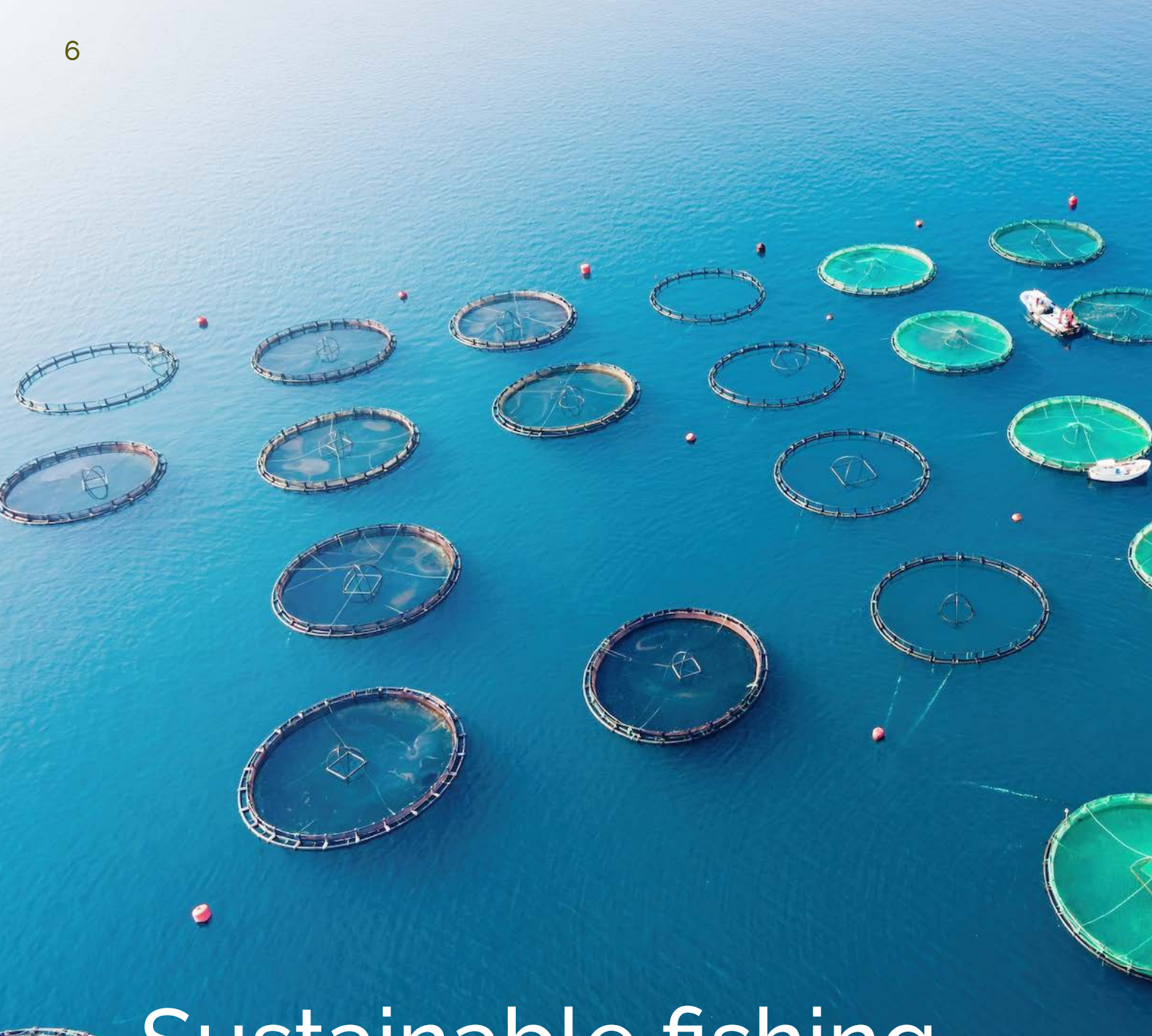
same site, this advanced coral nursery will boast a ten-fold larger capacity to nurture 400,000 corals annually. With construction quickly progressing, the project is anticipated to reach completion by December 2025.

Home to 25% of known marine species despite covering less than 1% of the sea floor, coral reefs are the bedrock of numerous marine ecosystems. This is one reason why scientists are so concerned about the rising rate of mass bleaching events, with experts estimating that up to 90% of global coral reefs will experience severe heat stress by 2050. With the frequency of such events on the rise, solutions for coral recovery will be crucial for healthy oceans.

In alignment with the Kingdom's Vision 2030 and its efforts to bolster marine conservation, KCRI is leveraging KAUST's world-leading research into marine ecosystems and serving as a platform for trialing innovative restoration methods. Set within a 100-hectare site, KCRI will deploy two million coral fragments, marking a significant step in conservation efforts.

KCRI seamlessly aligns with KAUST's overarching strategy, showcasing its dedication to catalyzing positive societal and global outcomes. Beyond environmental restoration, the project offers educational benefits, further reinforcing its alignment with the broader strategic goals outlined in Vision 2030.

In response to these efforts and its partnership with KAUST, NEOM CEO Nadhmi Al-Nasr said: "This significant initiative reflects NEOM's commitment to sustainability and to innovating solutions for the environmental challenges facing the world. As pioneers of sustainable development, reviving the vital sites of coral reefs is a natural step in our partnership with KAUST. Through our long-standing partnership with the University, we will also highlight the role of coral reefs, among the most important marine environmental systems, and the value of their preservation for future generations."



Sustainable fishing

In a world facing climate change and a rapidly growing population, food security is emerging as one of the most pressing global challenges. In response, the Kingdom has launched the Aquaculture Development Program (ADP), a joint effort coordinated by KAUST and MEWA, to transform the nation's food economy.

As one of its objectives, ADP is transforming the aquaculture sector in Saudi Arabia, a practice that involves the cultivation of aquatic organisms such as fish, shellfish and seaweed to meet domestic seafood demands and bolster the country's economy. KAUST's aquaculture efforts are expected to initially yield 280,000 tons of seafood but reach 530,000 tons annually by

“Aquafeeds represent up to 70% of production costs, so improving the feed conversion ratio (FCR) is the target for fish farmers.”

Dr. Asaad Mohamed
Director of the ADP

2030. Through this program, the Kingdom aims to reduce its reliance on imported fish, provide new jobs, attract investments and help local fishing communities become self-sufficient. Importantly, the program will alleviate pressure on wild fish populations,

which are currently endangered around Saudi's coasts due to overfishing and environmental stressors, and thus help preserve marine biodiversity. KAUST Beacon Development is an environmental consultancy department based in KAUST that oversees the program and staffed by a multidisciplinary team of marine biologists, fisheries experts, fish nutritionists, technical engineers, research scientists and other specialists. These people closely monitor and control every stage of the aquaculture production cycle, which includes fish breeding and behavior, nutrition, feed formulation, recirculated aquaculture systems and offshore sea cages.

KAUST's aquaculture efforts are expected to yield 530,000 tons annually by 2030

ADP strictly follows sustainable aquaculture practices in hatchery and cage farming, including the use of ecofriendly raw materials, such as poultry by-products, single-cell proteins, microalgae and insect meal, to produce aquafeeds. Additionally, ADP is implementing Integrated Multitrophic Aquaculture (IMTA), an innovative approach that involves farming multiple aquatic species of varying trophic levels together. In IMTA, waste products from one species are recaptured and converted into valuable resources such as feed, fertilizers and energy for another species. This circular economy approach minimizes energy losses and environmental deterioration while promoting sustainability.

"Aquafeeds represent up to 70% of production costs, so improving the feed conversion ratio is the target for fish farmers," said Dr. Asaad Mohamed, Director of the ADP.

To produce cost-effective aquafeeds, ADP has developed over 30 new high-value finfish feed formulations, achieving significant improvements of 10-15% in the feed conversion ratio and 15-35% in the economic conversion ratio. Adopting these new feed formulations could save Saudi Arabia \$417 million per year based on the predicted feed requirements for fish production.



ADP has two experimental facilities at its disposal: the KAUST Coastal and Marine Resources Core Lab and the hatchery, which will be fully operational by September 2024. Offshore cages in the open sea in Al Rayes are utilized to conduct research and evaluate grow-out, simulating commercial production.

The project has successfully reared and bred several species in captivity, including the snubnose pompano, sobaity seabream, orange-spotted grouper and mangrove red snapper, all of which are endemic to the coasts of Saudi Arabia. These species, being tropical in nature, thrive exceptionally well under the conditions found in the Red Sea, which is crucial for their successful performance in captivity.

For its success, KAUST Beacon Development is working with multiple organizations around the world that bring unique expertise to the Kingdom while also setting up programs that benefit the skills and job prospects of local communities.

"Looking ahead to the future of Saudi Arabia, ADP consistently invests in capacity building for Saudi nationals. Each year, KAUST Beacon Development welcomes trainees to join the team and gain expertise across various aspects of aquaculture, including laboratory analysis, hatchery production, aquafeed production and fish cage farming. This initiative aims to nurture a new generation of professionals who will drive the future of aquaculture production in the Kingdom," said Mohamed.



Heart disease in Arabs

Working with scientists at King Faisal Specialist Hospital and Research Centre (KFSHRC) and multiple academic institutes in the United States, KAUST researchers have developed a new method to predict the risk of cardiometabolic disease accurately in different ethnic populations based on genetic information. The method was demonstrated on Arab populations but is easily extended to other ethnic populations underrepresented in public databases.

While the scientific community has gathered genetic data on millions of people, most of them are of European descent. Consequently, the proportion of Arabs and individuals from other ethnicities in these databases is relatively small. Individuals at high risk within these underrepresented groups may not be properly identified using standard analysis methods. Focusing on Arab communities, the study presents a new framework that utilizes the same databases alongside public computational tools to determine polygenic scores, offering a more accurate prediction of heart disease.

One of the senior authors of the study, Dr. Akl Fahed, a cardiologist and scientist at Mass General Hospital and the Broad

Institute, said: "The power of this work lies in leveraging a framework to develop new polygenic scores for populations with limited genomic data using publicly available sources."

Another senior author of the study, KAUST Professor Dr. Xin Gao, added, "We have developed a general, pragmatic framework consisting of four steps that can be employed to optimize polygenic risk scores for new populations. This framework proves particularly valuable for populations that are underrepresented in current genome-wide association studies and large biobanks."

By examining the records of over 5,000 Arab patients, the researchers successfully associated genomic risk with disease severity using their framework. Furthermore, the study demonstrates that genetic risk complements conventional risk factors such as obesity, providing valuable insights into clinical utility.

Dr. Fowzan AlKuraya, a senior author of the study and medical geneticist from KFSHRC, explained that gaining a better understanding of the risk should prompt changes in both patient and physician behavior.

"This framework proves particularly valuable for populations that are underrepresented in current genome-wide association studies and large biobanks."

Dr. Xin Gao
KAUST Professor

"The hope is that by presenting a high polygenic score to someone, they will be motivated to take more proactive measures to address modifiable risk factors. This also applies to their physicians, who should reconsider interventions based on the polygenic score, including more frequent and earlier disease screenings," he said.

PEOPLE IMPACT

L'Oréal-UNESCO For Women in Science

Two KAUST researchers were recognized for their excellent science and inspiration to aspiring female scientists. Assistant Professor Dana Alsulaiman was named one of six 2023 L'Oréal-UNESCO For Women in Science Middle East Regional Young Talents. Ph.D. student Lila Aldakheel was also recognized by the organization for her achievements in the student category.

