

THE MIDDLE EAST

An end to oil dependency

The Gulf nations are injecting billions of petrodollars into research in an effort to ensure a sustainable post-oil future.

BY LOUISE SARANT

In 2008, Joel Malek, a DNA-sequencing specialist from Boston, Massachusetts, packed his bags and left one east coast for another, 6,500 miles away in Qatar. At the time, the Arab state was recruiting skilled scientists and academics to teach and conduct research in its 14-square-kilometre 'Education City', which was under construction on the outskirts of Doha. Malek was given generous funding to set up a genomics research lab for Weill Cornell Medicine-Qatar (WCM-Q), the first US medical school to open a campus in the country, in 2001.

Eight months after settling on the peninsula's shores, Malek received funding and began building his research team almost from scratch. Three years later, he published a draft genome of a date palm (*Phoenix dactylifera*) (E. K. Al-Dous *et al. Nature Biotechnol.* **29**, 521–527; 2011). Malek's work made it possible to determine the sex of the economically important crop at the seed stage, rather than waiting until the tree was five years old — a significant discovery because only females bear fruit.

As well as Weill Cornell, there are seven other US and European universities in Qatar. "Those universities came to Qatar because the country wanted to move very quickly into the future," explains Laith Abu-Raddad, a public-health specialist at WCM-Q. "One way to do it was to bring the best universities in the world into Qatar and ensure that they have the same quality and standards as the home institutions," he says.

The embrace of science in the Gulf states is motivated by near- and long-term concerns. The drop in oil prices that began in June 2014 put all of the Gulf economies "in a state of shock", says chemical engineer Steve Griffiths, vice-president for research at Masdar Institute in Abu Dhabi. Although oil prices are on a timid upward trend, the sharp loss in revenues has steered finances towards other sources of income. And there's little question that, as oil supplies dwindle, these countries will need a new engine to drive their prosperity.

QATARI INVESTMENT

Every year, the Qatar Foundation for Education, Science and Community Development reportedly allocates US\$320 million to run six

campuses of US universities. The foundation, created in 1995 by then emir Sheikh Hamad bin Khalifa Al Thani and his wife Sheikha Moza bint Nasser, is a non-profit organization that receives both private and government support.

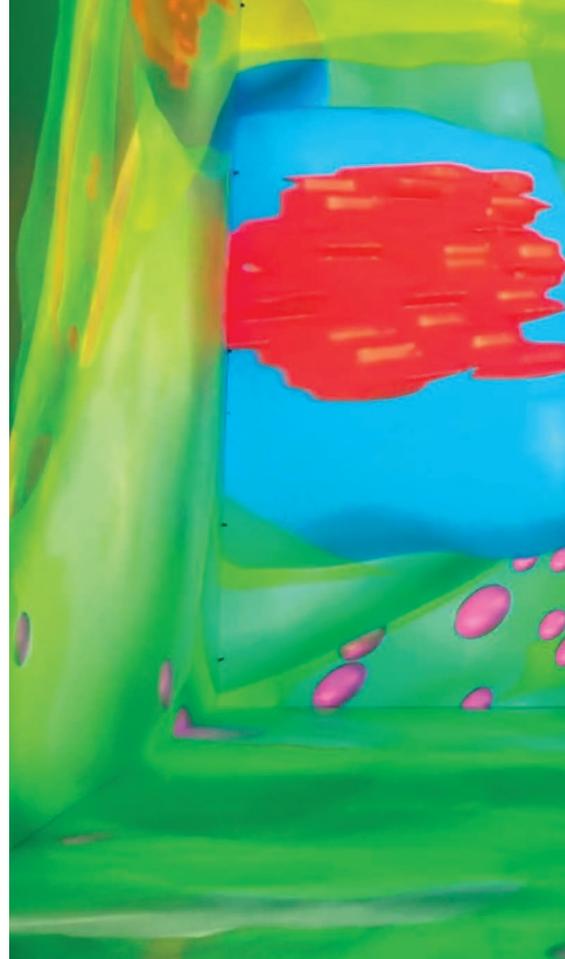
Tasked with paying for research and designing the country's science policy, the foundation established the Qatar National Research Fund (QNRF) in 2006. The QNRF awards money for research within the four national-priority sectors: energy and the environment; computer sciences and information technologies; health and life sciences; and social sciences, arts and the humanities. In May 2012, QNRF granted \$4.5 million to Malek's date-palm research as part of its National Priorities Research Program.

QNRF is still "a nascent organization", according to executive director Abdul Sattar Al-Taie. In its first stage, he says, it was focused on creating and nurturing a research culture in Qatar by providing training, creating career opportunities and bolstering the workforce with experienced scientists. "There will be many challenges to overcome before we can say that the country's investment in this area can absorb the government's full commitment," says Al-Taie. Its second phase, which started in 2011, focuses on mission-driven research that addresses Qatar's grand challenges — health care and water, and cyber and energy security — to ultimately create tangible knowledge assets such as intellectual property, Al-Taie says.

