IN DEPTH

Energy budgets at the Dutch Low-Frequency Array are stretched to the breaking point.

PHOTO: LOFAR/ASTRON

EUROPE

Europe's energy crisis hits science hard

Supercomputing and accelerator centers struggle with surging gas and electricity prices

By **Jacklin Kwan**

Soon after Jessica Dempsey became director of the Netherlands Institute for Radio Astronomy (ASTRON) in December 2021, she was forced to focus not on the stars, but on the electric bill. ASTRON operates the Low-Frequency Array (LOFAR), which relies on large computer clusters to process radio astronomy data. They consume about 2000 megawatt-hours per year—the equivalent of 800 households. When Dempsey sought to renew ASTRON's energy contracts this summer, she was shocked to find costs had tripled from 2021 levels. She now plans to seek emergency energy funding from the Dutch government; without it, she may have to scale back observations. "It's certainly an existential crisis if these [price] increases continue," she says.

Surging energy prices are hitting Europe hard—and not just households. Institutes that operate energy-hungry supercomputers, accelerators, and laser beamlines are also struggling—and may be harbingers for the rest of science. If prices continue to soar this fall and winter, "The impact for science is going to be significant," says Martin Freer, a nuclear physicist who directs the University of Birmingham's energy institute.

The primary cause of the crisis is a rebound from an economic slowdown during the COVID-19 pandemic. Power stations that had been shut down could not ramp up in time to meet renewed demand, says Jonathan Stern, who studies natural gas at the Oxford Institute for Energy Studies. Russia's invasion of Ukraine in February worsened the situation. Sanctions and Russian retaliation crimped supplies of Russian natural gas, which generates electricity and heats buildings, pushing European gas prices to more than 10 times their average historical values.

Early science casualties came in January, even before the Ukraine war, when Lumius, an energy contractor in the Czech Republic, declared bankruptcy, driving up energy prices for many Czech universities and research facilities. IT4Innovations, a national supercomputing center, was compelled to run its most powerful supercomputer at one-third of its capacity—creating delays for the 1500 users who used it for climate modeling and drug discovery. ELI Beamlines, a Czech facility that hosts high-power laser beams, had to shut down operations for a few weeks.

By May, the Czech government had agreed to bail out both facilities until the end of 2023, but their fate remains uncertain. Roman Hvězda, ELI Beamlines deputy director, worries the government will declare a state of emergency, which could restrict the gas the facility needs to heat its buildings. But electricity to power the beamlines is the bigger concern. If supplies are restricted, the facility may have to shut down again, for up to 6 months—which would not only curtail ongoing experiments for hundreds of users, but also delay calls for future ones, he says. "So, you're effectively losing not 6 months, but maybe 12, maybe even 18 months."

There's a similar concern at DESY, Germany's largest accelerator center. DESY has bought enough energy in advance to last into 2023 but might not be able to use those supplies if the German government imposes national energy restrictions, says Wim Leemans, who leads DESY's accelerator programs.

Leemans says DESY is exploring options to run its machines at lower energies. For example, it could turn down its synchrotron, a circular particle accelerator that produces bright x-rays for imaging proteins and materials, so that it only generates lower energy "soft" x-rays. That way it could continue to serve some users, he says. But its two large linear accelerators, used to produce laserlike pulses of x-ray light, would need to be shut down completely if the restrictions are severe. They rely on superconducting modules that need constant power-hungry cooling, Leemans says. "We cannot say, 'Well, we're only going to run some parts of the machine.'"

Reducing operations would hurt important research, he adds. During the pandemic, vaccinemaker BioNTech used DESY's x-ray

facilities to reveal how the SARS-CoV-2 virus uses its surface protein, spike, to dock with human cells. Other DESY researchers study materials used in solar panels and batteries. "It will have ramifications for slowing down innovations, right at the moment when we need them the most," Leemans says.

Big legacy machines may be hard to restart after a shutdown, adds Anke-Susanne Müller, who heads accelerator physics and technology at the Karlsruhe Institute of Technology. Turning off vacuums may damage delicate systems, stopping the flow of water in cooling systems may cause corrosion, and older control electronics might not turn on again. "If you suddenly switch a component off, they might not easily come back," she says.

CERN, the world's largest particle physics laboratory, in Switzerland, is also nervously watching the energy crisis unfold. CERN purchases energy from the French grid years in advance, but now the concern is supply. "For this autumn, it is not a price issue, it's an availability issue," says Serge Claudet, chair of CERN's energy management panel.