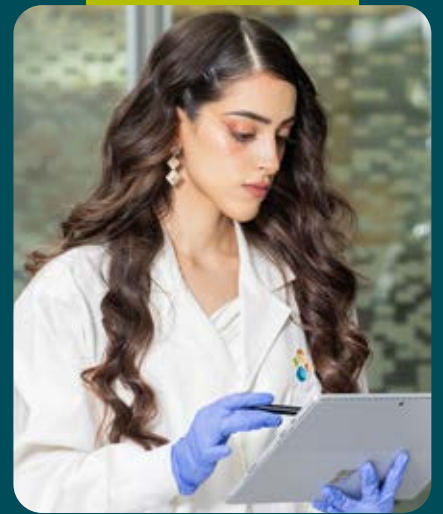
Since 2014, the L'Oréal-UNESCO For Women in Science Middle East Regional Young Talents program has recognized young Arab female scientists from Gulf countries who have excelled at the life or physical sciences.

Alsulaiman joined KAUST in 2021 after studying and working in several countries. Upon finishing her high school studies in Canada, she earned three degrees at Imperial College of London before joining MIT as an Ibn Khaldun Postdoctoral Fellow to combine polymeric biomaterials and micro-technologies in healthcare applications. Using her innovations to detect disease-specific nucleic acid biomarkers, including DNA and microRNA, she aims to give the healthcare industry tools for the early and accurate detection of several diseases such as cancer. Furthermore, her technologies save money and are minimally invasive, meaning more patients are likely to have access to the tests.

The award is a testament to not only her accomplishments but also the innovative approaches she has taken in developing biomarker detection technologies. It also considers how the candidate has advocated science to youth and encouraged Arab women to enter the field.

"I am tremendously grateful for this recognition. With the support and facilities I have access to here in Saudi Arabia and KAUST, I hope and intend to make bold and creative contributions to transforming the field of healthcare in the MENA region and beyond," she said.

Aldakheel is studying the effects of microplastics contaminating mangrove forests and ways to degrade the microplastics in the laboratory of Professor Alexandre Rosado. She is also examining microbial communities within microplastics, as they may have properties that promote microplastic degradation.



Dana Alsulaiman

Lila Aldakheel





Flash floods in the Gulf

Earlier this year, some countries in the Arabian Peninsula, including the United Arab Emirates and Oman, saw rainfall in one day that exceeded their average annual rainfall. This extreme weather event has led to massive flooding and the death of at least dozens in the region. Climate scientists fear countries should expect more of these events in the near future. Indeed, last year, a group of scientists at KAUST published the Climate Futures Report, which provides a comprehensive analysis of climate change and its consequences in the region.

While rising temperatures are predicted to increase the intensity and frequency of droughts and add stress to food production, they are also anticipated to increase flash floods like those seen across the Kingdom. Riyadh was one of those affected by the recent floods and has seen more than 10 floods in the past 30 years. Models in the report predict that annual maximum rainfall will increase by 33% before the end of the century under a high greenhouse gas emissions scenario.

Many nations are unprepared for these extreme weather events. As seen in the Arabian Peninsula, deaths are just one of the ways lives will be affected. With

roads flooded and flights canceled, the economic disruption has yet to be calculated, but there is no doubt the costs will be onerous.

“The Gulf region frequently experiences high-intensity, short-duration rainfall events that typically result in flash floods.”

Hylke Beck
KAUST Assistant Professor

“The Gulf region frequently experiences high-intensity, short-duration rainfall events that typically result in flash floods. These floods swiftly navigate through wadis toward the sea or ocean. However, urbanization, driven by a rapidly expanding population, has altered natural water flow paths, sometimes hindering the efficient passage of floodwaters, causing not only loss of life and damage to infrastructure and property, but also overwhelming sewage systems and potentially spreading diseases,” said Assistant Professor

Hylke Beck, a co-author of the Climate Futures Report. The report was done as a collaboration between KAUST, AEON Collective and King Abdullah Petroleum Studies and Research Center (KAPSARC).

While Saudi Arabia has 574 dams designed to protect against flash floods, the assumptions during their construction might not anticipate future climate change conditions. With its expertise in the field, KAUST is supporting MEWA by devoting its resources to improving the management of new and existing dams and enhancing flash flood warning systems.

KAUST has established itself as a global leader in the field, especially regarding climate in the Arabian Peninsula and Saudi Arabia. Because of its vast collaborations, KAUST has an extraordinary collection of satellite ocean and atmospheric data of the region, while its supercomputing facilities – top in the region – provide unprecedented capabilities for the analysis of this data.

As new research continues to provide new insights, Beck and other KAUST scientists plan to publish a new report for COP16 in Riyadh in December 2024.



The best supercomputing in the region

We are proud to partner with KAUST to accelerate its world-class research."

Trish Damkroger

Senior Vice President and Chief Product Officer of HPC, AI & Labs at HPE

Last year, KAUST's Shaheen III became operational. Moreover, the definitive global voice of supercomputer statistics, the TOP500 list, confirmed last year that Shaheen III is the Middle East's most powerful supercomputer, ranking 20th in the world.

Built by the world's leading supercomputer provider, Hewlett Packard Enterprise (HPE), Shaheen III is about six times faster than KAUST's previous supercomputer, Shaheen II, and has a processing power that exceeds 500,000 latest-generation MacBook Pros operating in concert.

Based on HPE Cray EX architecture, which also powers three of the world's top 10 systems, Shaheen III supports regionally unprecedented performance and scale, enabling high-resolution models of physical systems

KAUST will operate Shaheen III to support the construction and application of predictive mathematical models using

traditional simulations based on differential equations, emulation based on statistics, and machine learning based on neural networks. These mathematical models will be employed in the service of scientific discovery, engineering design and policy support.

KAUST Professor David Keyes remarked: "Supercomputing is part of KAUST's research and curricular DNA, with many of our faculty recruited around supercomputing. Computational approaches formerly lagged theoretical, observational and experimental approaches. Now, more often than not, they lead because of supercomputers like Shaheen III."

In its first phase, Shaheen III will be deployed to superpower research across many fields contributing to sustainability goals, such as campaigns in materials, catalysis, the combustion of alternative fuels, carbon sequestration and bioinformatics. Furthermore, Shaheen III will be used to create superior models for atmospheric and ocean dynamics and aerodynamics engineering, supporting KAUST's established research on Formula 1 racing vehicles, for example. Shaheen III will also provide advanced noninvasive imaging for areas such as the discovery of petroleum reservoirs, medical imaging and the nondestructive evaluation of structures.

"We are proud to partner with KAUST to accelerate its world-class research in fields such as climate change, clean energy and life sciences and to celebrate their achievement," said Trish Damkroger, Senior Vice President and Chief Product Officer of HPC, AI & Labs at HPE. "Research universities like KAUST are increasingly putting supercomputers at the heart of their curriculum because modeling, simulation, machine learning and AI capabilities are fundamental to scientific discovery and innovation."

As one of the world's leading supercomputing centers, KAUST is building on the success of its first supercomputer, Shaheen I, launched in 2009, followed by Shaheen II, a HPE Cray EX supercomputer that was 25 times faster than its predecessor at 5.54 petaflops/s. Over 66% of KAUST's faculty currently engaged in supercomputer activity on Shaheen II, with the percentage using Shaheen III expected to be even higher.

PEOPLE IMPACT

New Saudi Citizens

As part of its goal to achieve Vision 2030, a Royal decree was issued this year to grant Saudi citizenship to talented scientists, entrepreneurs and other experts. Among those who received the honor were KAUST professors Niveen Khashab and Noredine Ghaffour.

Both professors have had a long impact in Saudi Arabia. After earning her degrees in Lebanon and the United States, Khashab is a KAUST founder and helped set up the chemistry program. Her research has led to programmable and intelligent nanomaterials, attracting the attention of the medical industry for their usefulness in drug delivery and gene therapies and the agricultural industry for sustainability solutions.

Ghaffour, who earned his degrees in France, arrived at KAUST a year after Khashab for his extensive academic and industrial experience in desalination. His work focuses on reducing the economic and environmental costs of desalination for water supply sustainability by improving the performance of existing technologies and developing innovative, low-energy processes driven by renewable energies.

For Khashab, the news came half a year after she was recognized as a Great Arab Mind. The annual award is given to extraordinary Arabs around the world.

"This is a true honor. One of the reasons I joined KAUST was because I believed that Arab nations could once again lead in science and technology. This award doesn't only recognize me, it recognizes the great environment KAUST and the Kingdom of Saudi Arabia provide for scientists to thrive," she said.

The first decree for such citizenship was made in 2021.



Niveen Khashab

Noredine Ghaffour





Groundbreaking Saudi's geothermal potential

Partnering with KAUST is a testament of our joint alignment on harnessing alternative sustainable energy sources."

Meshary ALayed
TAQA Geothermal CEO and Managing Director

KAUST and TAQA Geothermal, a Saudi-based energy company, have partnered in an endeavor to unlock Saudi Arabia's geothermal potential.

The two partners have 'spudded,' or broken ground for, a shallow well 400 meters deep on the KAUST campus as a test case for the monitoring and surveillance of future geothermal energy extraction in Saudi Arabia.

The data gained from the well site will be used for the planning and risk mitigation of deeper geothermal wells. The temperature of geothermal energy acquired from a well depends on the well's depth, with deeper

wells providing hotter temperatures and, therefore, wider potential. However, the costs and risks increase with the well depth. Thus, 400 meters was decided as an appropriate initial depth to investigate novel processing and analysis techniques. This project will provide valuable data for future geothermal energy extraction.

The project is further designed to test new technologies, such as fiber optics and drill rigs, and to test new workflows for geology and seismology research, providing new knowledge on processing and analysis.

The project is led by KAUST Research Professor Thomas Finkbeiner, who said that geothermal energy, if harnessed efficiently, offers the most stable renewable energy source.

"Geothermal provides critical baseload energy available even when the sun does not shine or the wind does not blow."

The site was selected for its favorable geology and, considering the many KAUST researchers involved, proximity to KAUST.

TAQA Geothermal CEO and Managing Director, Meshary ALayed, remarked: "Drilling of this observation well on the KAUST campus marks real groundbreaking of the ambitious geothermal exploration project. Partnering with KAUST is a testament of our joint alignment on harnessing alternative sustainable energy sources for benefit of the Kingdom while advancing technology, research, and private sector partnerships."

