

NATO on 1 April of this year. "NATO's third role—science for peace—is the greatest achievement of any political military alliance I know of," he says. "However, it is still not adequately stressed [by NATO], and financial allocations are smaller than what they should be."

But Šlaus thinks education is still the key to progress and that in spite of the frustrations, he'll remain active in politics for a while yet. "Most of the threats

and dangers facing the contemporary world can be neither prevented nor reduced by military power and deterrence. The 21st century demands a knowledge-based society," says Šlaus. And physicists could help provide the solution. "They have a unique broader aspect based on their education, to think outside the box," he says. "And most of the solutions facing the world at the moment cannot be fixed by traditional methods." **Paul Guinnessy**

Divisions heat up as Senate mulls carbon caps

Republicans warn that curbs on greenhouse gas will worsen recession.

By a thin margin, the US House of Representatives passed a bill in late June that would mandate the first-ever reductions in US emissions of carbon dioxide. Climate-change politics then moved to the Senate, where Democratic leaders decided against earlier plans to put a bill to a full vote before the August recess. President Obama has promised to sign a bill once it reaches his desk.

Even as their majority grew to 60 members, Senate Democratic leaders faced an uphill battle to muster the three-fifths vote needed to pass climate legislation. Frank Maisano, who tracks energy issues for the law and lobbying firm Bracewell and Giuliani, last month estimated that more than half of Senate Democrats were undecided about how they will vote on capping CO₂ emissions. The reasons vary: Some are worried about their reelection bids; others are concerned about the cap's impact on their states' manufacturing or farming sectors. Only a handful of Republicans, including Maine moderates Susan Collins and Olympia Snowe, John McCain of Arizona, and perhaps Judd Gregg of New Hampshire, are likely to vote for carbon controls, he adds.

For his part, Obama praised the American Clean Energy and Security Act—better known as Waxman–Markey after its principal sponsors, Representatives Henry Waxman (D-CA) and Edward Markey (D-MA). Obama called the more than 1400-page bill "a bold and necessary step that holds the promise of creating new industries and millions of new jobs." In his remarks on 26 June, shortly after the House voted 219–212 to approve the bill, he said that the measure would "make significant new investments in the research and development of home-grown, renewable sources of energy." He also stressed the bill's creation of a system of

clean-energy incentives to complement his administration's earlier action to raise automobile efficiency standards and his pledges to double the nation's wind and solar power generation capacities.

Cap and trade

The centerpiece of the House-passed bill is a cap-and-trade system, in which the government sets a cap on the total amount of CO₂ that industry can emit in a year and then issues permits to businesses entitling them to emit CO₂. Businesses that want to increase their emissions will need to purchase additional permits from those who reduce their CO₂ output. Initially, all but 15% of the permits would be given away, with the remainder to be auctioned off. The cap would be tightened over time to achieve the reductions mandated in the House bill—17% below the 2005 level by 2020 and 83% by 2050.

The partisan division over CO₂ limits was apparent when the Senate Committee on Environment and Public Works kicked off its 7 July hearing. Chairman Barbara Boxer (D-CA) emphasized the new businesses and jobs that will be created as the US moves toward clean energy sources. She cited a recent report by the Pew Charitable Trusts stating that more than 10 000 new clean-energy businesses had been established in California from 1998 to 2007. During that period, investments in clean energy created more than 125 000 jobs and generated jobs 15% faster than the California economy as a whole, she said.

But James Inhofe (R-OK), the committee's ranking Republican member, pointed to a Rasmussen survey released 1 July in which 56% of the respondents said they were unwilling to pay more taxes or higher utility bills to slow global

warming. Inhofe, who once declared global warming "the greatest hoax ever perpetrated on the American people," asked Environmental Protection Agency administrator Lisa Jackson about a 2008 EPA analysis of a Senate bill that would have regulated carbon emissions. Jackson acknowledged that the analysis showed that US curbs alone would scarcely impact global CO₂ levels. But Secretary of Energy Steven Chu, seated alongside Jackson at the witness table, told Inhofe he disagreed with the EPA's conclusion. While he did not elaborate, Chu pointed out that the US and China together account for half of all emissions.