The QNRF has also funded research projects that led to the discovery of five exoplanets that bear the country's name (Qatar-1b to Qatar-5b), as well as a collaboration with CERN, Europe's particle-physics laboratory, to upgrade the Large Hadron Collider. On a less cosmic scale, the foundation has also funded research at the Qatar Environment and Energy Research Institute on novel excitonic materials to boost the energy, harvesting capacity of solar cells.

NATIONAL PRIORITIES

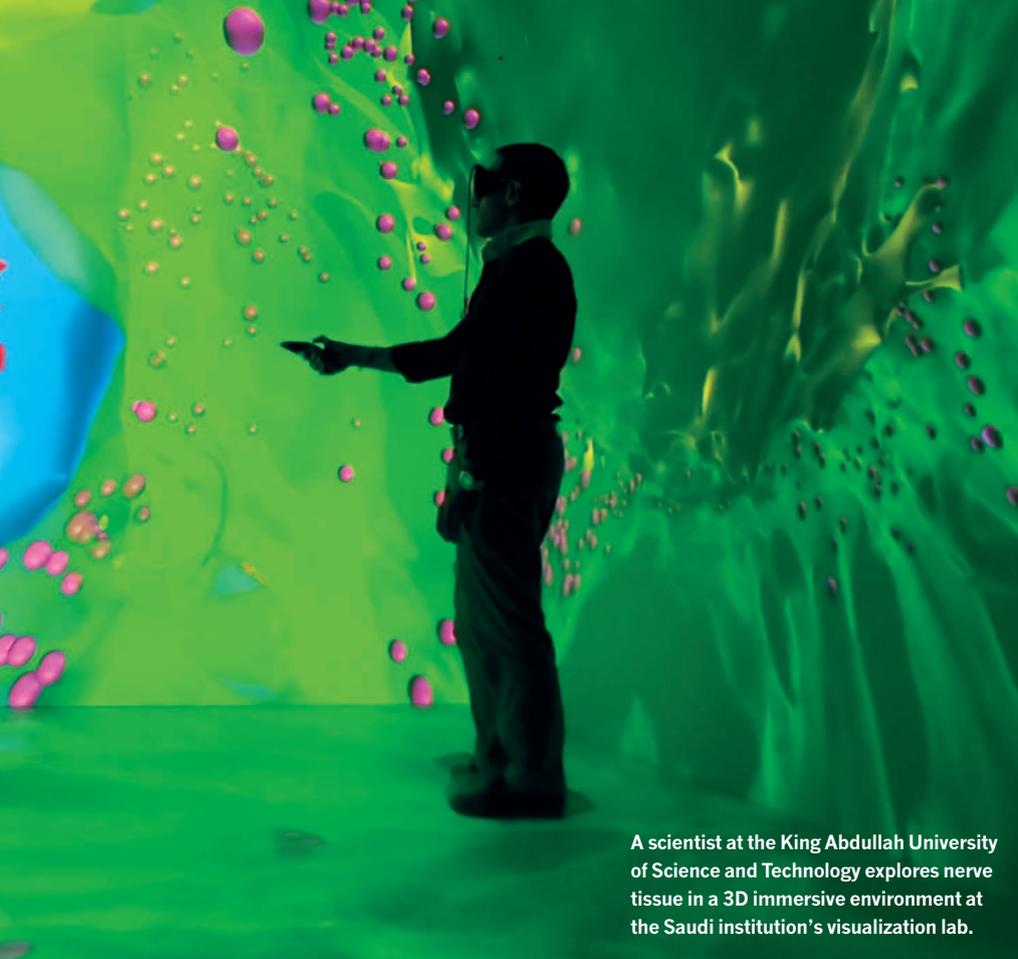
Elsewhere in the Gulf region, the United Arab Emirates (UAE) and Saudi Arabia are also striving to give an octane boost to their research and development (R&D) enterprises. In 2002, Saudi Arabia, the world's largest oil exporter, introduced the National Science, Technology and Innovation Plan (NSTIP), the



government's long-term strategy for scientific advancement. As part of the first phase, which ran from 2008 to 2014, 7 billion Saudi Arabian riyal (US\$1.9 billion) was allocated to R&D to help establish the kingdom as a regional science powerhouse. Those efforts are starting to pay off. In 2016, *Nature Index*, which tracks the quality and quantity of scientific publications in top journals by institutions all over the world, ranked Saudi Arabia as the most prolific producer of high-quality research in the Arab world, and second only to Israel in western Asia.

The NSTIP is implemented by the King Abdulaziz City for Science and Technology (KACST), which is charged with funding academic science at institutions throughout the kingdom. KACST's research budget in the National Transformation Program (NTP) for the next 5 years comes to \$8.3 billion. Among the projects supported by KACST is the Saudi Human Genome Program, which seeks to identify the genes responsible for genetic diseases by sequencing the genomes of 100,000 Saudi participants. KACST also has its own research laboratories, says Anas Alfaris, a KACST faculty member who chairs the task force handling the R&D strategy in the NTP.