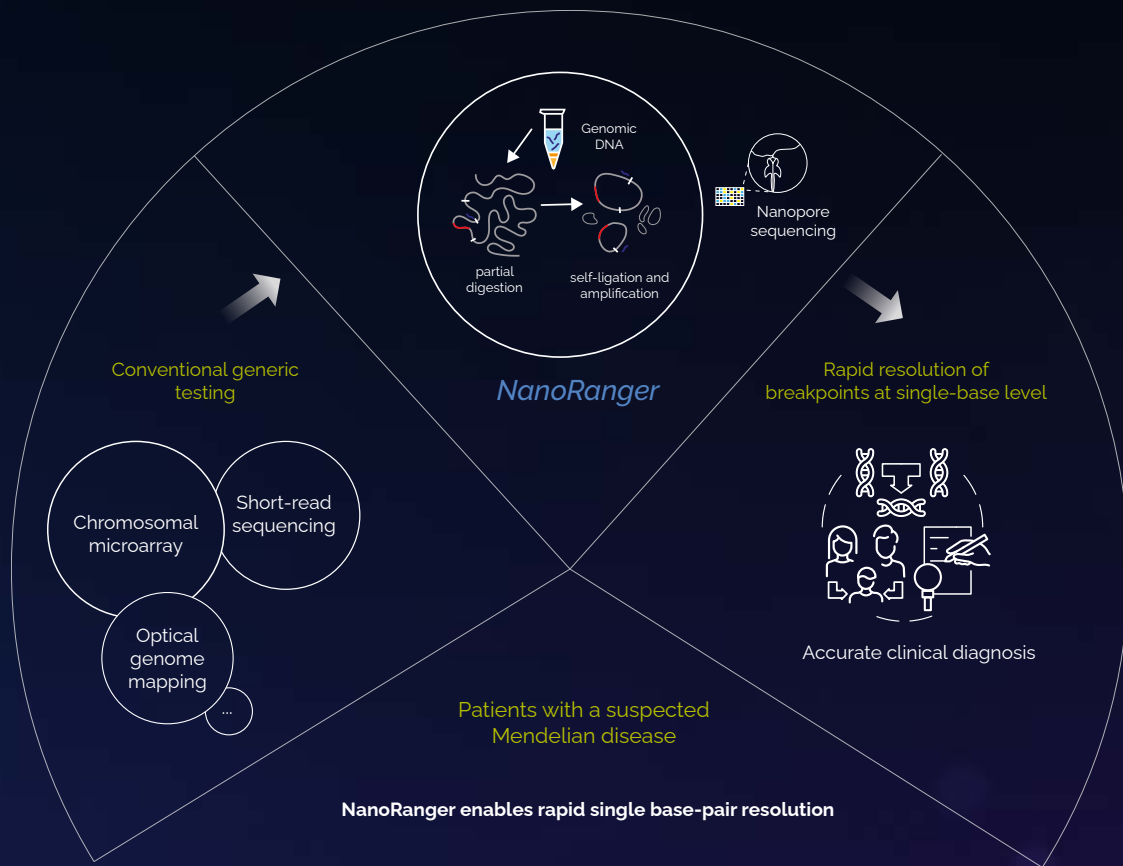
The project is also intended to build domestic partnerships between academia and industry for innovation and commercialization in geothermal energy.

KAUST technology gives hope to Saudi patients

“We have learned a tremendous amount about Mendelian diseases through gene sequencing, but many more remain undiagnosed and require long-read sequencing for their diagnosis.”

Mo Li
KAUST Associate Professor

Gene sequencing has become an invaluable diagnostic tool for identifying the mutations that cause genetic diseases. However, many of these mutations remain untraceable due to technological limitations. Working with medical scientists at King Faisal Specialist Hospital and Research Centre (KFSHRC), KAUST researchers have developed a new gene sequencing system called NanoRanger that promises a cheaper and faster tool for patients suffering from genetic diseases caused by an unidentified mutation.



Mendelian diseases, such as muscular dystrophy and sickle cell anemia, are diseases caused by an abnormality in a single gene and are among the most studied genetic diseases. Mendelian diseases are particularly prevalent in Saudi Arabia due to the Kingdom's high rate of consanguinity.

Each of the more than 60,000 genes in the human body is represented by two alleles, one from the mother and one from the father. In nearly all Mendelian diseases, both alleles are mutated, resulting in an autosomal recessive disease (compared with autosomal dominant). On the other hand, if the mutation exists in only one allele in an autosomal recessive disease, then the person is a carrier, meaning they do not suffer from the disease, but their offspring are at risk because the mutation can be passed on to both alleles if both parents are carriers. As a result, the family of someone suffering from a recessive Mendelian disease has far more carriers. Furthermore, communities where consanguinity is common show an unusually high prevalence. Numerous Mendelian diseases are responsible for high rates of infant mortality and morbidity in Arab nations.

"We have learned a tremendous amount about Mendelian diseases through gene sequencing, but many more remain undiagnosed and require long-read sequencing for correct diagnosis," explained Associate Professor Mo Li, whose laboratory developed NanoRanger.

Gene sequencing is a standard tool in medical genetics. The original gene sequencing technique was based on short-read sequencing, which has provided invaluable information on genetic diseases. However, short-read sequencing is not capable of analyzing certain complex structures in DNA, including those typically found in rare Mendelian diseases. Long-read sequencing fills these knowledge gaps but is technically more expensive and demanding.

Building on existing long-read sequencing technologies, NanoRanger offers a faster and simpler process to detect DNA abnormalities, such as structural variants, at base resolution. To grasp how small that resolution is, human DNA is constituted of a chain of four base types, and the human genome is over 6 billion bases long. Moreover, a mutation in only a single base is enough to cause a debilitating disease like sickle cell anemia or cystic fibrosis, for example.

Li said that NanoRanger is based on optimizing several processes in established gene sequencing.

"NanoRanger uses simple molecular biology strategies to fish out genomic regions that are suspected of harboring complex mutations, deletions or rearrangements."

To demonstrate the medical benefits of NanoRanger, KAUST scientists analyzed

clinical samples from 13 patients at KFSHRC, identifying genetic abnormalities that were undetectable previously. Thus, NanoRanger could provide a diagnosis not just for the patient but also for the parents who may not have realized they were carriers. Indeed, using the information gained from NanoRanger, one couple opted to conceive by in vitro fertilization to ensure their child did not inherit a disease for which they both carry the causal mutation. However, it should be noted that NanoRanger is still undergoing trials and is not yet available to patients. Finally, NanoRanger requires less DNA than other long-read sequencing methods, enabling more types of tests to be carried out.

Industry has taken note of this work. Globally, there are two leading commercial companies that provide long-read sequencing machines. KAUST is the first institute in Saudi Arabia to be a certified service provider for both, and one of them has reached out to Li about the further development and commercialization of NanoRanger.

"We have filed for a patent and plan to integrate NanoRanger into standard diagnostic routines in Saudi Arabia," said Li.

Research Impact

As a graduate university of science and technology, our research is paramount. Our more than 200 laboratories are dedicated to discoveries that enhance our understanding of our world and universe and change the way we live and the environment around us. In the next several pages are findings from the past months that exemplify this commitment. They are only a tiny fraction of the thousands of academic papers we publish annually, nearly a quarter of which are found in the top 10% of cited journals.

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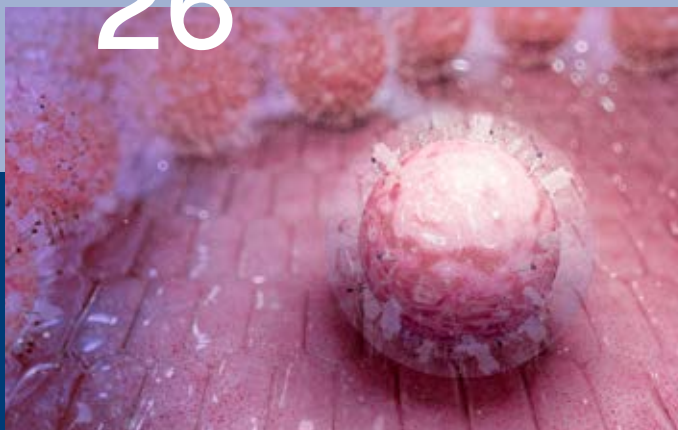
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Ancient life in the Red Sea



Vahrenkamp and Daffonchio on Sheybarah Island.

“These stromatolites live in an environment rich in biodiversity. This is unlike other stromatolites, which live in more restricted environments with less diverse life.”

Volker Vahrenkamp
KAUST Professor

KAUST researchers have discovered a rare bio-sedimentary formation off Sheybarah Island in the Red Sea. The formation represents only the second known group of living stromatolites ever found thriving in normal marine settings. The existence of these stromatolites sheds a new perspective on the origins of life on Earth and the possibility of life on other planets.

Stromatolites are viewed as fossils of the first life on earth that emerged some 3.4 billion years ago. Then common, they are nowadays rare and found only in extreme

environments, such as salt lakes and hypersaline lagoons. They are believed to have played a pivotal role in transforming Earth’s atmosphere by generating oxygen through the activity of photosynthetic microbes like cyanobacteria. The scientists found a complex and diverse community of microbes inhabiting the Sheybarah stromatolites, including the discovery of reticulated filaments, which were previously only known to be found in caves, marking the first time such filaments have been observed in stromatolites existing in a daylight environment.

The reticulated filaments are just one of several unusual properties of the Sheybarah stromatolites.

“These stromatolites live in an environment rich in biodiversity. This is unlike other stromatolites, which live in more restricted environments with

less diverse life,” said Professor Volker Vahrenkamp, who led the study.

An additional analysis led by Professor Daniele Daffonchio revealed that the discovered stromatolites unexpectedly share a similar microbial composition with living stromatolites near the Bahamas and only other living stromatolites known in a normal marine environment.

While the research is only at its initial stage, the KAUST team has already been contacted by scientists affiliated with the Mars mission, since the existence of stromatolites on Mars would give evidence of an early oxygen atmosphere to the Red Planet, suggesting the Red Sea stromatolites may provide insight on how, if ever, life formed on Mars.



Fooling coral reefs

The world's coral reefs are dying. The sea has seen half of its coral coverage disappear in the past fifty years, and scientists estimate that the total will reach 90% if temperatures rise two degrees Celsius. The effects are profound, as nearly a third of marine life calls coral reefs home, and nearly a billion people depend on them for their livelihood.

Corals themselves grow through a symbiotic relationship with dinoflagellate algae so essential that they cannot survive without them. The symbionts live inside the coral cells and provide them with enough photosynthetic products to cover most of their energetic needs. Thus, coral reefs flourish, creating the equivalent of an underwater rainforest rich with life. When this relationship breaks

down, however, as has been the case with rising temperatures, the corals will purge themselves of the symbionts, replacing their kaleidoscope of colors with a bland white, a process known as coral bleaching. More important, the corals starve and eventually die.

Yet some corals thrive in hotter temperatures, especially those in warmer waters like the Red Sea. Indeed, KAUST researchers, such as Professor Manuel Aranda, have shown that some coral species found in the Arabian Gulf are more tolerant of high temperatures than the same species found in other parts of the world like the Indian Ocean. The difference, the researchers have shown, is in their genes. They are therefore mating corals from different parts of the world under

the assumption that the offspring will be more thermoresistant than had they been parented only by corals from cooler places.

"A problem we're facing in our breeding experiments is that coral colonies from different places would usually not spawn at the same time. Using the coral spawning system, however, we can time their spawning to cross colonies that would naturally not cross," explained Aranda about a commercial system available at the KAUST Coastal and Marine Resources Core Lab (CMR).

By analyzing the genes of the parents and offspring using the advanced genome sequencing technology at the KAUST Bioscience Core Lab, researchers like Aranda expect to identify and isolate



◀ Coral experiments at the Core Labs

▼ Prieto (left) and Aranda observing the corals



the genes most likely to be responsible for temperature resilience and use this information to “increase the resilience of coral through selective breeding by crossing them with coral colonies from warmer environments,” he said.