EPA is accused

Sen. John Barrasso (R-WY) grilled Jackson about a report that the agency is accused of suppressing. An EPA economist alleged that he was ordered by his supervisor not to discuss his analysis questioning the scientific data the agency used to determine that CO₂ emissions must be regulated. Jackson replied that when she heard about the accusations, she personally told the economist to circulate his analysis widely and asked him to locate peer-reviewed research in support of his findings.

Sen. Lamar Alexander (R-TN), who recently called for the US to build 100 new nuclear reactors, complained about tepid White House support for nuclear power as a carbon-free energy source, in contrast to the administration's enthusiastic embrace of renewable energy sources. Chu responded by pointing to \$18.5 billion in loan guarantees that the Department of Energy has available for financing new nuclear power stations.

The reaction to passage of the House bill was largely predictable. Environmental organizations applauded it. "We're thrilled that Congress has finally caught up with science and the American people in recognizing the need to switch on clean energy. Our future is now looking more like the Jetsons and less like the Flintstones," said Kevin Knobloch, president of the Union of Concerned Scientists, in a statement. But some industry groups warned that the measure would saddle US businesses and consumers with higher energy costs and cause more US jobs to be shipped overseas to countries without emissions limits. Thomas Donohue, president of the US Chamber of Commerce, wrote in a statement, "Does anyone think this would be a good idea in the midst of the worst recession since the Great Depression?"

In his Senate testimony, Chu pointed to an analysis by the nonpartisan Con-

gressional Budget Office that estimated a cost per household of 48 cents per day to meet the greenhouse gas targets in the House bill. The CBO estimate did not include the economic benefits that will come with either the reduction in greenhouse gases or the slowing of climate change.

In his analysis, Mark Muro, policy director of the metropolitan policy program at the Brookings Institution,

lamented that under Waxman-Markey just 1.5% of the revenues generated from emissions permits would be devoted to R&D on renewable and other clean-energy sources. That's roughly \$1.4 billion annually, based on generally accepted price forecasts. Muro argued that the government ought to be spending \$20 billion to \$30 billion annually, compared with its current level of around \$5 billion.

David Kramer

SLAC free-electron laser sparkles into life

"It was a thrill of a lifetime for guys like me," says John Galayda about this spring's smooth startup of SLAC's free-electron laser, the Linac Coherent Light Source (LCLS), whose construction he oversees. "Accelerator guys thought it would be less trouble to lase at 15 Å, and that we would struggle at shorter wavelengths. As it turned out, we lased at 1.5 Å on the first attempt." The secret to success? "A jillion things had to be done exactly right."

"It's very rare that you turn on something of this complexity and it just works. It annihilated our expectations," says SLAC director Persis Drell. People expected it would take months to optimize the LCLS. "Some 112 meters of undulators, which generate the fields that accelerate electrons so they emit x rays, had to be aligned to 5 microns," says Drell. "The electron beam had to be high quality, with low emittance. There was technical hurdle after technical hurdle. But they started the lasing campaign, and two hours later it per-

formed just beautifully."

The on-time startup of the \$420 million LCLS is all the more impressive in light of the \$8 million budget cut it suffered with the federal budget's 2007 continuing resolution. To deal with the cut, says Galayda, "we delayed civil construction in the second experimental hall. And we spent every dime we had authority to spend in 2008." The second experimental hall is scheduled to be completed next July.

Meanwhile, the first experiments, set to begin next month, will focus on interactions of roughly 80-femtosecond pulses with atoms and molecules. "You have a gas of atoms or molecules, fire the laser, and measure the products. The interaction is with the core electrons, and you can kick out not one but two. So it's multiphoton, nonlinear physics," says Jochen Schneider, head of the LCLS experimental facilities division. Researchers want to study the resulting molecular explosions. Other experiments will involve coherent

The undulator system in SLAC's free-electron laser creates x-ray pulses tens of femtoseconds in duration; each pulse consists of around 10^{12} photons. The horizontal bar with a lower lip is 1 of 33 titanium undulator magnets, each 3.4 meters long. The dark blue insulated supporting columns are designed for low vibration and thermal stability.



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