Another major Saudi research project is the construction of the world's first large-scale, solar-powered desalination facility. It will be located in Al Khafji, near the Kuwait border. Advanced Water Technology, an arm of KACST, and the Spanish company Abengoa agreed to jointly build the plant, which is estimated to cost \$130 million and is expected to be completed by early 2017. It will supply 60,000 cubic metres of



A scientist at the King Abdullah University of Science and Technology explores nerve tissue in a 3D immersive environment at the Saudi institution's visualization lab.

money on R&D but I don't see any kind of diversification of the economy, in the sense of establishing industries that are not reliant on government funds and viable on a free-market level", Henderson says. The best gauge of diversification is the percentage of the budget derived from oil revenue, he says, which, in many of these states, is still "80–90% of the budget". With the current low price of oil, countries in the region are seeking investments with a clear near-term return.

Ironically, given that the long-term goal of research for the Gulf states is to free themselves from oil dependence, the drop in the oil price has reduced the amount of money available to fund science. According to Sami Mahroum, director of the Innovation and Policy Initiative at the graduate business school INSEAD in Abu Dhabi, this tightening may be temporary.

"The UAE and other Gulf countries do not expect to replace oil revenues with the commercialization of science — they are not that naive," he says. The aim is merely for "knowledge-intensive products to represent a greater share of the GDP". The UAE is investing in aerospace, semiconductors, health and energy to become, according to Mahroum, an integral part of these sectors globally, without being fully independent of what is happening around the world.

Mahroum thinks that although the UAE's economic diversification is more accomplished than that of other countries in the region, innovation is mostly Internet-driven and not triggered by R&D. Few successful companies have emerged from academic research, he says. The reason for this is structural. The economy is dominated by large, state-owned companies and by conglomerates run by influential families. Unless these big organizations decide to embark on large-scale R&D, Mahroum contends, science won't be the driver of economic diversification in the UAE or across the region. "Science and technology cannot be undertaken by start-ups that do not have the resources to invest in state-of-the-art labs, and cannot afford to wait for a decade for their product to be commercialized," he says.

Despite the current lack of research commercialization, Mahroum is sure that R&D will have a bigger role in the economy in the not too distant future, especially in areas such as energy, water, agriculture and health. "Those areas are in strong demand and high on the policy agenda, and have already a strong presence in local universities," he explains.

The introduction of legislation to liberalize the market and break monopolies in certain areas would encourage investments in science, Mahroum says. "It would drive more people to be trained in science and technology, and that as a consequence, the scientific output of the region would increase significantly." ■

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KAUST desalinated sea water a day.

Research funding is proceeding along two tracks, says Alfaris. The first includes funding fields in which the country could become a global leader — oil and gas, solar energy, water desalination and advanced materials. The second, Alfaris says, involves funding areas in which "we believe the kingdom needs to be fairly self-reliant", such as health, agriculture, food research, transportation, construction and information technology.

Given that Saudi Arabia still derives 80% of its budget revenue and 90% of its export earnings from the petroleum sector, it's not surprising that two-thirds of papers published in high-impact journals by Saudi researchers focus on chemistry. Researchers at the King Abdullah University of Science and Technology (KAUST), for example, are studying energy-efficient membranes for water desalination and developing metal-organic materials to offer clean-energy alternatives, reduce greenhouse-gas emissions and remediate chemical and biological agents.

The UAE has the most diversified economy of the region. Dubai especially so, because it does not have bountiful natural resources like the adjacent state of Abu Dhabi. Dubai started investing in logistics, airline and port infrastructure in the 1970s. In 2012, R&D expenditure represented 0.5% of the gross domestic product (GDP). That year the Ministry of Higher Education and Scientific Research announced a target of 1.5% of GDP by 2021. "Science is an essential component of the economic diversification in the UAE; it will establish a robust base

for R&D in crucial sectors such as aerospace, defence, energy, water, mining, space, health care, renewable energy, information technology and education," says Griffiths.

The Masdar Institute, where researchers are working on alternative energy, environmental sustainability and clean technology, is emblematic of Abu Dhabi's efforts to broaden its economy in preparation for a post-oil age. Griffiths says that the institute's satellite data are used

"We believe Saudi Arabia needs to be fairly self-reliant."

by Etihad Airways, Abu Dhabi's national airline, to predict periods of fog that impede air traffic, and its expertise in the area will be used as part of the UAE's space programme. Masdar has about 25 R&D collaborations with UAE companies and an equal number with international organizations, Griffiths says, in fields including energy, water, logistics, aerospace and defence, metals and mining, and semiconductors. "Large streams of revenues have been steered towards sectors where competition is not based on oil and gas," he says.

DWINDLING RESERVES

Christian Henderson, who is researching the political economy of Saudi Arabia at the SOAS University of London, explains that the strategies that were put in place to diversify the Gulf economies occurred at a time when oil was priced at \$100 a barrel (twice as high as in 2016), and money to invest in massive R&D projects was plentiful.

The Gulf countries "would like to spend