

years ago in Copenhagen (see *Nature* 462, 966–967; 2009), when world leaders first broke with the Kyoto formula to offer the developing world rewards without commitments. Japan, Canada and Russia, which all agreed to the original protocol, said that they opposed a second commitment period. Even the EU may not support an extension of Kyoto, Stavins says, although its trail-blazing carbon trading system could continue even if the treaty becomes dormant.

In Copenhagen, and again last year in Cancún, Mexico, countries such as China, Brazil and South Africa joined wealthy nations in making voluntary commitments to limit emissions of greenhouse gases. In exchange, wealthy countries agreed to ramp up financing to help the poorest countries prepare for global warming. The framework that emerged is more inclusive than Kyoto, but lacks the formal stature of a fully binding international treaty. Developing countries, as a bloc, are reluctant give up on the old protocol until something more concrete takes its place.

“The call to mandate a new treaty in place of the Kyoto Protocol should be understood for what it is — rich countries backtracking on inconvenient commitments, at the expense of the poor and the planet,” says Lim Li Lin, who works with developing countries at the Third World Network, a non-profit advocacy group based in Penang, Malaysia.

Under the Copenhagen Accord, countries agreed to try to limit global warming to 2°C and to consider lowering that target to 1.5°C. Actual commitments to greenhouse-gas cuts fell well short of what studies suggest are needed to meet the 2°C goal. The accord also includes provisions to slow deforestation, promote adaptation and hasten the spread of green technologies, with wealthy countries promising US\$30 billion in financing by 2012, which will increase to \$100 billion annually by 2020.

Negotiators were able to advance many of these initiatives in Cancún last year, but crucial details regarding which institutions will manage this money, who will decide how it is spent and how emissions commitments will be registered and tracked remain unresolved. “Durban needs to put the entire architecture of climate-resilient development on a more solid basis,” says Koko Warner, a climate policy expert with the United Nations University Institute for Environment and Human Security in Bonn, Germany.

But many fear that frustration over Kyoto could stall progress in other areas of the talks and threaten the viability of the Copenhagen Accord.

“I think what really kept developing countries at the negotiating table in Copenhagen was the \$100 billion per year,” says Timmons Roberts, who heads the Center for Environmental Studies at Brown University in Providence, Rhode Island. “If it’s just another empty aid promise, the Copenhagen Accord is going to fall apart.” ■

FUNDING

US science agencies dodge deep cuts

Partial 2012 budget mostly spares research, but deficit-reduction measures still pose a looming threat.

BY IVAN SEMENIUK

The most fractious and combative US Congress in recent memory is getting on with approving a 2012 budget — although perhaps only so that it can move more swiftly to the next battlefield. On 17 November, legislators passed a spending bill that includes allocations for several key science-related agencies. The bill has since been signed off by President Barack Obama.

The budget was a relief for researchers and their advocates, who had feared deeper cuts to science. Under the provisions of the bill, the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), the National Institute of Standards and Technology and the Food and Drug Administration (FDA) all received modest increases (see table).

Even NASA, which has seen its budget shrink by nearly US\$1 billion over the past two years — essentially because it has ended the space-shuttle programme — kept all its major science initiatives. It even got an increase for the 6.5-metre James Webb Space Telescope (JWST), which has been subject to chronic cost overruns that at one point prompted deficit-focused Republicans to propose dropping it from the space agency’s budget altogether.

“That wakes you up,” says Kevin Marvel, executive officer of the American Astronomical Society in Washington DC. The JWST has now been restored, with continued support endorsed by both the House of Representatives and the Senate, and NASA’s science budget has increased by 3.1%. Although this by no means solves all of NASA’s budget woes — the agency is also facing questions about a series of missions to Mars (see Editorial, page 446) — it is a reassuring outcome in financially uncertain times. “Compared to where we could have been, we are in a good place for 2012,” says Marvel.

The NSF is also cautiously optimistic: its budget grew unexpectedly by almost US\$200 million dollars to just over \$7 billion. However, this falls short of the nearly \$7.8 billion that Obama requested for the NSF in February. That amount would have helped to maintain a ten-year

doubling of funding for the agency, as set out by the America COMPETES Act that was reauthorized last year.

The budget “lifts a huge cloud that was hanging over the agency and makes it into a much smaller one,” says Michael Lubell, director of public affairs for the American Physical Society in Washington DC. Having used economic-stimulus money to increase funding to researchers in 2009–10, the NSF was already expecting to scale back its grants next year. The 2012 budget is not large enough to avoid that altogether, but the agency should be able to maintain its commitments to major research facilities while seeing a smaller reduction in grant-acceptance rates.

The FDA received a \$50-million increase in its congressional appropriation, \$39 million of which will go towards implementing a food-safety law passed in January. “It’s

“Compared to where we could have been, we’re in a good place for 2012.”

good that they saw the need to pass that funding, but we would like to have seen more,” says David Plunkett, a senior staff attorney at the Center for Science in the Public Interest, an advocacy group in Washington DC. The FDA had estimated that it would need more than \$183 million in extra funding in 2012 to implement the food-safety act.

The spending bill holds both victories and disappointments for NOAA. The agency’s budget will increase, with an allocation of \$924 million to continue funding its Joint Polar Satellite System — a programme with a history of budget problems, but one that politicians are reluctant to attack because its data are crucial for forecasting severe weather. Not so fortunate was an effort to combine a series of government functions in a national climate service, a stated goal of Jane Lubchenco, who was appointed as NOAA director by Obama in 2009. With climate science a favourite target of Republican ire, the proposed service was turned down.

