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huge cuts to all non-mandated government spending. Given the Republicans' determination to rein in a record federal deficit (see 'Budget battle heats up'), it is not at all clear that the president will be afforded the opportunity to play the innovation game that he hopes to win.

"It's going to be bloody," says Neal Lane of the political battle that is now set to unfold on Capitol Hill. A physicist at Rice University in Houston, Texas, Lane was director of the US National Science Foundation from 1993–98 — the last time a Democrat administration tangled with a Republican Congress over spending cuts — and later was President Bill Clinton's science adviser. His concern, he says, is that acrimony over the budget will delay progress and leave researchers spinning their wheels. "People are really hungry for anyone [in Congress] showing any sign that they are willing to work together."

For Patrick Clemons, a science-policy analyst and director of the research and development budget and policy programme at the American Association for the Advancement of Science in Washington DC, the differences between Obama and Republican leaders in the House are clear — but perhaps not as large as is sometimes assumed. "I think basic research is strongly supported by both sides," he says. Where opinions diverge, he says, is on the extent to which government should be engaged in fostering innovation, with Republicans more inclined to let the private sector drive it forward.

Holdren disagrees with the premise that the budget's theme represents an exclusively 'top down', government-driven model. "This is neither top down nor bottom up but both," he says. "This is a matter of unleashing the innovation potential that is in our society by drawing on all levels and getting them to work together."

Here is a closer look at what the budget will mean in key areas and agencies.

ENERGY

Energy is the domain in which Obama's vision is most ambitious — and most at odds with that of Republicans. Under the proposed 2012 budget, funding for the Department of Energy would increase by almost 12% from 2010 levels to \$29.5 billion, while fulfilling the president's pledge to bolster clean-energy research and development. The Office of Science would see its budget rise by 9.1% to \$5.4 billion, including \$2 billion for basic

How to innovate on US\$66.8 billion a year.

FUNDING

Obama resists research cuts

Increases for science and technology in the 2012 US budget prioritize innovation over reductions in the national deficit.

BY IVAN SEMENIUK, JEFF TOLLEFSON, MEREDITH WADMAN, ADAM MANN AND GWYNETH DICKEY ZAKAIB

On the morning his administration unveiled its budget request for the 2012 fiscal year, US President Barack Obama was addressing students at a school with a specialized science and technology programme in Baltimore, Maryland. The choice was deliberate. Obama has made numerous public appearances in recent weeks to push his strategy of "winning the future" for an embattled US economy by investing in research, innovation

and education. His latest budget, released on 14 February, puts numbers to the rhetoric, with a US\$66.8-billion request for federal science spending. The total represents a 6% increase over current funding, with some agencies (see table and graph) faring even better.

In a climate of fiscal restraint, the budget "contains more for science than many would have thought possible", says John Holdren, Obama's science adviser. But precisely what is possible is now the question. Obama's budget portrays an alternative universe that stands in stark contrast to that of Republicans in the House of Representatives, who are calling for

FOCUS ON 2011

Budget battle heats up

Even as Congress prepares to engage with US President Barack Obama's 2012 federal budget request, a clash of visions is continuing over the 2011 budget. Last year, the president's budget request included increases for most research-related functions in the government. That budget was never passed by the previous Congress and now, with a Republican majority in the House of Representatives, a very different scenario is emerging. In keeping with a campaign promise made during last autumn's midterm elections, this week House Republicans will introduce a bill that slashes US\$100 billion from Obama's 2011 request. The proposed cuts include reductions of 15% or more, relative to the 2010 budget, for several science agencies (see table).

One of the deepest cuts, an 18% reduction to the budget of the Office of Science at the US Department of Energy (DOE), reflects scepticism about Obama's energy agenda, says Barry Toiv, vice-president for public affairs at the Association of American Universities in Washington DC. If the cuts go through, he adds, some DOE labs may have to shut down for part of the fiscal year.

The House's vote will not be the final word on 2011 spending — the Democrat-controlled Senate and Obama will both need to agree to the budget.