KAUST scientists are therefore combing the coral genome, which is about one third the size of the human genome, for candidate genes. To confirm that these candidates give the corals a higher evolutionary fitness, Aranda and his colleagues are using gene-editing technology to study the effects of these genes on corals. However, these experiments depend on breeding, and most coral species spawn only once a year, giving scientists a short window to collect gametes and larvae for their experiments. Unsuccessful efforts mean scientists can do little more than wait until next year. The coral spawning system at CMR offers a solution.

By modulating the temperature and light of the system, CMR staff trick the corals into spawning at unnatural months. Thus, although a single coral will still spawn just once a year, the same species can spawn multiple times.

Scientifically, these experiments are known as assisted evolution – the artificial acceleration of evolution. They are also the basis for coral reef restoration efforts, be it in Saudi Arabia, such as the KAUST Coral Restoration Initiative (see p.5), or beyond. Currently, Aranda’s team is investigating two coral reef species: *Acropora hemprichii* and *Galaxea fascicularis*, both of which are found around the Arabian Peninsula, but the plan is to expand to several more species. Ultimately, coral offspring with the right genetic fitness will be introduced to seas experiencing rising temperatures as a strategy to protect and restore the reefs.

“Our focus is the Red Sea, but we aim to work with researchers internationally so that similar projects will benefit restoration efforts throughout the world.”

Manuel Aranda
KAUST Professor

“Our focus is the Red Sea, but we aim to work with researchers internationally so that similar projects will benefit restoration efforts throughout the world,” said Aranda.

Raindrops falling



The simple process of a droplet falling into water is underpinned by very complex dynamics. To study this phenomenon, researchers have traditionally focused on droplets of small diameters, where the physics of surface tension dominates gravitational forces. KAUST scientists, however, have investigated the impact of large water droplets, a more difficult problem, discovering that the droplet shape affects the outcome.

The researchers found that when large droplets fall into a pool of water, the shape of the droplet at impact greatly influences the depth and width of the cavity formed in the water. The maximum cavity depth is influenced by the velocity of the droplet at impact as well as the ratio of the height and width of the droplet.

"The impact of the droplet shape on cavity formation provides a nuanced understanding of a phenomenon previously assumed to be primarily influenced by droplet size and velocity," explained Sandip Dighe, a postdoctoral researcher in the laboratory of Associate Professor Tadd Truscott.

"The observation of extreme droplet shapes and their impact behavior, such as the 'bagging regime', where droplets flatten significantly upon impact, adds another layer to our understanding of fluid dynamics."

The study showed that cavity depth depends more on the droplet height than width, but the maximum cavity diameter is independent of the droplet height. More oblate droplets — those with greater horizontal diameters — decrease cavity depths for a fixed liquid volume. This is because an increase in the horizontal droplet diameter reduces the impact energy flux.

While the studied phenomenon can be seen in a puddle on a rainy day, Truscott explained that the implications are significant for a world trying to understand changes to our climate and oceans.

"This research enhances our understanding of natural phenomena such as raindrop impacts. The turbulence generated on raindrop impact is instrumental in mixing ocean surface

The impact of the droplet shape on cavity formation provides a nuanced understanding of a phenomenon previously assumed to be primarily influenced by droplet size and velocity."

Sandip Dighe
KAUST Postdoctoral Researcher

layers and facilitating the distribution of heat, nutrients and gases. Such processes are integral to environmental science, climate models, marine ecosystems and fluid mechanics. So gaining insights into droplet behavior improves our understanding in these areas too."

The research also has potential applications in fields such as mechanical and marine engineering. "It could inform the design of water-based cooling systems, optimizing fuel injection systems or development of technologies for tackling oil spills," said Dighe.



Artificial skin for the voiceless

Several tens of millions if not hundreds of millions of people around the world have problems creating or forming speech sounds. The lower quality of life is magnified in children, who fall behind in development and education. As a solution, a team of KAUST researchers led by Professor Khaled Salama have developed an assistive magnetic skin system for speech reconstruction they call AM2S-SR. AM2S-SR combines wearable magnetic skins and machine learning to track mouth movements for speech reconstruction.

"Most individuals with speech impairments rely on sign language, which very few people understand. Our technology enables a more natural way to communicate using only their mouth movements whenever they want and wherever they are," says Montserrat Ramirez De Angel, who is earning her Ph.D. at KAUST through this research.

Salama's laboratory is already established as a leader in artificial skin technology. Their skin is safe, comfortable to wear, can be modified into any shape and size, and does not require a wired connection to other devices. Further, the skin contains magnetized microparticles that, when coupled with magnetic sensors, can measure vibration, touch and movement.

Previous work by the group has demonstrated how the magnetic skin can be used to track facial expressions in people with quadriplegia and help them control wheelchair movements. The skin can also track eye movements, which could be used to analyze sleep patterns or interact with machines without making contact.

"When we tested magnetic skin samples around the mouth, we realized it could accurately read the movements involved in producing speech. We then embarked on this project to help people with voice disorders to communicate more easily," Ramirez De Angel explained.

AM2S-SR has been designed to help people with voice disorders caused by physical or functional damage that affects the movement of air from the lungs to vocal cords, throat, nose, mouth or lips.

The system involves two magnetic skin patches that are attached near the bottom lip. As the user talks, the artificial skin moves, causing changes in the magnetic field surrounding the mouth. These changes are detected by sensors — two magnetophones placed at each side of the face — that stream the data to a head-unit where it is processed and analyzed using a machine learning algorithm, which can

Most individuals with speech impairments rely on sign language, which very few people understand. Our technology enables a more natural way to communicate."

Montserrat Ramirez De Angel
KAUST Ph.D. Student

predict the intended words and letters. The predicted words are then exported to a display or speakers.

"Because mouth movements are so complex and differ between individuals, we had to collect a lot of data to train the system, but, as a result, it is very robust," said Ramirez De Angel.

Ramirez De Angel received an award for the live demonstration of AM2S-SR at the IEEE Biomedical Circuits and Systems Conference 2023, and the lab plans to test their technology in patients.

"I will begin a collaboration with a rehabilitation center in Italy, where we will train the system to accommodate specific speech-sound diseases, such as apraxia or asymmetric mouth movement coordination," she said.

PEOPLE IMPACT

Professor made UNESCO chair

One of the lasting impacts of COVID-19 is in education. With schools physically shutting down all around the world, there was a sudden, mad scramble to continue schooling online. This effort depended on an essential assumption, however: students were connected. This was not the case for about half of the world's schools, a number that reached closer to two-thirds in the least developed countries.



Facts like these led Professor Mohamed-Slim Alouini to incorporate into his research priorities an effort to, as he puts it, "connect the unconnected". His work in this area resulted in him becoming the United Nations Educational, Scientific and Cultural Organization (UNESCO) Chair on "Education for Connecting the Unconnected" in 2023.


Alouini is an international leader in communications science, developing solutions that transmit more data at higher speeds. His awareness of connectivity came when he was made a fellow by the African Academy of Sciences. In preparation for his acceptance talk in 2017, Alouini read more about the continent and realized that most achievements in communications science had a negligible impact on about one-third of the world's population.

Alouini's research seeks new connectivity approaches that bridge the digital divide and ensure that children and young people, particularly those in underserved and remote communities, are not disadvantaged in education.

"Despite significant efforts made in recent years to enhance cellular coverage across the Kingdom, further research is still required to connect the remaining unreached communities and underserved areas", said Dr. Mohammed Alotaibi, Deputy Governor, Radio Spectrum at the Saudi Communications, Space and Technology Commission, about the importance of Alouini's work.

At the same time, Alouini continues his work on communications research that achieves higher speeds, lower

latency and more devices, all key milestones that will expedite the adoption of 5G and eventually 6G technology (see p.30) as part of the Kingdom's priority of economies of the future.



Affordable solar cells

KAUST scientists have reported a new strategy for the design of perovskite solar cells that extends their stability and raises their efficiency to levels more comparable with their more expensive silicon solar cell counterparts. The KAUST solution involves thin perovskite layers at the top and bottom of the solar cell interface. The finding is expected to stimulate more investment in solar power by industries and nations, including Saudi Arabia, which plans to generate approximately 70% of its renewable energy from solar by 2030.

Since perovskite-based solar cells were first demonstrated in 2009, they have gained significant attention from the solar industry. Unlike their silicon-based counterparts, they can be created at low temperatures and are easily deposited on most surfaces, including flexible ones, making them lighter, more adaptable and cheaper. Finally, because they can absorb a wider spectrum of visible light wavelengths, perovskite solar cells are expected to achieve higher energy capacity than their silicon counterparts. However, perovskite solar cells will not overtake silicon solar cells no matter the cost so long as certain limitations remain.

"Stability is the biggest issue. Because we use low temperatures [in the synthesis], defects are unavoidable. The solution to overcome this is passivity materials with scalable solutions," says KAUST Randi Azmi, a postdoctoral researcher in the laboratory of Professor Stefaan de Wolf, whose group has regularly achieved world records with regards to solar cell performance.

Thin layers deposited onto the top and bottom of the 3D perovskite interface in the solar cell provide the best passivity. To maximize performance, these crystal structures must be controlled for their thickness, purity and dimensions.

The researchers tested several commercial ligands before identifying the one that best interacted with the 3D perovskites for passivation. This ligand did not wash away during the deposition process, maintaining a pure composition in the thin layers, resulting in an effective heterojunction on both the top and bottom sides of the 3D perovskites.

The scientists found that their perovskite solar cells with this new heterojunction have a power conversion efficiency of 25.6%, which is comparable with silicon

"Stability is the biggest issue. Because we use low temperatures [in the synthesis], defects are unavoidable. The solution is passivity materials with scalable solutions."

Randi Azmi
KAUST Postdoctoral Researcher

solar cells and higher than standard perovskite solar cells. More importantly, the efficiency showed a relative loss of only 5% after 1000 hours of exposure to high heat, whereas cells designed with other passivity materials saw relative losses of around 20%.

Further, by understanding how the ligand stabilizes the thin layers through a comprehensive characterization analysis that included electron microscopy, the team expects to further optimize the heterojunction for higher stability.

"The elegance of our work is the simplicity and scalability. Other perovskite labs should be able to incorporate our solution into their workflow," said De Wolf.



New stem cell for cell therapies

Hematopoietic stem cell (HSC) transplantations are a radical cure for all sorts of blood-related diseases, from leukemias to even HIV. However, this treatment comes with many risks, and HSCs themselves are a challenge to procure and prepare. KAUST researchers reported a method that enhances the functionality of an often-overlooked type of stem cell. If so, the findings promise better treatments for hematological diseases.

"These cells could go a long way toward improving regenerative medicine," said Professor Jasmeen Merzaban, who led the research.

For cell therapies, clinicians and scientists generally rely on the expression of proteins on the cell surface. For HSCs, this protein is known as CD34. In HSC transplants, patients with malfunctioning bone marrow are infused with a new set of healthy HSCs. HSCs that express CD34 show a good ability to hone to the bone marrow and establish themselves there, where they produce the whole repertoire of blood cells, including red blood cells, lymphocytes, platelets and more.

However, this emphasis on CD34-positive HSCs has inadvertently sidelined a population of CD34-negative counterparts that are mostly found in umbilical cord blood. Although these cells are limited in their migration abilities within the bloodstream, they are thought to have greater regenerative capacity because of their more primitive developmental state.

"There is deep untapped potential in using CD34-negative HSCs in transplantation," said Dr. Asma Al-Amoodi, a postdoctoral researcher in Merzaban's lab.

