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 ▶

structure. Given these challenges, the USPTO routinely granted broad patents that covered the suite of antibodies that attached to a particular target, rather than a specific antibody developed by an inventor.

DEVIL IN THE DETAILS

Over time, however, the technology for antibody analysis has improved. In 2014, two pharmaceutical heavyweights — Amgen in Thousand Oaks, California, and Sanofi in Paris — launched a battle over patents covering a potentially lucrative antibody treatment for high cholesterol.

The case reached a federal appeals court, where judges determined last year that inventors must provide a better description of the actual invention — a more defined set of antibodies — that they wanted to patent.

The USPTO responded with new guidelines for its examiners this year. Since then, patent rejections have piled up. A few weeks ago, patent attorney John Kilyk of Leydig, Voit & Mayer in Chicago, Illinois, learned that an application he was handling had run into trouble. "It was sufficient a few months ago, and now it's not," he says.

The court ruling is retroactive, so the move also jeopardizes existing antibody patents. "There's no doubt that the biotech companies that have been patenting antibodies are going to be harmed," says Storz. "There are a number of antibody patents that are now invalid, or would be if somebody tried to enforce them."

Universities in particular might struggle to put together the information now needed to win an antibody patent, says Rodney Sparks, an attorney with the University of Virginia's technology-transfer office in Charlottesville. Examiners are asking for more detail about the range of antibodies that can bind to a target and, specifically, where on the target those antibodies will attach.

"There's no doubt that the biotech companies that have been patenting antibodies are going to be harmed."

"In universities, our guys want to publish," Sparks says. "We don't have the ability, typically, early on to make lots and lots and lots of antibodies and screen for all of those characteristics." As a result, he says, universities will need to file narrower patents covering only a few of the possible antibodies, and might struggle to find companies willing to license them.

And applicants are facing pushback from patent examiners who are extending the tightened rules on an invention's written description to other kinds of patent applications, says Rigby. A broad patent for a method to treat disease by targeting a specific protein, she says, might now also be in question.

"It's not clear whether examiners have misunderstood and are overreaching, or whether this is a more general trend that the patent office is behind," Rigby says.

Yet the shift has been an unexpected boon to some companies. Benjamin Doranz, president of Integral Molecular, a company in Philadelphia, Pennsylvania, that produces and analyses antibodies, says that clients used to request analyses mainly to learn more about how their antibodies functioned. But increasingly, he says, the company's data are being used to bolster patent applications. Some of its clients are now patent-law firms.

Patenting antibodies has become much more treacherous, says Doranz. "But they're still of great value," he says, "so everyone is trying to figure out the new patent landscape, and how do we navigate it." ■

CORRECTION

The World View 'Transparency rule is a Trojan Horse' (*Nature* **557**, 469; 2018) misstated the number of signatories to the joint statement. It omitted to mention Cell Press and PLoS journals.