



MARK LEONG FOR NATURE INDEX

Etosha Cave, co-founder of carbon-conversion company Twelve, wants to expand her firm globally to tackle the climate crisis.

Checklist for a flying start

Taking research off campus and out into the world needs the right environment and financial support.

The foundations of many market-leading innovations can be traced to fundamental research done at universities. The science-led start-ups highlighted below show the importance of a strong pipeline from academia to industry, as they make their mark in clean energy, climate monitoring and health care.

Portable power *Twelve*

Etosha Cave, co-founder and chief science officer at Twelve, a start-up based in Berkeley,

California, hopes to reduce the reliance of industry on fossil fuels by providing a more sustainable option. Twelve's business centres on converting carbon dioxide from industrial waste streams into carbon monoxide, which can then be combined with green hydrogen – made by splitting water using renewable energy – and used to make synthetic fuels.

The firm's technology can be traced back to Cave's PhD research on the electroreduction of CO₂ – which essentially uses electricity to convert CO₂ into other molecules – at Stanford University in California. The work felt urgent and meaningful, she says, given the threat that fossil-fuel extraction and CO₂ emissions pose

to the environment. She wanted to take her research to the market as soon as possible – and that meant taking it beyond the bounds of academia. "It was going to die if we didn't bring it outside," says Cave.

After completing her PhD in 2015, Cave teamed up with fellow Stanford chemist, Kendra Kuhl, and Nicholas Flanders, an engineer and Stanford alumnus, with hopes of establishing a CO₂-conversion start-up. They joined the first cohort of a US Department of Energy-sponsored programme called the Cyclotron Road Project, which aimed to help entrepreneurs working in advanced manufacturing, clean power or electronics launch their business.

Run at the Lawrence Berkeley National Laboratory – about an hour’s drive from Stanford – Cyclotron Road provided lab space and funding to help push the trio’s CO₂ conversion science towards commercialization. The support was invaluable in turning their idea into reality, says Cave of the early stages of Twelve. At the time, venture capitalists in the science and technology space were funding things that could scale quickly and deliver fast returns, such as software and biotechnology, she says. “What we were doing – fundamental chemistry and electrochemical engineering – didn’t look anything like those sectors. Deep, lab-based research didn’t fit the typical venture-capitalist mould. Back then, very few investors were willing to take that kind of long view.”

Twelve’s technology, particularly its Opus system, is powered by renewable energy, and uses proprietary metal catalysts to speed up the conversion of CO₂ into carbon monoxide, which can be used to make base chemicals and materials for industry. By 2021, the company had raised US\$57 million in venture-capital funding and had collaborated with several multinational companies, including Microsoft, Procter & Gamble and Mercedes-Benz, which wanted to use Twelve’s technology in pilot projects to create materials for their products.

Twelve is preparing to flip the switch on its first commercial-scale plant, AirPlant. Located in Moses Lake, Washington, the facility runs on hydropower and converts CO₂ captured from a nearby ethanol plant into aviation fuel, called E-Jet, which can be blended with conventional jet fuel and used in existing aircraft. Last year, Twelve announced that it had raised US\$645 million from investors, including San Francisco-based private-equity firm TPG and Alaska Airlines, to develop sustainable jet fuel. Now with a team of 175 employees, Twelve’s ascent comes after nearly a decade of scientific hurdles and pivots and relentless fundraising, says Cave. “CO₂ is a very stubborn molecule to convert, and it took a lot of iteration, and a lot of capital to scale up. It’s been really challenging to do.”

For underrepresented founders, the climb can be even steeper. As a Black woman, Cave reflects that she “stood out a lot of times in the room”. She recalls how she and her co-founder Kuhl were an unusual sight in meetings. “People would remember our team – me and Kendra, the only women in the room.” In 2024, only 0.4% of US start-up funding went to companies with Black founders, according to Crunchbase, a data-analytics firm in San Francisco.

As Twelve continues to expand, Cave hopes to see it scale fast enough to make a real impact on the global emissions crisis. “With

our technology, you can make fuel anywhere in the world where you have direct air capture of CO₂,” she says. **Starre Vartan**

Against the flow *Riverkin*

Switzerland relies on hydropower to provide more than half of its energy needs – but there’s a problem. Rising temperatures and melting glaciers in the country’s mountainous regions are causing the surrounding landscapes to erode more quickly, sending increased amounts of gravel, sand and other debris into the rivers that feed the country’s hydroelectric plants. These sediments are damaging turbines and pipes and accumulating in reservoirs at an alarming rate, says Nitin Kumar, a data scientist and co-founder of Zurich-based start-up company, Riverkin.

Over the past few decades, Switzerland has lost around 28% of its hydroelectric energy capacity as a result of these changes, says Kumar. It’s a challenge that he and his Riverkin co-founder Jessica Droujko, an environmental engineer, hope to solve by installing sensors in rivers to alert hydropower operators when the water quality falls, such as after a flood (J. Droujko and P. Molnar *Nature Water* **1**, 758–759; 2023). The notifications would allow users to react, shutting down turbines to prevent damage when sediment levels are high, for example.

Established in 2024, Riverkin grew with

help from the Swiss Federal Institute of Technology in Zurich (ETH Zurich), Switzerland’s leading university in the Nature Index. It is one of more than 600 companies that have been incubated by ETH Zurich, which has a reputation for its spin-off success. The university is ranked second in Europe, after the University of Cambridge, UK, for the economic value generated by its spin-off companies, according to a report by Dutch analytics firm, Dealroom. “At ETH, they’re highly supportive,” says Kumar.