To prove her claim, Al-Amoodi and her colleagues characterized the different types of HSCs found in cord blood and noticed that CD34-negative cells were lacking in sialyl Lewis X, a sugar molecule expressed by CD34-positive HSCs that helps direct the latter cells to the bone marrow.

To address this deficiency, the researchers treated CD34-negative HSCs with enzymes necessary to boost production of this sugar. The result was CD34-negative HSCs with newfound homing abilities.

These cells could go a long way toward improving regenerative medicine."

Jasmeen Merzaban
KAUST Professor

After transplantation into mice, the modified CD34-negative cells quickly made their way into the bone marrow, where they continued to pump out new healthy blood and immune cells for months. The HSCs also showed elevated activity of genes involved in adhesion mechanisms that facilitate interactions and engraftment within the bone marrow environment.

"Given how effectively CD34-negative cells integrate with the bone marrow niche, their use could prolong cell regeneration in the transplant recipient," said Al-Amoodi.

She added that incorporating both CD34-positive and CD34-negative HSCs in transplantation procedures may enhance the therapeutic efficiency and reduce the cost of the treatment.



Greening the scent of Arabia

Sometimes called the scent of Arabia, resinous agarwood is one of the most expensive raw fragrance ingredients in the world. Known in the Middle East as oudh perfumes and bakhour incense, both products are made with the fragrant resinous wood of trees in the Thymelaeaceae family. This wood is burned for incense, and its precious resin is used to create perfumes. The trees are mainly found in the forests of Southeast Asia, India and Bangladesh, but demand for agarwood has rapidly outpaced the supply of slow-growing natural sources, and many species are now considered endangered.

The compounds responsible for the complex fragrances of agarwoods are known as sesquiterpenes (STPs) and are difficult to create chemically.

Now, a green synthetic solution to partially recreate agarwood-functionalized terpenes using engineered algae has been devised in the laboratories of Assistant Professor Kyle Lauersen and Associate Professor Gyorgy Szekely.

Inspired by visits to the old markets in Al Balad, Jeddah, the researchers first catalogued the chemical diversity of STPs in 58 agarwood samples by two-dimensional gas chromatography-mass spectrometry, a standard analytical technique used to study chemical compositions. They found that hundreds of STPs are shared across different agarwood samples, but each sample is unique, with a distinct chemical profile.

Lauersen's team then set out to reproduce some of the chemical complexity of agarwood STPs in algae using synthetic biology and a robotics-assisted workflow, which allowed them to produce and screen large numbers of the compounds made from the algae.

Several bioengineers – including Lauersen – have previously shown that engineered algae can be used to produce natural chemicals, such as the STP patchoulol (patchouli fragrance) and other scent molecules. In their latest research, scientists in Lauersen's group used the green alga *Chlamydomonas reinhardtii* to produce nine distinct STP chemical products widely found in agarwood. They then harvested the molecules from the growing algae using a biocompatible solvent, a process known as "microbial milking."

From there, green chemists in Szekely's group generated more than 100 STPs through a sustainable reaction process using the algal-produced terpenes.

"This total bioprocess represents a sustainable way to source fragrant terpene mixtures compared to the harvest of endangered trees," said Sergio Gutiérrez, one of the scientists involved in this project.

Because the algae naturally consume CO₂, the process the KAUST scientists discovered may also provide a way to convert waste carbon into something of value. Lauersen said that to make the process even more sustainable, the algal hosts could be grown in wastewater.

This total bioprocess represents a sustainable way to source fragrant terpene mixtures compared to the harvest of endangered trees."

Sergio Gutiérrez
KAUST Ph.D. student

"Their ability to thrive on the nutrients found in wastewater and use CO₂ as the sole carbon source means that using algae as a bioengineering platform can facilitate lost resources in waste streams to be converted into valuable products," he remarked.

Although more research is needed for the discovery to reach commercial scale, Lauersen believes there is wide scope for other combinations of microbial-engineered terpene production and synthetic chemistry to produce fragrant mixtures.

"This work shows the potential of combining synthetic biology, sustainable bioprocess design and green chemistry to provide a complementary source of terpene chemicals. This could alleviate some of the pressure on agarwood supplies in the wild and be used for other applications, such as the production of medicines."



Clues for malaria vaccine

The discovery by KAUST researchers of a malaria protein that helps the parasite grow inside red blood cells and contributes to the parasite's immune evasion could pave the way for new vaccines or therapeutics to combat the deadly infection.

The protein, known as PfAP2-P, was previously identified by KAUST research that explored malarial genes and proteins displaying rhythmic 24-hour expression patterns — an adaptation that allows the parasite to synchronize its activities with those of the host during its developmental cycle.

The expression levels of PfAP2-P seem to peak first around 16 hours after the invasion of red blood cells and then again some 24 hours after that. These peaks coincide with the activation of genes linked to two crucial biological processes. The first is when malaria parasites coat the red blood cells they infect with various combinations of sticky proteins to elude immune recognition, and the second is when groups of young parasites prepare to exit infected red blood cells and invade other uninfected red blood cells.

This observation intrigued scientists in Professor Arnab Pain's group, including research scientist Amit Kumar Subudhi, and led them to interrogate PfAP2-P's function.

Through a series of molecular experiments, Subudhi, Pain and their colleagues showed that PfAP2-P serves as an essential regulator of multiple key biological processes of the parasite. The protein acts

as both a repressor of genes involved in immune evasion and as a brake on genes associated with the parasite's transition to its sexual stage of development.

The researchers also identified several novel proteins that are directly or indirectly regulated by PfAP2-P, some of which could be targeted for future drug development. Moreover, they discovered that PfAP2-P acts as an activator of the proteins required for the parasite to exit infected red blood cells and invade new ones.

Perhaps the most promising discovery came from studies on mutant malaria

We are currently exploring the potential of these mutant parasites as vaccine-like immune triggers."

Amit Kumar Subudhi
KAUST Research Scientist

parasites that lack a working version of PfAP2-P. These parasites could not control the coordinated expression of highly variable sticky proteins at the surface of the red blood cells involved in skirting immune detection.

Red blood cells infected with these PfAP2-P-defective parasites expressed the full array of sticky surface proteins, rather than employing the usual hide-and-seek strategy used by parasites without the mutation. As a result, the defective parasites were readily recognized by malaria-destroying antibodies that, in principle, could help train the body to fend off naturally occurring malaria infections.

"We are currently exploring the potential of these mutant parasites as vaccine-like immune triggers for warding off natural malaria infections in people," said Subudhi.



PEOPLE IMPACT

MIT under 35 Innovators

KAUST is delighted to have three of its scientists, Hamed Albalawi, Hend Mohamed and Walaa Khushaim, listed among the 15 MIT Technology Review Innovators Under 35 MENA is 2023. The honor is given to innovators whose inventions and research in their respective scientific fields are shaping the future.

Under the mentorship of Professor Charlotte Hauser, Albalawi has developed calcium carbonate photo-initiated ink and is testing its effectiveness for 3D-bioprinting scaffolds for coral restoration and bone regeneration. The mechanical properties of the scaffolds mimic the conditions in which coral and bone growth naturally occur while accelerating the growth rate for faster recovery. Moreover, the ink is a sustainable, cheaper option than standard commercial products used for similar purposes. Albalawi earned his undergraduate degree in the U.S. before returning to his native country to study for his Ph.D.

After earning degrees in her native Egypt and then Korea, Mohamed joined KAUST as a postdoctoral researcher and is now a research scientist working in Associate Professor Pedro Castaño's lab, where she investigates catalytic processes that reduce carbon emissions. She has developed new catalysts and catalytic processes to produce sustainable aviation fuel, chemicals and electricity from renewable sources, CO₂ and wastewater.

During her doctoral studies at KAUST in Professor Khaled Salama's lab, Khushaim developed multiplexed

biosensors based on functionalized nanomaterials for the early detection of acute myocardial infarction (i.e., heart attacks). These biosensors are integrated into portable, miniaturized diagnostic devices for the simultaneous detection of multiple heart biomarkers, including cardiac troponin I, which is a standard biomarker for heart attacks because it leaks into the blood as heart cells die. Like Albalawi, the Jeddah native earned her degrees abroad (U.S. and U.K.) prior to joining KAUST. From September 2023, Khushaim joined the Hadley Sikes laboratory at MIT as an Ibn Khaldun Fellow, where she is continuing her research on developing sustainable and user-friendly biosensors.

"Receiving this prestigious award for our innovative technology in early heart attack detection is an incredible honor. It's more than just recognition; it's a validation of our mission to bring groundbreaking healthcare innovations to the world. The impact of this cost-effective technology could potentially save countless lives globally," she said.

This is not the first time multiple KAUST scientists have received the honor of being named MIT Technology Review Innovators Under 35 MENA in one year. Three won the award in 2022,



Hamed Albalawi

Dr. Walaa Khushaim



and several others have won since the first Innovators Under 35 MENA were announced in 2018.

Innovation Impact

The “Valley of Death” is the metaphor used to describe a critical stage of translating scientific invention into viable commercial product. KAUST aims to build the strongest bridge over this valley in the region by providing funding and programs that empower and educate scientists so that they become entrepreneurs. These efforts are not limited to KAUST people, as the University aspires to build an innovation ecosystem that will become the regional leader and global envy.

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KAUST startup earns funding windfall



Among the many successful startups to come out of KAUST is iyris, which is disrupting the agricultural sector. Earlier this year, the company received \$16 million in series A funding.

iyris (previously known as RedSea) is developing multiple unique technologies for cheaper costs and higher yields. Its flagship SecondSky technology blocks infrared radiation while permitting the passage of photosynthetic radiation. Thus, greenhouses incorporating SecondSky are exposed to less heat, reducing cooling costs and water usage while simultaneously extending the growing season. These effects have extraordinary value, especially in arid regions such as Saudi Arabia and other Arab nations, and already the company is finding an impressive market that has reached Europe and North America.

"SecondSky technology took years of research at KAUST in my labs, with the University being the first investors to jump on board in 2018," said Associate Professor Derya Baran, one of the founders of iyris.

"KAUST has been a consistent supporter of our development from early startup to a commercially viable Agtech company."

The round was led by Ecosystem Integrity Fund - a San Francisco-based climate and sustainability fund - and supported by current and new institutional investors including Global Ventures, Dubai Future District Fund (DFDF), Kanoo Ventures, Globinvest and Bonaventure Capital.

The funding will also help iyris continue the development of its biotechnology, which involves innovative and adaptive plant genetic processes formulated by another of its founders, Professor Mark Tester.

"We developed plant genetics via a novel hybridization process that has the potential to breed resiliency to salinity, heat and drought across a broad range of crops, ensuring stress resistant, dependable food production," he said. "The technology is already demonstrating exciting results with some of the world's largest tomato growers in large-scale, open-field trials."

The latest funding success of iyris is proof that KAUST is an innovative force in the Kingdom."

Ian Campbell

Vice President of KAUST's National Transformation Initiative

Ian Campbell, Vice President of KAUST's National Transformation Initiative, said: "The latest funding success of iyris is proof that KAUST is an innovative force in the Kingdom. In fact, KAUST startup initiatives have been one of the key drivers of the Saudi Arabian deep tech startup ecosystem. iyris is a disruptive startup in the Agtech industry and we are excited to see continued momentum with this latest investment round."

KAUST pushes Saudi to forefront of 6G

A view of the KAUST Beacon through KAUST's optically transparent RIS.