The US government is still running at 2010 levels thanks to an interim bill — a continuing resolution — passed by Congress in December. That will expire on 4 March, adding urgency to this week's debate. Another continuing resolution could be required before the House and Senate agree. The delays prevent programme changes designated for 2011 (such as NASA's shift away from a mission to return to the Moon) from being enacted and reduce the window in which budget savings can be realized. If there is no agreement on either a budget or a continuing resolution, most government activities could be shut down, as occurred during the administration of then-president Bill Clinton in 1995–96.

"It's really disruptive," says Jennifer Zeitzer, the director of legislative relations for the Federation of American Societies for Experimental Biology in Washington DC. "Science benefits from advance planning. When budgets are frozen you can't plan," she says. **Eugenie Samuel Reich**

US BUDGET REQUESTS AND PROPOSED HOUSE CUTS (US\$ MILLION)

Agency	2010 enacted	2011 requested	2011 (after proposed cut)	2012 requested
National Institutes of Health (NIH)	31,089	32,089	30,519	31,829
NASA	18,724	19,000	18,421	18,724
Environmental Protection Agency (EPA)	10,298	10,020	7,283	8,973
National Science Foundation (NSF)	6,873	7,424	6,597	7,768
Centers for Disease Control and Prevention (CDC)	6,475	6,342	5,419	5,893
Department of Energy Office of Science (DOE OS)	4,895	5,121	4,010	5,416
National Oceanic and Atmospheric Administration (NOAA)	4,853	5,554	5,089	5,498
US Geological Survey (USGS)	1,112	1,133	1,105	1,118
National Institute of Standards and Technology (NIST)	862	922	700	1,004
Department of Homeland Security (science and technology) (DHS ST)	1,006	1,018	931	1,177

► energy sciences, an increase of 24.1%.

Funding for energy efficiency and renewable energy would increase by more than 44.4% to \$3.2 billion, and the Advanced Research Projects Agency–Energy would receive \$550 million, building on the \$400 million it received through the economic-stimulus bill in 2009. Cutting across programmes, the department is proposing to invest \$425 million in a new 'SunShot' project that is intended to reduce the cost of solar energy by 75% within a decade.

The budget also includes a request to fund three new Energy Innovation Hubs, which would focus on electricity storage, smart-grid technologies and critical energy materials such as rare metals used in solar panels. All told, six hubs would receive \$146 million. But Congress has so far limited that programme to the three existing hubs, and few expect that to change this year.

"This budget is going to run into significant headwinds in the Republican House," says Michael Lubell, director of public affairs for the American Physical Society, headquartered in College Park, Maryland. "There is going to be a big push back, and the administration is going to have to fight very hard to keep any of this."

To help offset the new costs, the Department of Energy will gain \$3.6 billion in revenue from fossil-fuel subsidies that the president is proposing to cancel — another idea that may encounter problems on Capitol Hill. The budget would also scale back fossil-fuel research by 44.5% to \$453 million, most of which would be focused on technologies for carbon capture and storage.

BIOMEDICAL

Under Obama's budget, the National Institutes of Health (NIH) in Bethesda, Maryland, would receive an increase of \$745 million (2.4%) over its 2010 budget, bringing its top line to \$31.8 billion in 2012.

The proposed increase is considered a win for the agency as other programmes throughout the

government face serious cuts. Still, it does not keep up with government projections of biomedical inflation, estimated at 3% in 2012. The agency thus projects a 2.4% drop in the number of new and competing research project grants it will award in 2012, a fall to 9,158. That, in turn, is expected to drive the success rate of grant applications down from 21% in 2010 to 19% in 2012.

Under Obama's proposal, most of the NIH's 27 institutes and centres would see their budgets grow by about 1.5–2%. The Office of the NIH Director would receive \$122 million in new money, a boost of 10.4%; of this, \$100 million would fund the Cures Acceleration Network (CAN), a new programme authorized in the 2010 health reform law that

aims to speed highly needed cures from lab to bedside.

The CAN is slated to become part of the proposed National Center for Advancing Translational Sciences (NCATS),

which would be devoted to hastening the discovery of drugs and diagnostics. The NCATS featured prominently in the prose of the Obama budget, but was not funded as a discrete centre. Instead, the funding details for NCATS will be delivered to Congress in a budget amendment in the coming weeks, says NIH director Francis Collins. He adds that the agency has simply not had time to work out the detailed budget for the new centre, mainly because it has not determined the placement of the pieces of the National Center for Research Resources, which is to be broken up at the same time as the NCATS is constituted.