CERN uses 1.3 terawatt-hours of energy annually, roughly the equivalent of 250,000 households. French energy authorities might order CERN to not operate at times when the electric grid is least stable—typically mornings and evenings. If frequent, those requests could significantly reduce CERN's data output, Claudet says. He says CERN may have to shut down smaller accelerators in order to sustain the Large Hadron Collider, the world's most powerful accelerator.

Even with energy procured for the short term, Claudet says CERN's budgets will be stretched to pay for it. "This is a financial concern because the energy prices on the market are very high, up to 10 times higher."

Stern predicts it will take at least 2 years for prices to fall to typical levels. Meanwhile, peak prices will depend on the severity of Europe's winter and whether Asian countries bid against Europe for global supplies of liquid natural gas. Stern says it's unclear whether governments will keep research labs afloat, or prioritize aiding industry. Smaller research laboratories in universities may be left to fend for themselves, he says.

Freer warns of real-world consequences. He gives the example of accelerators at Birmingham that produce isotopes for medical imaging—programs that would either need to be suspended, run at a loss, or pass on their costs to local hospitals. "It's going to be a challenging time to get through," he says. "It may mean, like with COVID, there will be a hiatus in science programs." ■

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COVID-19

Private venture tackles Long Covid, aims to test drugs soon

Initiative to explore whether coronavirus lingers in patients

By **Jennifer Couzin-Frankel**

A new, privately funded venture announced last week has recruited more than 20 top scientists and is pouring $15 million raised so far into Long Covid research. It plans to explore whether lingering virus causes symptoms and to launch clinical trials as soon as possible. The scientist who spearheaded the Long Covid Research Initiative (LCRI), microbiologist Amy Proal at the nonprofit PolyBio Research Foundation, says the goal is to bring in $100 million, with half of that going to trials.

That sum will still be dwarfed by the behemoth RECOVER initiative at the National Institutes of Health (NIH), which has more than $1 billion to fund Long Covid projects. But RECOVER has come under fire for its sluggish pace. Proal and others say new strategies are needed to distribute funds faster and to embrace higher risk, higher payoff research.

"We need a spark, we need a philanthropic organization that has a risk tolerance much greater than NIH," says E. John Wherry, an immunologist at the University of Pennsylvania who is part of LCRI and has advised on RECOVER grants. Wherry compares NIH money to the bonds in an investor's portfolio—"lumbering, slow-changing things that give you the core of what you need." But sometimes, "bonds are not going to be the tool you use," he says.

PHOTO: HYOUNG CHANG/*THE DENVER POST*

An 18-year-old hospitalized with Long Covid.

NIH said in a statement it welcomes the private initiative because "the public can only benefit from multiple research efforts." However, NIH also called RECOVER "unprecedented" in scale and crucial to giving researchers "a fighting chance at identifying the underlying mechanisms of Long COVID."

LCRI was born after several patient advocates with Long Covid and a professional background in technology startups approached Proal early this year. "The enormity of the problem really outweighs the size of the response," says one, Henry Scott-Green, a Google product manager. The Centers for Disease Control and Prevention estimates that nearly one in five people who contracted COVID-19 may have persistent symptoms, which can include fatigue and brain fog.

So far, LCRI has received $15 million from investors including the Chan Soon-Shiong Family Foundation; more commitments are expected soon, Proal says. That first batch of funding will support basic research by participating scientists. They will focus on whether SARS-CoV-2 persists in Long Covid patients and drives their symptoms. Studies include a hunt for virus in intestinal, nerve, vascular, and other tissues, including those procured from autopsies. Researchers will also dig deep into immune cell behavior that may reflect viral persistence.

If virus lingers in the body, antiviral therapies might reduce symptoms. Proal hopes the collaborative can soon begin clinical trials of such therapies, and that its scientists can nail down the kind of biomarkers drug companies crave for assessing a candidate treatment, such as immune signatures or other measures in blood.

NIH has said that it, too, expects to launch several Long Covid trials this fall. Those involved in LCRI—and often RECOVER as well—stress they want to complement each other, not work at cross purposes. David Putrino, an LCRI member and neurophysiologist at the Icahn School of Medicine at Mount Sinai who is also on a RECOVER subcommittee, has criticized the NIH initiative but now hopes at least for détente. "No matter … what's gone before, we need to swallow our pride and work together." ■

With reporting by Jocelyn Kaiser.