black women training to be physicians. The proportion of men among African-American medical students decreased by more than 20% over the same period. Data from the Association of American Medical Colleges show that, in 2015, 41% of black male applicants were accepted into medical school — the lowest rate across all genders and ethnicities. “This is a crisis that affects not only blacks, but also our national ability to have excellence in science and medicine,” Laurencin says.

Racial diversity in the medical professions can help to address health inequalities. Studies have shown that people from minority groups receive better care when their physicians have similar backgrounds.

“Having racial diversity leads to not just more doctors, but also better-prepared doctors who go into communities of colour,” says Liliana Garces, an education researcher and legal scholar at the University of Texas at Austin. She adds that one promising strategy for increasing diversity in medical schools is reducing the admission procedure’s emphasis on standardized tests, which “don’t end up capturing the student’s potential, and only contribute to more racial inequities in the student body”.

Ross University School of Medicine in Portsmouth, Dominica, accepts students from under-represented minorities with lower standardized test scores and grade point averages than white applicants. The university — which has campuses in Dominica and the United States — gives these students educational support during the first semesters of medical school and connects them with a mentor from a similar background.

Environments where black men can build a community help to improve graduation rates, Laurencin says. And programmes that give financial support to undergraduate students of colour and provide early exposure to research increase representation in science, technology, engineering and mathematics PhD programmes.

But Freeman Hrabowski, president of the University of Maryland, Baltimore County, which runs one such programme, notes that universities and medical schools need funding to expand these efforts. “Without funding,” he says, “there is no serious commitment.” ■

A demonstration power plant run by NET Power in Houston, Texas.

ENERGY

Zero-emissions plant begins key tests

Start-up firm NET Power is developing a new approach to capturing and storing carbon.

BY JEFF TOLLEFSON

A team of engineers in La Porte, Texas, has spent the past several weeks running tests on a prototype power plant that uses a stream of pure carbon dioxide — not air — to drive a turbine. If the zero-emission technology developed by NET Power in Durham, North Carolina, succeeds, it could help to usher in an era of clean power from fossil fuels.

The company broke ground on the roughly 25-megawatt plant in March 2016, after raising US$140 million for the project. It completed construction last year. It is now running a battery of tests on the combustor that powers the plant, a one-of-a-kind device built by the Japanese industrial giant Toshiba. If the tests go as planned, NET Power will hook up the turbine and begin generating electricity later this year.

Officials say everything is running smoothly so far. “We’re still smiling,” says chemical engineer Rodney Allam, the facility’s lead designer.

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NET POWER AND MCDERMOTT

Allam is now a partner with 8 Rivers, a technology company in Durham that co-owns NET Power with Exelon, a major electricity provider in Chicago, Illinois, and McDermott International, an energy-services company in Houston, Texas.

What separates the La Porte facility from a standard power plant is the CO_2 cycle at its core. A conventional power plant burns fossil fuels to generate steam that drives a turbine — and it also emits CO_2 as a by-product.

By contrast, NET Power will drive its turbine with a loop of hot, pressurized CO_2. The first step is to fill the system with CO_2, which must then be heated to drive the turbine — much like a conventional power plant heats water to create steam.

The combustor then ignites a mixture of natural gas and oxygen, which is extracted from the atmosphere in a separate facility. This heats up the CO_2 in the loop that drives the turbine, but it also produces further CO_2 that must be siphoned off to keep the system in balance.

ENERGY ECONOMICS

The result is a stream of pure CO_2 that can be buried or put into a pipeline — rather than the atmosphere — at almost no cost. That gives it an edge over existing technologies for stripping CO_2 out of a conventional power plant's exhaust; these drive up costs while sapping around 20% of the plant's power.

Allam says that, if all goes well, NET Power's technology will produce electricity as cheaply and efficiently as a conventional, modern gas-fired power plant — and earn extra revenue by other means. For instance, oil companies might buy the plant's excess CO_2 and pump it into their wells to boost oil production. NET Power could also sell nitrogen and argon produced by the plant's air separator.

A coal-fired power plant in Houston that is equipped with a competing CO_2-capture technology is already delivering the gas it collects to a nearby oil field. The $1-billion Petra Nova project came online in January 2017. It uses an amine-based solvent to capture about one-third of the emissions from a single power-generating unit — up to 1.6 million tonnes of CO_2 annually.

"If the plant does everything they say, it's hard to imagine why you would want to build a traditional power plant."

But the project — a joint venture between NRG Energy in Princeton, New Jersey, and JX Nippon Oil and Gas Exploration in Tokyo — depended on both a $190-million grant from the US Department of Energy and additional oilfield revenue to turn a profit, says Daniel Cohan, an atmospheric scientist at Rice University in Houston. By contrast, he notes NET Power's claim that its power plant will turn a profit even before it begins selling CO_2.

"If the plant does everything they say, it's hard to imagine why you would want to build a traditional power plant," Cohan says. "But there are still a lot of ifs ahead."

One major challenge will be ensuring proper combustion of oxygen and methane in the presence of CO_2, which normally acts as a fire extinguisher. NET Power is several months behind schedule on this task, but project officials say that was the result of Toshiba's decision to test the plant's combustor on site rather than sending it to an independent test facility; that meant installing and reconfiguring equipment at the otherwise complete plant.

Once the project begins producing electricity, NET Power engineers must also show that the plant operates as efficiently as advertised, says Howard Herzog, who studies carbon capture and sequestration at the Massachusetts Institute of Technology in Cambridge. The challenge, he says, will be to address the inevitable problems that arise when engineers are building the first-of-a-kind facility without sacrificing energy efficiency or driving up costs.

NET Power officials say they are ready to take advantage of recently expanded US government tax credits for carbon capture and sequestration projects — beginning with a proposed 300-megawatt plant that could be operational by 2021. But the company's chief executive, Bill Brown, says the firm isn't reliant on subsidies, and is already seeking customers and manufacturing partners abroad. It is also looking at potential markets for CO_2, which could soon become a cheap chemical feedstock.

"We don't like to rely on policy around here," Brown says. "We like to rely on science." ■

INTELLECTUAL PROPERTY

Rush to protect billion-dollar antibody patents

A US federal court decision has left biotech working to preserve intellectual-property rights.

BY HEIDI LEDFORD

Universities and biotechnology companies in the United States are scrambling to protect some of their most valuable assets: patents on antibodies. These immune-system molecules form the basis of drugs that rake in about US$100 billion per year. But securing intellectual-property rights to antibodies has become much more difficult, under guidelines released in February by the US Patent and Trademark Office (USPTO).

The revised rules come after a federal court decision last October narrowed the scope of antibody patents — including those that have already been handed out. "People are still trying to make sense of it," says Ulrich Storz, a patent attorney at Michalski Hüttermann & Partner in Düsseldorf, Germany. "These were very powerful patents."

Storz and others will discuss the implications of the shift on 6 June as part of a panel at the Biotechnology Innovation Organization annual meeting in Boston, Massachusetts.

BROAD PROTECTIONS

Antibodies are proteins made by the immune system that bind to a specific target, such as a protein produced by a microbe, to interfere with its ability to promote disease. This has made them powerful drugs against some illnesses.

Therapeutic antibodies are structurally complex, and in many cases, changes to their amino-acid sequences will not affect their function. So a patent based solely on an antibody's sequence might be vulnerable to competition, says Barbara Rigby, a patent attorney at Dehns in Brighton, UK. A competitor could tweak the sequence to create a new antibody that performed the same function.

In addition, for many years researchers lacked the technology to sequence an antibody, to define how it bound its target or to introduce specific changes to its ▶