Our ongoing partnership with KAUST yielded significant advancements in telecommunication technologies, which have been crucial in pushing the boundaries of what's possible in the 5G and emerging 6G space."

Mashhour Al-Sudairy

Head of Local Content at Ericsson Kingdom of Saudi Arabia

It is estimated that more than 50 billion devices will be online by 2025, ranging from those that control electric grids for cities to the personal handheld devices we use every day. The amount of data these devices transmit was impossible just 10 years ago, but improved telecommunications technologies have transformed our world and how we communicate with one another. 5G (fifth-generation telecommunications, achieving speeds of 10 gigabytes per second) and soon 6G (with lower latency and faster speeds) are making more data available to

more people and more devices instantly just about everywhere in the world.

While telecommunications companies can invest in their own research and development to innovate 5G and 6G technologies, a more promising model has them partnering with universities. For Ericsson, the multinational telecommunications company based in Sweden, KAUST is that university.

Earlier this year, Ericsson announced that it was continuing its funding for two telecommunications programs at KAUST. The first, managed by Professor Mohamed-Slim Alouini, is investigating free-space optics (FSO), and the other, managed by Professor Atif Shamim, is developing reconfigurable intelligent surfaces (RIS); both technologies have been identified by industry as critical for achieving 5G and 6G technology rollout.

"Our ongoing partnership with KAUST yielded significant advancements in telecommunication technologies, which have been crucial in pushing the boundaries of what's possible in the 5G and emerging 6G space. As we move into the next

phase, our focus will further revolutionize connectivity and telecommunication technologies," said Mashhour Al-Sudairy, Head of Local Content at Ericsson Kingdom of Saudi Arabia.

The next generation of telecommunications

When a message between two devices, like smartphones, is sent, the signal from one phone normally does not go directly to the other. Instead, it is first received by a base station, which manages the signals for all wireless devices in a defined area. In the past, base stations would be connected by fiberoptic cables, but this approach is not economical for 5G and 6G.

FSO describes communications in which a laser transmits a signal through free space (outer space or air) to a detector without a cable. FSO is not new technology; Alexander Graham Bell, the father of the first telephone, is attributed to have demonstrated it. However, it must overcome certain limitations before its widespread use for 5G and 6G.

"The problem is that it is perceived as unreliable. One reason is that it is very sensitive to weather conditions – fog, haze, rain, sandstorms," explained Alouini. "As the signal passes through air, it attenuates so that the signal reaching the detector is weaker than that emitted by the transmitter." Moreover, the attenuation increases with signals of higher frequency, and 6G has the highest frequency to date (at least 100 GHz).

The second reason is that it is difficult to maintain the alignment of the laser and receiver. This misalignment can occur through inevitable weather changes, such as the extreme temperature highs during the day and lows at night common in Saudi Arabian deserts, causing thermal expansion of the equipment.

Alouini is quantifying the degree of weather effects on the signal transmission. His project is building an exhaustive database of events in Saudi Arabia that answers why communication outages happen, how often they happen, and how long they happen. With this information, Ericsson and other companies can strategically place their base stations and set up auxiliary systems for when they fail.

Smart surfaces for telecommunications

RIS provide another solution to the problem of signal loss. Buildings in urban areas often house base stations on their rooftops.

However, these same buildings obstruct signals from other towers, deflecting them from their original pathway. RIS correct the deflection by acting like mirrors that redirect a signal around the obstacle except, unlike a mirror, which rotates its axis to change the angle of light, the physical angle of RIS does not change. Instead, the array of cells constituting the RIS are electronically reconfigured.

These cells are not cheap, especially when considering a single RIS is comprised of hundreds or even thousands of individual cells. Each cell is typically constituted of metal, insulator and semiconductor layers, and its fabrication is done in a cleanroom, which is a laboratory environment that includes expensive equipment and is operated by highly skilled and educated staff. Shamim has developed inks and printing processes that make the cleanroom unnecessary. Printing of the cell can be done in a standard scientific laboratory with basic equipment and less labor. Thus, the price of one cell drops from several U.S. dollars to under a dollar. The expected savings will go a long way to 6G accessibility, which is why his inks and printed RIS have attracted the attention of industry partners like Ericsson.

Another issue is installation. In principle, RIS can be placed anywhere on a building including concrete walls and glass windows. However, without optical transparency, RIS will obstruct any light penetrating the windows. The solution is

an RIS technology that can control the electromagnetic signals without affecting window transparency.

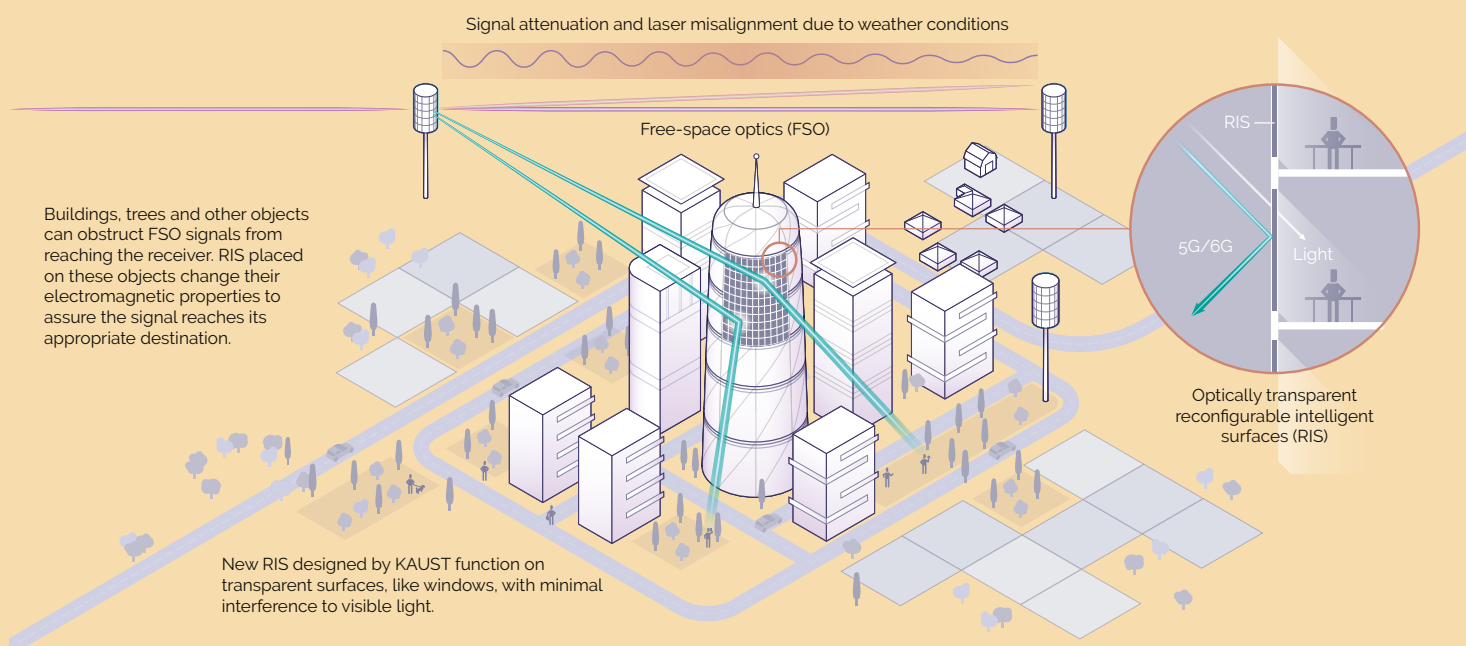
"Installing RIS on windows is challenging. We need RIS that can control electromagnetic signals without affecting the light penetrating through them; however, most metals are opaque," explained Shamim.

For a new standard in RIS technology, Shamim's group has come up with a metallic ink composed of silver nanowires. This ink has set a world record for the combination of optical transparency and conductivity.

In the next phase of the Ericsson project, Shamim is examining how to extend his affordable manufacturing technologies to the higher frequencies needed for 6G.

"The knowledge we have gained from 5G about design and testing will go a long way towards 6G," he said.

By testing novel FSO and RIS technologies in Saudi Arabia and collecting an unprecedented amount of data on Saudi weather conditions and communications performance, KAUST is positioning the Kingdom as a leader for 6G, attracting companies to invest and scientists to test their research.





Diabetes diagnostics

KAUST and amplifAI health representatives at the MoU signing. (from left) KSHI Associate Director Imed Gallouzi, KAUST VPR and KSHI Director Pierre Magistretti, KAUST Professor Andrea Fratalocchi, amplifAI health CEO Meshari Alwashmi and amplifAI health Head of AI Eng. Mustafa Alghali.

More than 500 million people live with diabetes, a number that is expected to increase by over 100 million by 2030. The rate of diabetes is even higher in Saudi Arabia, with nearly 20% of the population diabetic. In response, Saudi Arabia has declared diabetes and its complications a top national health priority. Among these complications is lower limb amputations. Diabetes is the leading cause of such amputations worldwide, including more than 80% of lower-limb amputations in the U.S. In fact, experts have estimated that lower-limb care makes up one third of diabetes costs.

To reduce the number of amputations, KAUST is teaming up with amplifAI health to develop a new disease detection system that combines the artificial intelligence (AI) technology of the Saudi company and the hyperspectral imaging technology Hyplex™ designed by Professor Andrea Fratalocchi. As a first initiative, the collaboration will test the combination of technologies for the detection and management of diabetic foot complications. A clinical trial is in planning.

This effort could save Saudi Arabia more than 2 billion Riyals annually in medical costs and reduce 1.5 million foot amputations worldwide every year, profoundly improving the quality of life of millions of people."

Andrea Fratalocchi
KAUST Professor

"This effort could save Saudi Arabia more than 2 billion Riyals annually in medical costs and reduce 1.5 million foot amputations worldwide every year, profoundly improving the quality of life of millions of people," said Fratalocchi.

Hyplex™ can collect Terabytes of data in one second, which is vastly superior to the Gigabyte-scale of current commercial cameras, offering an abundance of new information for early disease detection.

Through the KAUST spin-out Pixeltra, Fratalocchi is already testing Hyplex™ with Saudi hospitals for the diagnosis of skin cancer. However, this partnership will be the first time applying his technology to diabetes care.

"I am excited about our collaboration with KAUST, as it positions amplifAI at the forefront of science and innovation. This partnership combines our thermography AI-powered software with KAUST's novel hardware to make a significant impact on global health. Together, we are pioneering advancements that have the potential to reshape the future of healthcare," said amplifAI health CEO Meshari F. Alwashmi.



Clean concrete

Concrete production relies heavily on sand; however, most of the sand in the Earth is unsuitable for concrete manufacturing due to its fine particle size and smooth surface. Consequently, riverbeds and other suitable construction sands are overmined, causing landscape degradation, and transported thousands of kilometers, increasing the associated carbon cost. ClimateCrete, a KAUST spinoff, is developing a radical new solution to vastly reduce these environmental costs. Last winter the company announced the successful close of \$3.3 million series A funding to further develop its sustainable construction technology.

Patented technology developed in the lab of Professor Jorge Gascon, one of the company's founders, uses local sand for manufacturing. It converts the fine sand of the Arabian Peninsula into rougher particles suitable for concrete manufacturing. Significantly, this conversion lowers the need for cement and reduces CO₂ emissions by up to 60% through both the reduction of cement and transport.

