

SCIENCE UNDER TRUMP 2.0: THE LIKELY WINNERS AND LOSERS

The incoming US president is expected to gut research on the environment and infectious diseases, but could buoy work in artificial intelligence, quantum research and space exploration. **By Nicola Jones, Alexandra Witze, Jeff Tollefson and Max Kozlov**



ILLUSTRATION: JASIEK KRZYSZTOFIAK. IMAGES: MUSK: FREDERIC LEGRAND — COMEO/SHUTTERSTOCK; DRUG VIAL: MD RAFAYAT HAQUE KHAN/EYEPIX GROUP/FUTURE PUBLISHING VIA GETTY; ROCKET: CHARLES BOYER/ALAMY; TRUMP: REBECCA NOBLE/GETTY; OIL WELLS: JOHN CICCARELLI, BLM CALIFORNIA; CHIP: LUZA STUDIOS/GETTY

As Donald Trump prepares for his second term as president of the United States, two starkly different outlooks are emerging among scientists and engineers. Some technology companies, space enthusiasts, artificial intelligence (AI) developers and others expect favourable policies for their fields in the coming years, and are hugely excited about the possibilities for exploration and innovation. Yet, for countless other scientists and academics – including those who work on climate, Earth sciences and biomedicine – there is concern that important research will be cut, deprioritized or vilified.

During his first stint in the White House, in 2017–21, Trump promoted unproven treatments for COVID-19 and denied the risks of climate change. He also undermined scientists at his own agencies and repeatedly sought to slash funding for science, although Congress shielded federal agencies such as the National Institutes of Health (NIH), National Science Foundation (NSF) and the Environmental Protection Agency (EPA) from the most drastic cuts.

Researchers say that for areas such as environmental science and infectious diseases, the next four years could be even more damaging. Guided by an initiative to be co-led by billionaire entrepreneur Elon Musk, known as the Department of Government Efficiency, the Trump administration has said it will slash the number of “unelected bureaucrats” who develop regulations. This could include thousands of scientists at the EPA and the Food and Drug Administration (FDA). Trump is also planning to remove employment protections for many federal workers, which would allow him to replace scientists and other specialists with loyal political appointees more easily.

Still, some parts of the US research and development (R&D) landscape could see a relatively bright future under the next administration. Policy experts point to human space exploration and technologies that are of strategic importance to the United States as areas that could benefit from the Trump White House and the Republican-controlled House of Representatives and Senate.

As President Trump takes office, *Nature* explores which areas of science and research are likely to win or lose under his administration.

High hopes for AI, quantum science and technology

In Trump’s first term, his science adviser at the time, Kelvin Droegemeier, pushed to support what he called “industries of the future”: AI, quantum information science (QIS), advanced manufacturing, advanced communications and biotechnology. Policy specialists expect these sectors to get continued attention in Trump’s second term.

Such areas have also drawn support from

the administration of US President Joe Biden. “Trump and Biden may clash on everything else, but on AI and quantum, they’re virtually in sync,” says Mohammed Soliman, director of the strategic technologies and cybersecurity programme at the Middle East Institute in Washington DC. “AI and quantum are the new front lines in the US–China rivalry, and both know it. This isn’t just policy – it’s a tech arms race,” he says.

In 2018, Congress and the Trump administration created the National Quantum Initiative. The following year, Trump issued an executive order that launched the American Artificial Intelligence Initiative to support US leadership in AI, including guidance on regulating industry without squashing innovation. And in 2020, Trump announced plans for more than US\$1 billion in funding to create a dozen national AI and QIS research institutes.

Biden followed with his 2023 executive order on AI. It mandated the creation of an AI Safety Institute and a National AI Research Resource pilot project, a system for sharing computing power, data sets and algorithms to facilitate academic and small-business AI work. The future of these initiatives is now unclear. Trump has promised to repeal Biden’s order – in part, he says, because it hinders AI innovation. And the US National Institute of Standards and Technology, which oversees the AI Safety Institute, has been a target of past efforts to chop federal budgets. Policy researchers expect that Trump’s future executive orders will strengthen the federal use of AI for national security and military uses.

Trump has been critical of Biden’s bipartisan 2022 CHIPS and Science Act, which authorized billions of dollars to boost US semiconductor manufacturing, saying that imposing tariffs on commercial rivals in China could achieve the same goal for free. But Trump is unlikely to gut the act, given its contribution to local economies and jobs, says Charles Wessner, who studies science and technology policy at Georgetown University in Washington DC.

Overall, Wessner says, “for tech R&D there’s likely to be a lot of continuity”. He adds that “cutting willy-nilly is going to be hard”. But there are some wild cards, such as whether immigration policies might restrict the inflow of students and workers to US engineering and related fields.

And some researchers are nervous about what will happen if companies are left to police themselves when it comes to AI technologies. “I’m in favour of much stronger action from the government on AI regulation,” says Nate Sharadin, a philosopher at Hong Kong University and a research affiliate at the non-profit Center for AI Safety in San Francisco, California. “It was vanishingly unlikely” if Democratic candidate Kamala Harris had won, says Sharadin. “And it’s a joke under Trump.”