Having moved from India to do a PhD at the University of Zurich, Kumar met Droujko, who had moved from Canada to pursue a PhD at ETH Zurich. Droujko developed the sensor hardware as part of her PhD research – work that was accelerated by a fellowship that she won from ETH Zurich worth 150,000 Swiss francs (US\$182,000) in 2023. In 2024, she teamed up with Kumar, who developed the software that accompanies the sensor. Riverkin’s sensor can measure water level, temperature, turbidity and fine sediment concentration remotely and in real time, and is cheaper and more efficient than similar devices, according to the company.

Kumar says the things that attracted him to Switzerland were its leading universities, stable political and economic environment, and “a culture of science-based innovation”. He adds that diversity is also a big draw that is often overlooked. Foreigners comprise more than one-quarter of Switzerland’s population and having access to such a diverse workforce allows companies to “approach challenges



Riverkin co-founder Jessica Droujko (left) and one of the company’s sensors installed in a river.

from entirely different angles”, says Kumar. In his experience at Riverkin, this “leads to fresh, focused thinking and a more holistic understanding of every problem we tackle”, he says.

To expand Riverkin, Kumar and Droujko are taking things one step at a time. A large-scale validation study of Riverkin’s sensor is under way, which involves testing how reliably it connects to satellites so it can transmit real-time data to users, even in remote locations with no phone coverage. The team also wants to start collecting global water-quality data to check for patterns linked to climate change.

In addition, there are plans to extend Riverkin’s services beyond the energy sector to make an impact in wastewater management and mining, which is also affected by sedimentation. The goal, Kumar says, is one day to make water data as accessible and actionable as weather data, so that we can “make our waters cleaner for future generations”.

Sandy Ong

Disease detector *NalaGenetics*

Singapore-based biotechnology company NalaGenetics is preparing to roll out a nationwide genetic screening programme in Indonesia for people with leprosy. Indonesia has one of the highest rates of leprosy in the world, and the NalaGenetics team hopes that its DNA testing kits, which will be distributed to roughly 16,000 leprosy patients annually, will help to make treatment safer and more effective.

The earliest iterations of the tests were developed with volunteers living in Indonesia’s remote Papua province, on the island of New Guinea (H. Krismawati *et al.* *BMJ Open* 12, e057173; 2022). The tests identify whether the patients carry a variant of the *HLA-B* gene that would predispose them to having a fatal reaction to the anti-leprosy drug dapsone, thereby allowing them to receive alternative treatments. Since communities in Papua have been screening for this gene variant, the mortality rate of leprosy patients has been reduced from close to 10% in 2021 to almost zero. The screening tests are now also being distributed to patients in Nepal and India.

NalaGenetics’ roots are firmly planted in southeast Asia, says co-founder and chief executive, Levana Sani. The company plans to expand throughout the region, adapting its DNA kits to screen for diseases and health indicators that are pertinent to local communities. This includes cancer, cardiovascular disease and diabetes, as well as adverse drug reactions.

Sani says many of their peers in other start-up businesses in the region move to the



NalaGenetics co-founders (left to right) Astrid Irwanto, Alexander Lezhava and Levana Sani.

United States owing to its “very strong” environment for intellectual-property protection and fundraising. “We chose to stay in southeast Asia because we have inroads here, and we wanted to build a more profitable company, growing and educating local markets.”

Despite the attraction of the United States, Singapore has many advantages for entrepreneurs. It has a strong reputation for fostering innovation, having ranked fourth in the Global Innovation Index 2024, published by the World Intellectual Property Organization – up from fifth in 2023. Sani says the country provides a

“We chose to stay in southeast Asia because we have inroads here, and we wanted to build a more profitable company.”

nurturing ecosystem for research-led start-ups such as NalaGenetics, which in 2016 spun out of the Genome Institute of Singapore at the Agency for Science, Technology and Research (A*STAR), Singapore’s largest public sector R&D agency. Together with A*STAR, Singapore’s two largest universities, the National University of Singapore and Nanyang Technological University (NTU), produce most of the country’s science and technology spin-offs. NTU has been especially prolific, having incubated about 160 companies since 2017. “The government has been tremendously helpful,” says Sani. “They listen, put out surveys, and visit companies to

really try and get our input.” Because the Singapore market is very small, the government encourages companies to go global right away, she adds. “We got a lot of financial aid, help with market research and go-to-market activities, as well as finding collaborators.”

Sani says that having access to grants that are tailored to a start-up’s development phase – whether it’s producing a first prototype or getting it market-ready – and relatively efficient application and review processes are big draws for entrepreneurs in Singapore. The country also benefits from having a very good reputation for high-quality research, she adds. “If you say that you’ve done clinical trials in Singapore, nobody questions if your data is clean.”

But there is one downside to having such an advanced start-up ecosystem. Singapore “is so far ahead of its neighbours that market translation is really challenging”, Sani says. Pharmacogenetics – which looks at how genetic variations can affect a person’s response to medications – has a strong presence in Singapore companies, for example, but markets elsewhere “might not have even heard of the word”, she says. The trick is to identify ‘early adopters’ – physicians who are open-minded about new treatments and technologies – says Sani, which is what helped NalaGenetics to expand its leprosy tests beyond rural Papua.

Genome testing is a “super competitive” industry, Sani admits, but if governments start recommending and subsidizing tests such as those from NalaGenetics, they could one day “go mainstream”, she says.

Sandy Ong