"Only 5% of the world's sand can be used for concrete. At ClimateCrete, we have developed technology that modifies the

surface of the sand particles, making a much more durable and stable concrete," said Gascon. "This modification process improves the quality of the concrete and reduces the need for CO₂ emitting cement. Transportation costs and associated CO₂ emissions are also eliminated."

Furthermore, concrete products made with ClimateCrete technology cost no more than importing sand, giving the expectation that the market for ClimateCrete will be global. In Saudi Arabia alone, more than \$1 trillion worth of real estate and infrastructure projects are planned.

Another co-founder of ClimateCrete, KAUST Distinguished Researcher Professor William McDonough, named one of TIME's 100 most innovative leaders driving business climate action, further commented: "The adoption of this technology presents an immense opportunity for Saudi Arabia. With an executable first pilot program to prove its technology and solution, ClimateCrete is positioned to establish a path for unprecedented growth within the construction manufacturing industry in Saudi Arabia and the region. ClimateCrete technology also enables a 100% domestic supply, assisting Saudi Arabia to reach

ClimateCrete is poised to change the economics and environmental impact of concrete applications radically."

Patrick Suel
Managing Director, Captain K

its ambitious targets to become carbon-neutral by 2060."

"ClimateCrete's technology transforms abundant but mostly unusable fine sand into a precious new commodity for the construction industry worldwide," said Patrick Suel, Capital K's managing director who led the investment in ClimateCrete. "The resulting concrete is stronger while reducing global CO₂ emissions. Considering that the world is fast running out of construction sand, ClimateCrete is poised to change the economics and environmental impact of concrete applications radically."



Saudi's tech ecosystem in China

In the past year, KAUST has greatly bolstered its ties with leading innovation and academic institutions in Shenzhen, China's tech hub and home to many of the country's leading tech companies such as Huawei and Tencent. The partnership with Shenzhen aims to fortify KAUST as a premier research and technology base by developing entrepreneurship programs that will transform research ideas by individuals and organizations across Saudi Arabia into commercial products.

As a testament to the value of this partnership, the mayor of Shenzhen, Qin Weizhong, led 50 delegates from Chinese research institutes and universities to KAUST. The visit also included a trip to Riyadh, where the delegation was hosted by the Research Development and Innovation Authority. During the visit, agreements were made to share capabilities in research, education, innovation and entrepreneurship.

The Shenzhen collaboration is part of a central pillar of KAUST's new strategy, through which the University is intensifying its drive to launch initiatives that establish connections with elite academic

My role as founder, engineer and educator is to prepare these new leaders to be critical thinkers and resilient entrepreneurs."

Zexiang Li
InnoX founder

institutions and innovation hubs worldwide. These alliances aim to deepen scientific relationships, catalyze technology adoption and promote research commercialization to raise the Kingdom's economic competitiveness.

One outcome of the partnership is the ShenTech Bootcamp, jointly organized by KAUST and the Shenzhen InnoX Academy. For its inaugural program, the boot camp invited 45 founders, students and entrepreneurs from Saudi Arabia. The participants were connected with leading innovators in the region to learn the skills needed for transforming their ideas into tangible products that have real-world impact.

Additionally, Shenzhen is an important feature of KAUST's new Technology Innovation and Entrepreneurship (TIE)

Master of Science degree. The 16-month program is designed to teach students the entire product development lifecycle, from ideation to prototyping to commercialization, with the expectation that graduates will launch entrepreneurial ventures and/or secure positions in innovative companies within the Kingdom of Saudi Arabia and beyond. During the program, students will spend 10 months at KAUST and 6 months in Shenzhen, where they will engage with incubators and leading startup founders to develop their entrepreneurial ideas. The first cohort was accepted to begin in fall 2024.

The founder of InnoX, Zexiang Li, who is also a visiting professor at KAUST, is excited about the knowledge-sharing opportunities with Saudi Arabia.

"My role as founder, engineer and educator is to prepare these new leaders to be critical thinkers and resilient entrepreneurs," he said.

PEOPLE IMPACT

Coast to coast on three wheels

Associate Professor Matteo Parsani has been a mentor and inspiration to many KAUST scientists and students since his arrival at the University. While much of that influence has come from his science, he made arguably his greatest impact last winter with an unprecedented trip across the country.

Through his Athar -- East to West challenge, Parsani brought to the attention of people in the region the challenges faced by people with disabilities but also their remarkable potential. Athar -- East to West had him cross 3000+ km of Saudi Arabia on a handcycle. The journey was completed in 30 days and passed through 10 cities before ending in KAUST.

Well before the decision to take this ride, Parsani was known on campus for his intense physical therapy program to recover from a spinal cord injury that left him in a wheelchair. Riding a customized handcycle, he is out on the campus daily, sometimes covering 120 km. His remarkable gains in stamina and strength over the years and his desire to contribute to Saudi Vision 2030 by promoting physical activity motivated him to take on the challenge.

"I believe in the power of personal stories to inspire change. My journey embodies the spirit of determination and resilience. I also see this as an opportunity to showcase Saudi Arabia's commitment to inclusivity and its promotion of adaptive sports and, in general, sports to enhance quality of life."

The effort also had a scientific component, as Parsani was wearing a number of experimental technologies developed at KAUST, including 3D-printed on-skin electrodes, a solar-powered smart helmet, to track his biometrics and to evaluate their usefulness for sports medicine, rehabilitation medicine and other health purposes.



East to West had him cross

**3000+
km**

of Saudi Arabia on a handcycle.

KAUST gives \$1 million to 10 startups

“The journey that TAQADAM has been on is remarkable and its vision for future progress can be characterized as ambitious.”

Mai Bin Dayel

SAB Head of ESG and Communication

TAQADAM, one of the longest running accelerator programs in the Middle East, awarded a funding pool of \$1 million to 10 startups at its annual accelerator earlier this year.

The accelerator, having completed its seventh year, is an initiative by KAUST and Saudi Awwal Bank (SAB). The 10 companies were selected from a group of 24 who had already raised \$20 million. They were all founded in the MENA region and selected from more than 1,000 applicants after a series of screenings. Each of the 24 received \$40,000 to grow their businesses in the program.

During the program, participating companies work with mentors and investors over six months for strategic growth and funding acquisition. TAQADAM reaches its climax during the final week when each company is given three minutes to pitch

and 10 minutes for Q&A before a judging panel of 27 global and regional investors, such as 500 Global, Hala Ventures, Tech Invest Com, E& Capital, SRMG Ventures, BECO Capital and MSA Capital.

Since its inception in 2016, TAQADAM has produced a number of successful startups — many of whom have raised funding or found a new home in Saudi Arabia. WhiteHelmet, for example, provides digital twin technology for construction management

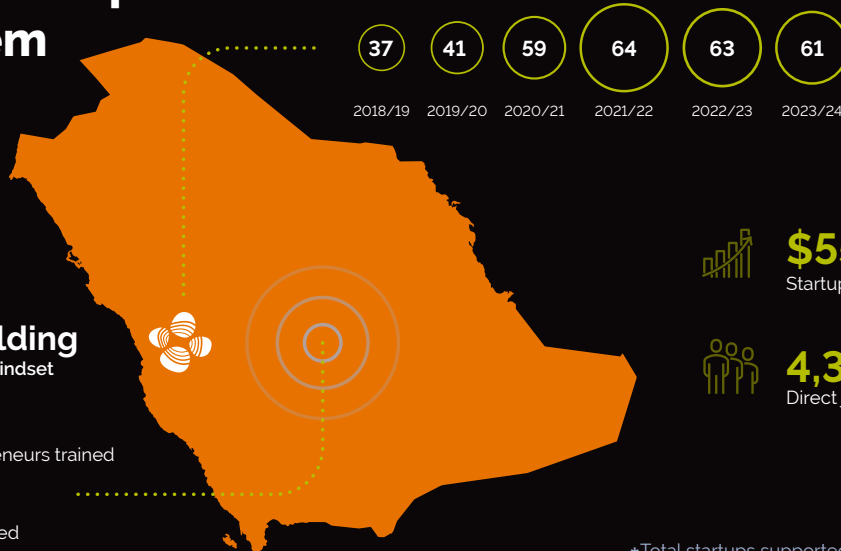


and has built an impressive client list. This is an example of a deep tech company supported by TAQADAM that is creating value and contributing to many influential projects in the Saudi economy. BuildNow, a TAQADAM startup from the 2023 cohort that accelerates construction projects by offering build now and pay later credit facilities to the industry, recently announced new seed funding of \$9.4 million at LEAP.

The new KAUST strategy, launched in August 2023, has a renewed focus on startup support. TAQADAM will continue to accelerate the growth of innovative technology companies that are solving challenges for consumers and businesses

KAUST Startup Ecosystem

Startups in our ecosystem



Capacity building

An entrepreneurship mindset

30,769
Innovators and entrepreneurs trained

4,236
SME professionals trained



\$556M
Startup capital raised



4,392
Direct jobs created

*Total startups supported by KAUST 2011-2024

and creating jobs within the economy. From 2024, KAUST has additionally supported TAQADAM by investing more time in fast pilot programs and portfolio support to help the startups do more deals with corporations searching for digital transformation synergies. It is also providing support for strategic projects in the Kingdom by searching for cutting edge technologies to meet construction, logistical, sustainability and smart city aspirations.

In total, TAQADAM has supported over 245 companies that have since raised over \$218 million. To qualify, companies must possess a minimum valuable product in deep technology and have expansion plans to Saudi Arabia.

Speaking at this year's showcase, SAB's Head of ESG and Communication Mai Bin Dayel said: "TAQADAM is a platform to explore new ideas, connect with individuals that share the same passion,

be inspired by stories of determination, and continue to contribute to a prosperous and sustainable future for all. The journey that TAQADAM has been on is remarkable and its vision for future progress can be characterized as ambitious."

The 10 selected companies

AbuErdan

Transforming poultry farming using smart technology

Bonocle

A braille education and entertainment platform

BuildBench

A leading business-to-business construction platform using digital data to increase efficiency and reduce risk

COGNNA

A software as a service (SaaS) cybersecurity-threat detection and response platform that detects and neutralizes threats that might otherwise go undetected

Equiptal

Heavy equipment management connecting businesses to a vast supplier's network

Fai

A technological solution for financial processes through automation and AI

LogesTechs

Integrated delivery and warehouse management systems

RimRubber

Multinational online tyre marketplace

STUCK?

Language-support platforms for businesses using AI

Teradix

Streamlines and automates the sourcing and procurement process


 Fund...

Google funds multiple KAUST projects

Several KAUST scientists are the recipients of Google seed grants for AI research. The scientists will use the funds to advance multilingual, multimodal machine learning, specifically in generative and large language models (LLMs). Expected applications include health, cross-cultural language understanding, sustainability, privacy and education.

The grants are timely, as KAUST announced a new Center of Excellence (CoE) on Generative AI led by Bernard Ghanem and Juergen Schmidhuber. The CoE aims to accelerate and establish excellence in generative AI research and development in the Kingdom by innovating general-purpose generative AI models and training best practices that fuel specialized solutions in the four national priorities.

Schmidhuber believes the grants affirm KAUST's world-class AI research. "Our AI faculty are exploring frontier areas of machine learning and visual computing, specifically computer graphics and visualization. We are happy to see Google is supporting this."

