Timofte, a process engineer at the company.

In some ways the technology is similar to that of Carbon Engineering, but Climeworks will instead use granules to soak up the CO_2, using a module that will sit on top of an incineration plant. (The technology is still classed as air capture because the material will scrub CO_2 from air near the plant rather than from the expelled gases.) Waste heat from the incinerator will be used to drive the captured CO_2 off the granules, which can then be reused.

The company has arranged to sell CO_2 produced in this way to the firm Gebrüder Meier, which will use it to increase crop yields in greenhouses. Climeworks is also assessing the beverage industry as a source of potential customers, says Timofte.

If such companies are to scale up further and make money, one challenge will be finding buyers for their CO_2, says Tim Kruger, a geoengineer at the University of Oxford, UK, who organized the Oxford meeting and runs a company, Origen Power, that hopes to generate carbon-negative energy. And it is not clear whether companies will be able to produce CO_2 or related products at a price that is competitive enough to attract a wide pool of clients.

In 2011, a report from the American Physical Society (APS) estimated that air capture would cost at least US$600 per tonne of CO_2, assuming a large system that removed 1 million tonnes of CO_2 per year. But Climeworks says that its price will be in that range in the first year of its plant's operation, despite being on a smaller scale than the APS example. The company also expects that cost to fall as the technology develops. Keith, meanwhile, says that the CO_2 produced by Carbon Engineering's plant is expensive, but emphasizes that it is a pilot; he says that prices of $100–200 per tonne of CO_2 are realistic for the bigger iterations that it is planning.

ELIZA GRINNELL/SEAS, HARVARD

David Keith, chairman of Carbon Engineering.

Even if the companies cannot compete on price with conventionally manufactured CO_2 (which can be as low as tens of dollars per tonne but can be significantly higher), there are other factors that could help to create demand for air-captured CO_2. The introduction of a carbon tax could incentivize big emitters to pay other companies to mop up their CO_2 to avoid paying the tax. And if the world is ever to become completely carbon neutral, air capture will have a part to play, says Nilay Shah, an engineer working on low-carbon technologies at Imperial College London.

Efforts to mitigate climate change should focus on capturing CO_2 at the source. But there are many scenarios in which pre-emission capture is not viable. "Once you start to get into things like capturing carbon from vehicles or from household boilers, that's much more expensive," says Shah. "You may well be better off capturing CO_2 from the air."

Keith emphasizes that his company is not trying to fix climate change on its own. "Air capture has been stuck in a catfight between one group of people saying it's a silver bullet and one group saying it's bullshit," he says. "The truth is it's neither." ■

AWARDS

DNA-repair sleuths win chemistry Nobel

Tomas Lindahl, Paul Modrich and Aziz Sancar share prize for work on how DNA heals itself.

BY DANIEL CRESSEY

The 2015 Nobel Prize in Chemistry was awarded last week to three researchers for their work on DNA repair.

Tomas Lindahl, Paul Modrich and Aziz Sancar "mapped, at a molecular level, how cells repair damaged DNA and safeguard the genetic information", said the Royal Swedish Academy of Sciences in Stockholm, which awards the prize.

DNA is not a stable molecule, but slowly decays over time. For life to exist — as Lindahl first realized while working at the Karolinska Institute in Stockholm in the 1970s — there must be repair mechanisms that fight back against this process.

Numerous scientists have since chronicled the many ways in which damaged DNA is patched up, says Stephen West, who works on DNA repair at the Francis Crick Institute in London, where Lindahl is now an emeritus group leader. "The DNA-repair field is a large field," says West. "Many of us thought a Nobel would not go to this field because there are so many people with a claim to the prize."

But the three repair mechanisms recognized with the Nobel prize "are probably the three most important and best-understood mechanisms", he says, adding that the awards are "fantastically well deserved".

REPAIR JOBS

Lindahl, who is regarded as one of the founders of the field, chronicled a process dubbed base excision repair, in which specific enzymes recognize, cut out and patch up bases in the DNA molecule. Before his work, "I don't think anybody really considered the idea that DNA requires active engagement by a set of housekeeping processes to keep it in a stable state," says Keith Caldecott, who studies DNA repair at the University of Sussex in Brighton, UK, and did postdoctoral work with Lindahl.

Sancar — who was born in Savur, Turkey, but has spent most of his professional life in the United States and is now at the University of North Carolina at Chapel Hill — worked in the 1980s to explain how cells use enzymes to repair damage to DNA from ultraviolet rays or other carcinogens, through a system called nucleotide excision repair.

"We need DNA repair but we don't like it that the cancer cells have DNA repair."

And in 1989, Modrich, who is at Duke University School of Medicine in Durham, North Carolina, published work on a third mechanism — 'mismatch repair' — which deals with errors produced when DNA is copied.

This September, the prestigious Albert Lasker Basic Medical Research Award was also awarded for work on how cells correct damage to DNA. But it went to two other researchers: Evelyn Witkin of Rutgers University in New ▶

L TO R: JUSTIN TALLIS/AFP/GETTY; HHMI; SAMUEL CORUM/ANADOLU AGENCY/GETTY

Tomas Lindahl, Paul Modrich and Aziz Sancar share the 2015 Nobel Prize in Chemistry.

Brunswick, New Jersey, and Stephen Elledge of Brigham and Women's Hospital in Boston, Massachusetts.

WIDER IMPACTS

Speaking to reporters in Stockholm at the Nobel press conference, Lindahl noted that understanding DNA repair has implications for human health. People with faults in their repair system have an increased risk of developing cancers, because damaging mutations can go uncorrected. Cancer cells themselves survive damage by using enzymes to patch up DNA, and there is now interest in therapies that target DNA-repair pathways in tumour cells. "We need DNA repair but we don't like it that the cancer cells have DNA repair," Lindahl said.

Work in the field has had an impact in other areas, too. Lindahl's research proved influential in the 1980s and 1990s, when scientists were first working to extract and analyse ancient DNA. The patterns of DNA damage that he first characterized are now used as a stamp of authenticity to show that DNA is ancient, and not modern contamination.

The chemistry prize follows the award of the Nobel Prize in Physiology or Medicine to William Campbell, Satoshi Ōmura and Youyou Tu for their work on therapies against parasitic infections. The physics Nobel went to Takaaki Kajita and Arthur McDonald for showing that neutrinos have mass. ■

CORRECTIONS

The News story 'Neutrino flip wins physics prize' (*Nature* **526,** 175; 2015) wrongly implied that physicists knew about all three types of neutrino in the 1960s. In fact, the tau neutrino was postulated only in the 1970s. The News Feature 'The impenetrable proof' (*Nature* **526,** 178–181; 2015) wrongly located the University of Antwerp in the Netherlands. It is, of course, in Belgium. In the News Feature 'The mitochondria mystery' (*Nature* **525,** 444–446; 2015), the quote "The standards for a shampoo seem to be harsher" was erroneously attributed to Ted Morrow. When he said these words, he was characterizing the stance of another researcher, not expressing his own opinion, and the quote should not have been included.