Constituents of the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, were unsettled by Obama's proposal, which cuts the amount of agency funding that would flow through standard congressional

DIVERGING AGENDAS

Comparison of budget requests for 2011 and 2012 against this year's proposed cuts by House Republicans reveals a large divergence over investment in energy and basic research.

spending committees by \$588 million, to \$5.9 billion. At the same time, the Obama administration is proposing to pour \$753 million into the agency — money made available for disease prevention and public health by the 2010 health reform law.

Some adherents don't like the trade-off. "CDC does not fare well in this budget," says Georges Benjamin, executive director of the American Public Health Association in Washington DC. "Although it appears that they have gotten some overall increases, there were significant cuts and rearrangements in some vital programmes."

SPACE

In contrast to the increases at other agencies, NASA's overall proposed budget remained level at the \$18.7 billion it received in fiscal year 2010. Within that, however, the agency's science budget is slated to grow by roughly half a billion dollars, with \$360 million allocated to earth science and about \$175 million for planetary science. Astrophysics and heliophysics would also see modest increases of \$36 million and \$14 million, respectively.

"Science is moving gingerly forward amid greater uncertainty at the rest of NASA," says Matt Mountain, director of the Space Telescope Science Institute in Baltimore, Maryland.

One science project that exemplified the uncertainty is the James Webb Space Telescope (JWST), successor to the Hubble Space Telescope, which an independent review found would cost at least \$1.5 billion more than anticipated (see *Nature* 468, 353–354; 2010). The White House budget grants \$374 million to the JWST for 2012, although the review revealed that the telescope would need \$500 million

over the next two years to meet an expected launch date of September 2015.

With the 2011 budget still in limbo, a 2015

launch date is unrealistic and could even slip past 2016, said JWST programme manager Rick Howard in a press briefing. The delay could mean further cost overruns for the mission.

Most of NASA's 2012 reductions stem from the retirement of the space-shuttle fleet, which will see its final two budgeted flights, plus an additional flight that has been authorized by Congress but not yet funded in 2011. The new

A lesson in competitiveness: Barack Obama talks to students.

budget will usher in a post-shuttle future, albeit tentatively. It includes \$840.6 million to fund commercial companies to develop a vehicle that could ferry astronauts and cargo to the International Space Station, and \$2.8 billion towards a heavy-lift launch vehicle that would replace the now-defunct Constellation programme of the George W. Bush era. Neither decision will sit well with elected representatives who favour a more robust human programme. "This budget ignores the human space flight priorities outlined by Congress last year," congressman Peter Olson (Republican, Texas) posted on his web site after the budget's release. "We fought this battle last year and won, and I believe we will do so again."

COMPETITIVENESS

Under Obama's proposal, the National Science Foundation (NSF) would see a budget boost of 13% above 2010 enacted levels, with most of the nearly billion-dollar increase spread across the agency's core research-funding areas. The increase is "consistent" with the America COMPETES Act, says Amy Scott, associate vice-president for federal relations at

the Association of American Universities, referring to legislation that aims to double the money for key science-funding agencies, including the NSF, over 10 years. Similarly, Obama proposed that another agency under that Act, the National Institute of Standards and Technology, receive a 16.3% increase in funding for 2012.

The NSF increase includes funds to build major research facilities, including \$103 million for the Ocean Observatories Initiative, a project intended to provide continuous, interactive access to the ocean using a network of sensors. Another \$87.9 million would go to the construction of the National Ecological Observatory Network, a facility that will collect data on climate change, land-use change and US invasive species. Less fortunate is the Deep Underground Science and Engineering Laboratory in Lead, South Dakota, a joint project with the Department of Energy. As anticipated, it will receive no further NSF funding after this year (see *Nature* 468, 1013; 2010).

The increase at NSF would also extend to education and human resources; programmes aimed at providing better training for science teachers; and improvements to undergraduate instruction. This dovetails with the other education initiatives in the budget that Obama laid out in straightforward terms to the students he met this week.

"For us to be successful as a country, you're going to have to succeed. And for you to succeed, you're going to have to be able to possess the skills and knowledge of a twenty-first-century economy," Obama said. "That means math, and that means science." ■

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