funded two research projects in 2002 that laid some of the foundation for today's highly effective mRNA-based COVID-19 vaccines (K. Karikó *et al. Immunity* **23**, 165–175; 2005).

US officials hope that a big budget boost (see 'Slow and steady') for the NSF could similarly yield breakthroughs. With its current budget, the NSF funds only 20% of grant applicants each year, even though 30% of proposals are rated highly meritorious by review panels, said NSF director Sethuraman Panchanathan during the Senate appropriations hearing on 13 April.

"My worry is that when we leave behind these ideas, somebody else picks up on" them — namely, global competitors, said Panchanathan. To properly support all the highly meritorious applications would require a doubling of the NSF budget at least, he explained.

From bench to market

What's badly needed, officials say, are more mechanisms for translating basic research into commercial technology. So all three proposals include money to create a technology directorate at the NSF.

The Biden administration's infrastructure plan proposed a $50-billion infusion of cash for the NSF, with a focus on funding research and development for emerging technologies. The Senate's Endless Frontier Act would increase the agency's budget to $100 billion over five years to support a new technology directorate. And members of the House proposed the National Science Foundation for the Future Act, which would increase the budget to $18.3 billion by 2026, and create a much smaller technology initiative called the Directorate for Science and Engineering Solutions.

Not everyone is in favour of building such a directorate at the NSF, however. Critics, including legislators in US states with national laboratories, worry that it would duplicate existing government efforts. At the Senate appropriations hearing, senator Joe Manchin pointed out that the US Department of Energy (DoE) already supports work at national laboratories involving technologies, such as quantum computing and artificial intelligence, that are highlighted in the Endless Frontier Act. Manchin, a West Virginia Democrat, chairs the Senate committee that oversees the DoE. He said that tasking the NSF with a greater responsibility for developing innovative technologies might just "reinvent the wheel".

In his testimony, Panchanathan assured legislators that the new directorate would partner with initiatives at the DoE and other federal agencies, while also capitalizing on existing areas of expertise at the NSF.

Far from diminishing the importance of basic research, a technology directorate could "add a dimension" to the NSF mission, says Neal Lane, a science-policy researcher at Rice University in Houston, Texas, who served as NSF director from 1993 to 1998.

Still, researchers worry that the rapid expansion of technology-focused initiatives at the NSF might eclipse its primary focus on basic science — a mission unique to the NSF among federal agencies. Paul Hanle, former president of the climate-science research group Climate Central, says the NSF's investments in fundamental research need to be carefully safeguarded so that the new technology focus does not "gobble up resources and push inquiry-based science into the sidelines".

Given that the three proposals are similar, change at the NSF seems inevitable, says Christopher Hill, a science and technology-policy researcher at George Mason University in Arlington, Virginia. But, he says, a cash infusion alone won't lead to technological innovations. For this initiative to be successful in the long term, he adds, the NSF might have to undergo a cultural shift that would reflect its broadened focus.

During the congressional hearings, some legislators expressed concern that a marked boost in NSF funding would not be distributed equitably. For instance, they pointed out that more than one-quarter of NSF funds in 2020 went to just three US states: California, Massachusetts and New York.

Members of the science community are also concerned that an influx of funding will draw more graduate students and postdocs, who won't be able to find jobs if the budget later tightens. This happened after the NIH's budget stagnated following its boom.

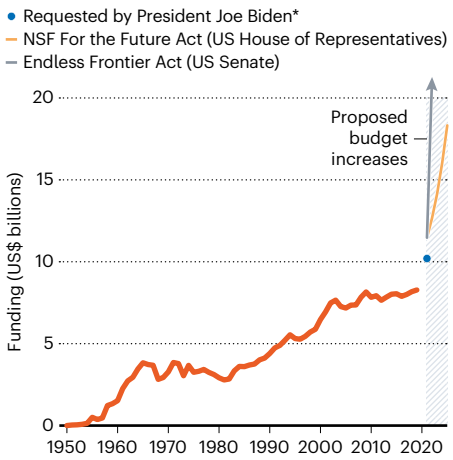
Still, proponents of a budget boost hope that it could help to address a lack of diversity in the STEM workforce.