US astronauts head for the Moon and beyond

Space exploration is another likely winner, as space billionaires try to convince Congress to spend more on human space flight.

NASA’s biggest priority now is its Artemis programme to send astronauts to the Moon.



Robert F. Kennedy Jr. at a rally against stricter vaccine rules for children in Washington state.

Feature

For that effort, it built a new heavy-lift rocket, the Space Launch System (SLS), and a crew capsule named Orion. But the SLS costs more than \$4 billion per launch and is not reusable. The Trump administration could try to sway Congress to cancel the government rocket programme and instead use launch vehicles developed by private companies – including SpaceX in Hawthorne, California, which is run by Musk, who donated heavily to Trump's campaign.

That would be a huge shake-up for Artemis, but one that could ultimately help NASA, say some researchers and space-industry experts. The agency is behind schedule on its Artemis plans; it flew an uncrewed SLS test flight in November 2022, but delayed its November 2024 mission to launch astronauts on the rocket until April 2026. It has also pushed back plans to land humans on the Moon to mid-2027 at the earliest.

Trump's choice for NASA administrator, the billionaire private astronaut Jared Isaacman, might also advocate for major changes if he is confirmed. Isaacman paid SpaceX to fly him on two commercial space missions, and has spoken about what he regards as waste and delays in government contracting projects.

Meanwhile, China is working on plans to send astronauts to the lunar surface, adding urgency to Trump's 'America First' approach; his administration pledged in 2017 to return humans to the Moon by 2024.

NASA's plans to send astronauts to Mars in the 2040s might also accelerate. Musk has expressed a strong desire for humans to colonize Mars, and he will probably try to influence NASA to get there sooner using SpaceX's Starship vehicle, say space-policy researchers. So NASA might be pressured to get astronauts to the Moon quickly, and then pivot to Mars. "I believe we're still going to get a lunar landing," says Laura Forczyk, executive director of space-consulting firm Astralytical in Palm Bay, Florida. "Whether or not Artemis continues into the far future, we don't know."

How NASA's science programmes will fare under a Trump administration is unclear. Isaacman has supported space science before; he packed 36 experiments onto his recent space flight, and in 2022 he tried to convince NASA to let him use a SpaceX vehicle to boost the decaying orbit of the Hubble Space Telescope. But NASA is a major funder of Earth-science studies, and those programmes might be at risk if Trump fulfils his promises to slash climate research.

Chilling times for climate scientists

Climate and environment are areas in which scientists are bracing for the worst. In a repeat of his first term, Trump is expected to roll back or loosen regulations on toxic chemicals, greenhouse gases and other types of pollution; he has argued that these regulations



Donald Trump in 2020 after the first launch of NASA astronauts in SpaceX's Crew Dragon craft.

PAUL HENNESSY/SOPA IMAGES/LIGHTROCKET VIA GETTY

hurt the economy. Efforts to cut costs and staff are likely to hit the EPA particularly hard, but environmental research programmes at other agencies, such as NASA and the National Oceanic and Atmospheric Administration, could also be targets for cuts.

Trump might start by trying to reduce agency budgets, which would require action by Congress. Lawmakers stepped up to defend the EPA during Trump's first term, but the political dynamic has changed: many Republicans are now lining up behind Musk's calls for massive reductions in federal spending.

Trump's nominee to lead the EPA, congressman Lee Zeldin of New York, is a long-time supporter of Trump and has a mixed record on supporting EPA budgets and initiatives. Policy analysts expect that he will move to reduce staff at the agency and roll back pollution regulations if he is confirmed by the Senate.

"Trump's plans for EPA are a five-alarm fire, and the health of millions of Americans hangs in the balance," says Jeremy Symons, an adviser to the Environmental Protection Network, a non-profit organization of former EPA officials in Washington DC that was established during Trump's first term.

Efforts to cut staff could take time. But Russell Vought, who has been tapped by Trump to lead the powerful White House Office of Management and Budget (a post he held during the first Trump administration), has said that the goal from day one will be to "traumatically" affect EPA scientists and staff and make them feel like "villains" so that they don't want to come to work and do their jobs.

It might be harder for the incoming Trump administration to roll back many of the massive climate investments focusing on areas from electric-vehicle infrastructure to technologies for capturing and storing carbon dioxide from the atmosphere. Those investments were enacted in 2021 and 2022 by Congress under President Biden, and have an estimated total worth of more than \$1 trillion up to 2032.

There are nonetheless likely to be changes at agencies such as the Department of Energy (DoE), which Trump has tapped oil-industry executive Chris Wright to lead. Federal investments in various clean-energy demonstration projects under the DoE could "fade into the background" under Wright, says Thomas Hochman, director of infrastructure policy

at the Foundation for American Innovation in San Francisco.

But many policy experts say that the Trump administration could face challenges as it seeks to scale back climate investments that are already flowing to companies and communities in states that have Republican leaders. Energy companies, for example, stand to benefit from investments in carbon capture and the clean production of hydrogen, which can serve as an alternative fuel in vehicles, among other uses. But climate advocates warn that the only way to halt global warming is to stop using fossil fuels, and Trump has promised to do the opposite.