By investing in pioneering research with KAUST, we hope to continue fostering multilingual, multimodal machine learning breakthroughs that will benefit the region and beyond."

Sarah Al Hussein

Google Head of Public Policy in Saudi Arabia

Examples of the ongoing research at KAUST that will benefit from the funding include continual learning by Ghanem, in which AI models based on machine learning and visual computing continue to learn from streams of data; generative AI models by Professor Tareq Al-Naffouri that enhance the performance and adaptability of mobile networks to enable flexible and efficient open radio access network (RAN) infrastructure; and AI models by Associate Professor Mohamed Elhoseiny that can interpret and generate visual and linguistic data across multiple languages and cultural contexts in order to address the diversity in human emotional experiences.

Also receiving funding are Professor Xin Gao to build a generative AI model for the design of drugs that can control signaling proteins in cells and Assistant Professor Di Wang to extend his research on privacy protection in machine learning to graph neural networks. Along with the funding, Google plans to match each faculty awardee with a Google researcher who can serve as their sponsor.

Sarah Al Hussein, Google's Head of Public Policy in Saudi Arabia, expressed her enthusiasm about supporting KAUST researchers: "Google is committed to empowering local researchers and institutions to introduce relevant solutions to users, businesses and governments in an AI-first world. By investing in pioneering research with KAUST, we hope to continue fostering multilingual, multimodal machine learning breakthroughs that will benefit the region and beyond."



Greening organic waste

CarboSoil is specially engineered for alkaline sandy soils – it acts as a sponge for nutrients, which dramatically improves plant health and yield. This carbon-dense material will last for hundreds to thousands of years."

Himanshu Mishra
KAUST Professor

Every year, gigatons of organic waste is landfilled globally; in Saudi Arabia alone, the number is 20 million tons. As the landfilled organic waste degrades, carbon leaks into the air as carbon dioxide or methane, both greenhouse gases. As part of its green initiative, Saudi Arabia has vowed to reduce its organic landfilling by 90% by 2035. To reach this goal, the CarboSoil technology at Terraxy, a KAUST spin-off, promises a solution that transforms organic waste from environmental pollution into desert rehabilitation.

Saudi Arabia is at a huge natural disadvantage for plant growth because its dearth of freshwater and intense solar radiation. Moreover, its highly alkaline sandy

soils restrict the availability of calcium, phosphorus and other nutrients and is ineffective at holding water, which causes nutrient leaching.

Briefly, CarboSoil repurposes chicken manure into a product that renders sandy soil amenable to better farming yields. It does this by acting as a sponge for nutrients. The invention came from incorporating two innovative processes developed by Professor Himanshu Mishra and his colleagues.

"Sandy soils are poor at holding water and nutrients," said Mishra, who, along with KAUST alumn Adair Gallo, is a co-Founder of Terraxy. "CarboSoil is specially engineered for alkaline sandy soils – it acts as a sponge for nutrients, which dramatically improves plant health and yield. This carbon-dense material will last for hundreds to thousands of years. Therefore, the application of 1 ton of CarboSoil to the soil is equivalent to capturing 2–3 tons of CO₂, enabling a scalable way to fight climate change."

The production of CarboSoil depends on a unique method for the pyrolysis of organic waste, such as chicken manure, crop residue, food scraps, and sewage sludge. Not only do soils dosed with CarboSoil

emit less CO₂ as organic waste than those undosed, they sequester the greenhouse gas in the soil, making it a carbon-negative technology. Terraxy claims that for every ton of CarboSoil used, three tons of organic waste is reduced.

While CarboSoil will benefit any region seeking to reduce the pollutant effects of organic waste, the technology is especially pertinent to Saudi Arabia, since regular compost degrade rapidly in the soil under hot conditions. In comparison, the evaporative loss of water in soils dosed with CarboSoil is reduced by up to 80% in the same Saudi conditions. Furthermore, field tests by Terraxy across multiple Saudi locations have shown that plant yields increase by 30–70%.

It has been an eventful launch for Terraxy, as the company has received over 20 awards, grants and achievements, including being chosen as one of Deloitte Technology Fast 50 Start-ups (Impact Category) in the MENA and Cyprus region in 2024, recognized as "Top Innovator" by the World Economic Forum's Uplink Platform (2023) and awarded first prize at the ITAS Arab Youth Competition by the Prime Minister of Qatar (2023).

PEOPLE IMPACT

The legacy of Dr. Najah Ashry



Her passion gave that next generation in Saudi Arabia a chance to realize their dreams."

Professor Suzana Nunes
KAUST Vice Provost

Before her passing in July 2024, Dr. Najah Ashry passionately aligned KAUST's mission with national priorities, driving strategic initiatives to help build a robust knowledge economy. Her visionary leadership left an indelible mark on KAUST, the Kingdom's scientific landscape and future generations.

Joining KAUST in 2008 as its founding Senior Assistant Provost, Dr. Ashry was instrumental in establishing the strategic vision and plans for Graduate Affairs, including admissions, enrolment management, registration and Saudi Arabia's foremost STEM scholarship — the KAUST Gifted Students Program (KGSP).

Professor Suzana Nunes, KAUST Vice Provost for Faculty and Academic Affairs, emphasized the lasting impact of Dr. Ashry's contributions, highlighting the multitude of KGSP alumni who have benefited from her advocacy and hard work. These people will hold leadership roles long into the future. "Her passion gave that next generation in Saudi Arabia a chance to realize their dreams," she said.

In 2011, Dr. Ashry became founding Vice President of the Saudi Initiatives organization — later renamed Strategic National Advancement (SNA) — to further align KAUST with the national priorities. Through a portfolio that included talent development and management, corporate social responsibility and strategic engagement, Dr. Ashry was devoted to creating the scientific infrastructure needed for the Kingdom's future innovation ecosystem.

She ensured every Saudi student attending the University received personalized support when seeking assistance. By championing the creation of youth initiatives such as the Saudi Research Science Institute (SRSI) and KAUST Space, Dr. Ashry was a pioneering force fostering hundreds of talented young Saudis toward science education during her tenure, which established a pipeline for enrolment to both KGSP and KAUST graduate studies.



Najah injected into every student in every program she directed a sense of responsibility to put the privilege of world-class educational experiences to work. No coasting was allowed."

Dr. David Keyes
KAUST founder

"Najah injected into every student in every program she directed a sense of responsibility to put the privilege of world-class educational experiences to work. No coasting was allowed." said her fellow KAUST founder, Dr. David Keyes, in reminiscence. "I was thrilled when she replicated MIT's RSI program as 'SRSI', brought into our labs every summer 99th-percentile Saudi scholars, and charged them to excel for their country."

Through SNA divisions such as Saudi Graduate Recruitment and Development (SGRD), Specialized Enrichment and Social Responsibility, Dr. Ashry spearheaded impactful KAUST initiatives. She was instrumental in establishing the National Academic Talent Development Program (NATDP), enabling teacher's assistants and lecturers from other Saudi universities to pursue advanced degrees at KAUST.

Dr. Ashry guided a team committed to empowering Saudi Arabia's workforce, preparing KAUST talent for the domestic job market, and utilizing KAUST resources to improve the lives of Saudis in neighboring communities. A visionary leader and advocate for gender representation in STEM, she pioneered professional development for Saudi women before such programs were widely available in-Kingdom.

Prior to KAUST, Dr. Ashry held

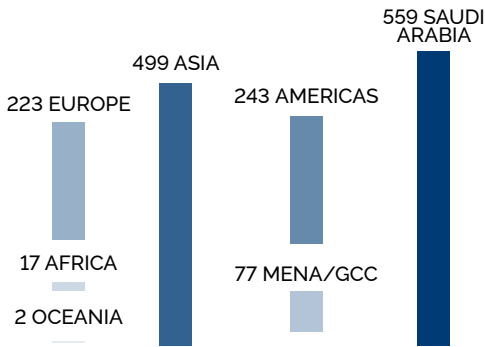
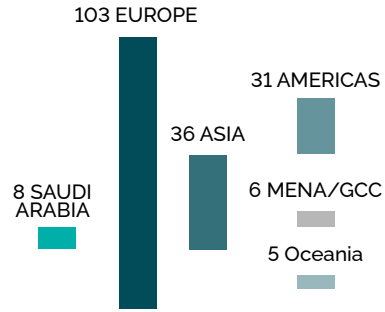
positions as a management information systems (MIS) professor, department chair, dean and head of the 40,000-student women's section at King Abdulaziz University. Over the years, she served on many prominent board and committees, reflecting her dedication to advancing the Kingdom's education, innovation and societal development.

In 2020, Dr. Ashry earned the Middle East Women Leaders Excellence Award for Knowledge Management, which recognizes female leaders significantly improving productivity and innovation through integrating technology and knowledge management into work processes.

KAUST in numbers

189
faculty

12% FEMALE
88% MALE

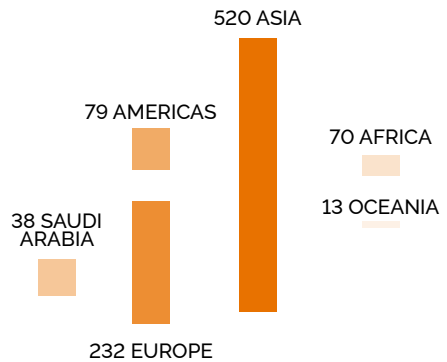


1620
students

39% FEMALE
61% MALE

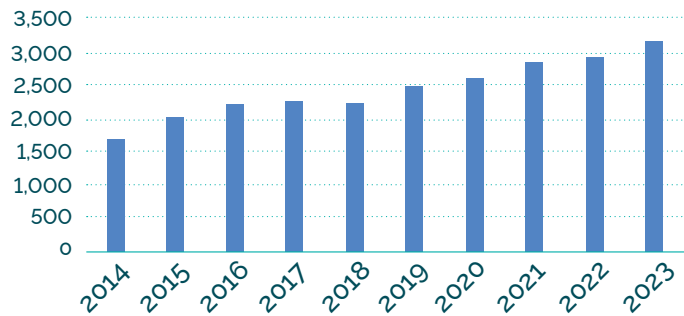
952
Scientists

21% FEMALE
79% MALE



Number of KAUST publications 2014-2023

24,546
Publications



KAUST bibliometrics 2014-2023

858,441
Citations

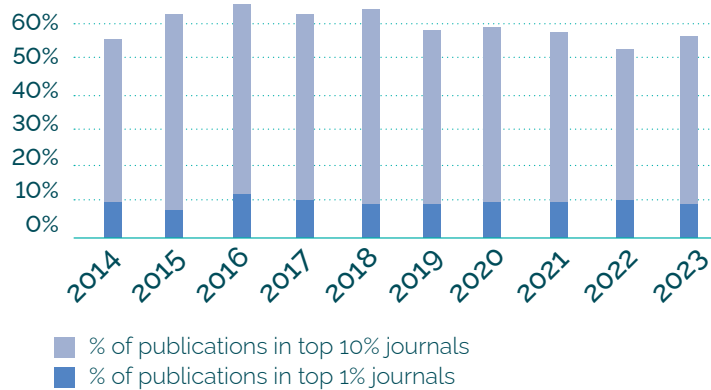
35 Citations
per publications

452 Citations
per faculty per year

24% Publications in Top 10%
Citation Percentiles (%)

54% Publications in Top 10%
Journal Percentiles (%)

Publications in the top journal percentiles 11,197 (53.8%)



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