For now, Congress continues to iron out the details, with the goal of arriving at a single plan. The Senate has introduced a new draft of the Endless Frontier Act, with updated language to address the broad perspectives presented in the hearings.

"I've never been as optimistic that, finally, the National Science budget will be significantly increased," says Lane.

SLOW AND STEADY

Since its launch in 1950, the US National Science Foundation has experienced only gradual changes in its budget. Now it stands to gain a massive funding boost if any of the proposals under consideration are adopted.



Years are fiscal years, and funding is in constant 2020 dollars to adjust for inflation. Data exclude the $3 billion given to the NSF in 2009 through the American Recovery and Reinvestment Act. *Excludes $50 billion requested by Biden with no time frame specified.

KEY COVID RESEARCH HIT BY CUT TO UK FOREIGN-AID BUDGET

Britain's scientists buffeted by uncertainty as pandemic's economic fallout shrinks project funds.

By Holly Else

Bitter and angry are the words that epidemiologist Oliver Pybus uses to describe his feelings when he opened an e-mail from his university's research-services department this month. The e-mail told him that funding for one of his research projects would be cut by one-quarter. It was the second such notification that he had received in 2021. The first listed a 70% cut to another project.

Pybus, who is at the University of Oxford, UK, is part of one of the world's leading teams working on identifying and tracking new variants of the SARS-CoV-2 coronavirus. The latest cut to his team's funding will affect a surveillance project in Brazil, where COVID-19 infections, some caused by fast-spreading variants, are surging (see page 15). Both cuts are the result of reductions that the UK government made last year to its foreign-aid budget, some of which funds research.

"There can't be many more important scientific projects today than this," says Pybus. He and his team are tracking the genomic changes in the SARS-CoV-2 virus, and have so far identified significant variants of concern. "We have

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been working absolutely flat out for 14 months. Everyone is drained and exhausted. It makes me feel that has been unappreciated," he says.

The reductions to the UK aid budget, also known as official development assistance (ODA), have hit more than 800 other research projects, affecting thousands of UK and overseas researchers. Since 2014, the government has channelled a portion of ODA funding to public science agencies to help researchers address pressing problems in the developing world, such as emerging infectious diseases, by building collaborations with researchers overseas. But in November, in response to the economic fallout of the COVID-19 pandemic, politicians slashed provisions for the ODA from 0.7% of gross national income to 0.5%.

The cut left UK Research and Innovation (UKRI) — the agency that oversees the main ODA research schemes, and the nation's central research funder — with a shortfall. As a result, it has been unable to meet its existing commitments to universities that had already secured multi-year grants. More than 12,000 people have signed a petition to reverse the cut, which reduced ODA funding for 2021–22 to £125 million (US$174 million), £120 million less than they were expecting.

Emergency funds

In mid-March, UKRI began writing to universities that would be affected by the ODA cut to tell them about the shortfall. The letters ask institutions to reprofile, reduce or terminate the grants that had been won. Many are now scrambling to work out how to do this. The University of Oxford has 18 awards affected, and administrators have applied the cut equally across grants, "with very significant impact on research and researchers, here and with our overseas partners", according to a spokesperson for the institution.

At University College London (UCL), where 36 projects are affected and the cuts total £6.6 million, administrators have created an emergency global-health research fund worth up £2 million to help alleviate some of the pressure on its scientists. David Price, the institution's head of research, says that the cuts are unprecedented.

Nick Greene, a developmental neurobiologist at UCL, has had a grant for a global-health trial cut by 25%. The grant is jointly funded by several organizations hit by the aid cuts. The trial, which was about to start in northern China in collaboration with Peking University, is designed to look at whether inositol supplements can prevent some neural tube defects during pregnancy. It is the precursor to a larger clinical trial, and the culmination of 20 years' work, he says.

The trial might not now go ahead. If it does, it's likely that the number of participants will be cut. "There is the stress of not knowing what the next step is," Greene says.