Trump is also expected to pull the United States out of the 2015 Paris climate agreement a second time; he first completed that process in 2020, only for Biden to later rejoin the pact. Policy experts say that such a move by Trump could reduce pressure on other countries, including China, to accelerate their own climate efforts. But the biggest question for many energy experts is how Trump's promise to raise tariffs on goods imported from places such as China and Mexico will affect the global transition towards clean energy.

If trade wars are exacerbated by Trump, it will ultimately slow the development of climate-friendly technologies, says David Victor, a political scientist at the University of California, San Diego. "This is where a second Trump administration could cause a lot of harm," he says.

Make America healthy again – or not

Many researchers are expressing concern over potential changes in public-health policy and funding from the new administration and Congress. But others hope for opportunities, such as renewed interest in chronic diseases and the health risks of ultra-processed foods.

Trump has nominated Robert F. Kennedy Jr to lead the country's nearly \$2-trillion Health and Human Services (HHS) department, which oversees agencies such as the NIH, FDA and the Centers for Disease Control and Prevention (CDC). Kennedy, who must be confirmed by the Senate, has vowed to "make America healthy again". He would do this, he says, by tackling the root causes of chronic diseases, removing toxic substances from the environment and combating corporate corruption.

How Kennedy might accomplish these goals is unclear, because the United States does not have a single health system and the federal government does not control local decision-making on many key health-policy issues, including water fluoridation and school vaccination requirements (both of which he has criticized). Nevertheless, Trump has promised to let Kennedy "go wild" on health. And as head of the HHS, he would have broad power over the regulation of medicines and vaccines,

payment for health-care services, funding of biomedical research and communication of public-health initiatives.

Notably absent from Kennedy's agenda is a plan to bolster the country's preparedness for infectious diseases, says Georges Benjamin, executive director of the American Public Health Association in Washington DC, an advocacy organization for public-health professionals. In 2023, when Kennedy was running for president, he said he would seek an eight-year pause for infectious-diseases research at the NIH so that the biomedical funder could instead focus on chronic conditions such as diabetes and obesity.

A long-time anti-vaccine activist, Kennedy has questioned the FDA's vaccine-approval process. However, he has said that he does not want to take away access to any vaccines.

Trump's first administration embraced the idea that people should be able to try treatments for which there are data on safety but not efficacy. This approach led to Trump's FDA allowing people to use hydroxychloroquine as a treatment for COVID-19. The agency rescinded its authorization about three



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months later, after it acknowledged that the drug was unlikely to be effective against the disease. The study that ignited interest in that treatment was later retracted.

Holly Fernandez Lynch, a bioethicist at the University of Pennsylvania in Philadelphia who studies the FDA, expects this 'right-to-try' concept to make a resurgence during Trump's second term. "I would expect this administration to be sceptical of things [such as vaccines] that have strong evidence, and be totally open to things that are not supported by evidence at all," Fernandez Lynch says.

For example, she points to Kennedy's post on the social-media platform X (formerly Twitter) less than two weeks before the US election, in which he claimed that the FDA is in a "war on public health" that includes the agency's "aggressive suppression" of a litany of items, such as raw milk, stem cells, psychedelics and sunshine.

Some of these proposed health reforms, such as more reviews of vaccine safety – which could require more staff or agency funding – contrast with Musk's commission to

make government more efficient by trimming federal bureaucracy and spending. It's still unclear which of these forces will win out, but it will be important for the incoming administration not to focus solely on reductions, Fernandez Lynch says.

"Efficiency doesn't mean less – it means doing a good job with the fewest necessary resources," she says. "Sometimes, efficiency will demand more resources." For example, hiring more FDA staff to review drug applications would speed up reviews, says Fernandez Lynch.

Republican lawmakers have also signalled their appetite for major structural changes to the NIH. These could combine some of the 27 institutes and centres – and increase oversight of certain types of research related to high-risk pathogens or national security. This heightened attention on the NIH's structure is an opportunity to address the agency's perennial problems and reflect on whether the world's largest public funder of biomedical research could be spending its money better, says Sasha Gusev, a statistical geneticist at the Dana Farber Cancer Institute in Boston, Massachusetts.

But taking a "burn it down and start fresh" approach risks kneecapping an agency largely considered to be a "crown jewel" of biomedical research globally, Gusev says. He hopes that reforms will instead focus on evaluating whether the peer-review process for grants accurately predicts success or if it's too conservative, and whether there is sufficient diversity among the agency's grantees.

With Musk's influence on the incoming administration, there could also be implications for biomedicine, especially in the quest for innovation. Musk has, for example, criticized drug approvals as being too slow. And his company Neuralink has made advances in developing brain-computer interface devices, although there are concerns over the firm's secrecy regarding the technology.

Overall, the picture for science could be mixed, says Michael Lubell, a physicist at the City College of New York in New York City, who tracks science-policy issues. "I don't think that Trump knows anything about basic research, nor do I think most of the people who are advising him care about it."

He says that "there will be some winners" for science, particularly in fields that are supported by Musk and other technology giants. But with federal budgets expected to go down, says Lubell, "that also means there are going to be losers".

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