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For more on the US budget crisis, see: go.nature.com/eg2noo

Another Obama appointee who is feeling the wrath of the right is John ▶

► Holdren, director of the White House Office of Science and Technology Policy (OSTP). Noting the OSTP's defiance of a 2011 congressional rule that bans the office from collaborating with China (see *Nature* 478, 294–295; 2011), the House appropriations committee hacked away nearly one-third of the office's relatively small budget, leaving Holdren with \$4.5 million to run his agency.

Neal Lane, a senior fellow at the James A. Baker III Institute for Public Policy at Rice University in Houston, Texas, and a one-time science adviser to former US president Bill Clinton, calls this direct attack by the appropriations committee on a part of Obama's administration an unusual move that is “very counterproductive” for science policy, and will have damaging consequences for the OSTP and US-based research as whole. “It's the only place in the federal government where anybody is paying attention to the overall health of science and technology in the country,” says Lane.

The action is one of many indications that the 2013 budget process, which will unfold during a presidential-election year, is likely to be hijacked and delayed by political manoeuvring. As *Nature* went to press, a bipartisan ‘super-committee’ of legislators tasked with finding a way to reduce the federal deficit by \$1.2 trillion

A WORK IN PROGRESS

A spending bill enacted on 17 November includes 2012 budget allocations (US\$ millions) for several key federal science agencies. Still to come are final numbers for the National Institutes of Health, the Department of Energy and the Environmental Protection Agency, among others.

Agency	2010 actual	2011 estimated	2012 requested	2012 enacted
NASA	18,725	18,448	18,724	17,800
National Science Foundation	6,873	6,860	7,768	7,033
National Oceanic and Atmospheric Administration	4,853	4,588	5,498	4,894
Food and Drug Administration	2,362	2,447	2,744	2,497
National Institute of Standards and Technology	863	750	1,004	751

Sources: White House Office of Management and Budget; American Association for the Advancement of Science; FDA; US Senate Committee on Appropriations.

seemed all but certain to miss its 23 November deadline. This would trigger steep across-the-board cuts for all branches of the federal government, including all science-related agencies, beginning in January 2013 — unless Congress intervenes before then to overturn its own rules (see *Nature* 476, 133–134; 2011).

In the short term, legislators will move on to the next phase of their 2012 budget negotiations. By 16 December they must agree on a budget for those branches of the government not addressed in last week's spending bill. Among those are the Department of Energy

and the Environmental Protection Agency, frequent victims of Republican attack that were marked for significant cuts in 2011. Also to be determined is the allocation for the National Institutes of Health, the federal government's largest research enterprise at \$30 billion. The agency is waiting to learn whether its ambitious bid to launch a centre for translational science will survive this year's budget battles (see *Nature* 477, 141–142; 2011). ■

Additional reporting by Susan Young and Meredith Wadman.

PARTICLE PHYSICS

Higgs hunt enters endgame

Large Hadron Collider could soon deliver a clear verdict on missing boson.

BY GEOFF BRUMFIEL IN GENEVA, SWITZERLAND

Bill Murray is a man with secrets. Along with a handful of other scientists based at CERN, Europe's particle-physics facility near Geneva, Switzerland, Murray is one of the few researchers with access to the latest data on the Higgs boson — the most sought-after particle in physics.

Looking at his laptop, he traces a thin black line that wiggles across a shaded area at the centre of a graph. This is the fruit of his summer's labours. “It's interesting, actually, looking at this again,” he muses. A tantalizing pause. “But no, I can't say...”

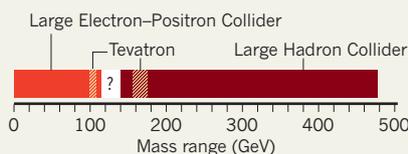
Despite Murray's coyness, there are few places left for the Higgs to hide. Billed as the particle that helps to confer mass on other matter, and the final missing piece in the ‘standard model’ of particle physics, the Higgs would be a huge prize for CERN's Large Hadron Collider (LHC), the world's most powerful particle accelerator. But so far, the two massive detectors there — ATLAS, where Murray works, and the Compact

Muon Solenoid (CMS) — have not seen any convincing signals of the elusive particle.

At a conference in Paris on 18 November, teams from ATLAS and the CMS experiments presented a combined analysis that wipes out a wide swathe of potential masses for the Higgs particle. Gone is the entire mass range from 141 to 476 gigaelectronvolts (GeV; energy and mass are interchangeable in particle physics). Together with earlier results from the 1990s, the analysis leaves a relatively narrow window of just 114–141 GeV in which the Higgs could lurk (see ‘Cornering the Higgs’).

CORNERING THE HIGGS

Data from various particle accelerators restrict the mass of the Higgs particle, if it exists, to the range 114–141 gigaelectronvolts (GeV).



Analysis of the very latest data from this autumn — which Murray isn't yet ready to share — will scour the range that remains. If it turns out to be empty, physicists may have to accept that the particle simply isn't there. Working around the clock, the detector teams hope to have this larger data set analysed before the end of December. “We'll know the outcome within weeks,” says Guido Tonelli, spokesman for the CMS detector.

WAITING FOR GOD

The quest for the Higgs boson, often called the ‘God particle’ after the title of a 1993 book by Nobel prizewinner Leon Lederman, is the public face of science at the LHC. Most high-energy physicists wince at the deistic designation, but they hold a near-religious devotion to the boson. Contrary to the popular view, their belief has less to do with mass than with fundamental forces.

Four fundamental forces are at work in nature: gravity, the strong nuclear force, the weak nuclear force and electromagnetism. Since the mid-1960s, physicists have strongly