POPULAR GENOME SITE HITS ONE MILLION CORONAVIRUS SEQUENCES

The GISAID repository now hosts SARS-CoV-2 sequences from most nations on Earth.

By Amy Maxmen

More than 1.2 million coronavirus genome sequences from 172 countries and territories have now been shared on a popular online data platform — a testament to the hard work of researchers around the world.

Sequence data have been crucial to scientists studying the origins of SARS-CoV-2, the epidemiology of COVID-19 outbreaks and the movement of viral variants across the planet.

"Because countries are submitting data from so many parts of the world, you have a system where we can watch how the virus spreads through the world," says Sebastian Maurer-Stroh, a Singapore-based scientific adviser at GISAID — the Global Initiative on Sharing Avian Influenza Data.

Several databases for genome sequences exist, but GISAID is by far the most popular for SARS-CoV-2. It was conceived in 2006 as a repository of genomic data from influenza viruses. At the time, many countries withheld genomic information. One fear was that the countries generating the data would not get credit, or would not reap the benefits of research stemming from their original sequencing work. But after two years of negotiations between governments and scientists about data-sharing agreements, GISAID launched.

When COVID-19 began spreading in China, Maurer-Stroh says, the GISAID team immediately reached out to researchers and politicians around the world, to understand what barriers might prevent them from sharing genomic data on SARS-CoV-2.

Although outreach helped, Maurer-Stroh says, the site's popularity is mainly due to its mechanism of sharing and the quality of its tools for sequence display and analysis.

Some wealthy countries have uploaded huge numbers of sequences and account for the lion's share in their regions (see 'Collaboration in the time of COVID'). For example, as of 20 April, the United States had shared 303,359 sequences, and the United Kingdom's tally stood at 379,510 sequences.

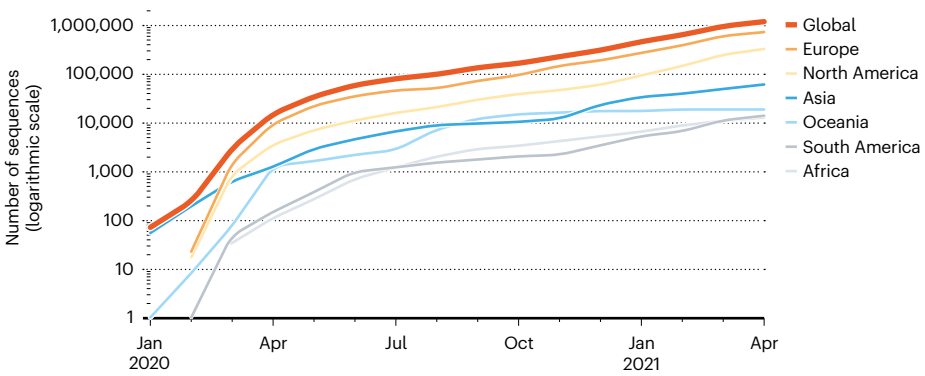
But glaring gaps exist. Not a single SARS-CoV-2 sequence has been uploaded from Tanzania, and countries with significant outbreaks, including El Salvador (67,851 cases, but only 6 sequences uploaded) and Lebanon (513,006 cases, 49 sequences), are lagging far behind.

To search or download sequences from GISAID, or use genomic-analysis tools, people must register and agree to terms that include not publishing studies based on the data without acknowledging scientists who uploaded the sequences and contacting them about collaboration. Such gatekeeping has upset some scientists, who argue that there should be no barriers standing in the way of access.

But GISAID probably would not have hit the one-million mark without such an approach, because it would have lacked assurances against exploitation, speculates Tulio de Oliveira, the director of the KwaZulu-Natal Research Innovation and Sequencing Platform in Durban, South Africa. He says: "This is the first time I've seen people sharing so much data before publication."

COLLABORATION IN THE TIME OF COVID

More than one million SARS-CoV-2 genome sequences have been shared on the GISAID database since January 2020, from every region of the world.



SOURCE: GISAID

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