Industrial R&D Wins Political Favor

In an election year dominated by economic issues, both Republicans and Democrats are touting government support for industrial research

WHAT ARE THE CHANCES THAT GEORGE BUSH and the front-running Democrats will agree on any aspect of economic policy in an election year as contentious as 1992? Not great, you might guess. But, surprisingly, they have already quietly agreed on one approach to stimulating the U.S. economy: The Bush Administration has recently taken to trumpeting its support for industrial R&D—a topic it has treated with extreme caution in the past 3 years—while both Paul Tsongas and Bill Clinton have announced that they, too, want the government to invest more money in science and technology, especially in applied research.

It's no surprise that the Democrats would advocate increased government investment in R&D aimed at making American industry more competitive. The Democratic Congress, in fact, has for years been adding money to the budget to finance the development of technologies such as high-definition TV and semiconductor manufacturing that it believes will be critical to industrial growth. The news is that the Administration, which has long argued that the government should support basic research and leave industrial research to industry, is beginning to sing a similar tune, pushing budget increases for a raft of joint industry-government research efforts (see table). Representative George Brown (D–CA), chairman of the House science committee, is delighted, saying the Administration is "plugging programs...which we helped to create here in the science committee"—the same ones, Brown says, that "they were fighting 6 months ago."

The fact that the White House and Congress appear to be using similar song sheets doesn't mean that they are entirely in harmony, however. They differ, for example, on how aggressive the government should be, with the leading Democratic candidates and key members of Congress like Brown arguing that the White House should establish a central agency to devise new technology strategies, and the Administration rejecting this idea as too heavy-handed. There's also discord over the future of civilian technology projects that Congress has added to the Department of Defense's (DOD) budget over the years—projects that have made the Pentagon, in effect, the central agency of U.S. technology policy. And it is not clear that everybody in the White House is ready to join the chorus. But, with the state of the economy a hot political issue, this election year could produce a significant expansion of government efforts to pump up "competitive" U.S. industries.

The Administration's change of heart came slowly. Throughout the Reagan years, the White House steadfastly argued that, aside from offering tax relief, the government should stay out of industry's way. The Bush White House under Chief of Staff John Sununu initially sounded the same theme, but some Administration officials, led by presidential science adviser D. Allan Bromley, pushed for a more interventionist approach to supporting critical technologies. Observers like former IBM research chief Lewis Branscomb say that it became clear in September 1990 that the interventionists were gaining the upper hand. That was when Bromley issued a report on "technology policy." It blessed in principle the use of U.S. funds for private sector initiatives, so long as the money went to "precompetitive generic technologies" and not specific products.

This was followed by budget requests for 1991 and 1992 for some new technology projects, mainly in the Commerce Department. The amounts were far less than the enthusiasts in Congress wanted (*Science*, 5 April 1991, p. 20), but the requests were a signal that the Administration was beginning to set a new course. Now, with Sununu gone, that course seems more firmly established. In a sign of the times, Bromley last week called reporters to his office to hear his plans to launch a "manufacturing technology initiative" that will probably lead to increased funding for manufacturing R&D next year (*Science*, 13 March, p. 1350).

Although the Administration seems to have climbed aboard, it remains worried, however, about where this bandwagon is headed, and its worries are reflected in the mixed signals that still come from the White House. For example, according to Branscomb, a professor at Harvard's John F. Kennedy School of Government and an expert on technology issues, Bromley sought to cram "a page and a half" of technology initiatives into the president's State of the Union message on 28 January. But only a couple of sentences got in. One was a routine plug for the R&D tax credit and the other a token reference to the value of the $76 billion the government will spend this year on research and development.

INDUSTRIAL TECHNOLOGY SAMPLER

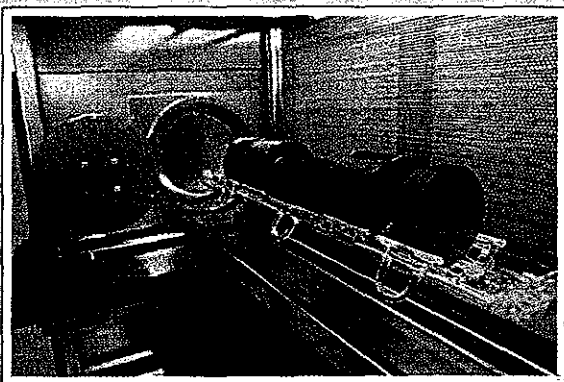
Agency	Name	Start	1993 Request ($ millions)
Defense	Manufacturing Technology (industrial base)	1980	$138
Air Force	National Center for Manufacturing Sciences	1986	0 (1992: $37)
DARPA	Sematech	1989	$80
DARPA	High Definition Systems (video)	1989	$10
DARPA	High Performance Computing	1992	$163
DARPA	Other Manufacturing Technology	1992	$165
DARPA	Precompetitive Technology Consortia	1991	0 (1992: $60)
Energy	Advanced Battery Consortium	1991	$42
Energy (Sandia)	Specialty Metals Processing Consortium	1990	$0.5
NIST (Commerce)	Manufacturing Technology Centers	1988	$18
NIST	Advanced Technology Program	1990	$68
NSF	Engineering Research Centers	1985	$53
NSF	Manufacturing Initiative (overlaps centers, above)	1985	$105
OSTP, NSF	Critical Technology Institute	1992	$1*

*(available 1992-1993: $7.6m)

Sematech: Model Project Gets Mixed Reviews

Ever since it began in 1988 as an experiment in joint research on computer chip manufacturing, Sematech has been the most visible example of a government-sponsored "critical technology" project—an approach Congress and the Administration are now backing in a variety of areas. How well has it worked? Congress must soon answer that question, for this spring, the companies in the consortium will be seeking another 5-year commitment of funds. The Administration, though still favorable, has asked that the annual government contribution be cut from $100 million to $80 million. And several review groups—including Congress's General Accounting Office—are weighing what Sematech accomplished with the $800 million in public and private funds it has already received.

The evaluators will find that opinion is divided. Early supporters of Sematech like Erich Bloch, former director of the National Science Foundation—still think it's an excellent project. Bloch says Sematech has built up an "infrastructure" of equipment for research in chip manufacturing and become a valuable education center. Yet those who doubted Sematech from the beginning—like T.J. Rodgers, president of Cypress Semiconductors in San Jose, California—still criticize it. To Rodgers, it's a boondoggle, a subsidized "country club" for wealthy corporations. There are a few, like economist Kenneth Flamm of the Brookings Institution, who have come around from a skeptical view to believing, as Flamm says, that Sematech "has been doing some good stuff recently...targeting long-term problems" in manufacturing design.



©1990 SEMATECH

Hot technology. *Sematech has shifted focus from mass production to flexible manufacturing.*

Sematech was founded by 14 computer chip companies producing 80% of U.S. chips on the open market. (One has since dropped out.) They had become an endangered species in the mid-1980s, threatened by Japanese conglomerates that were flooding the market with cheap memory chips. The Sematech group argued that unless the U.S. government helped out, domestic companies would fall behind in R&D and eventually cede the entire market to foreign firms. Because high-tech weapons rely so much on electronics (and because the Pentagon had deep pockets in those days), the Reagan Administration saw this as a national security problem. It agreed that the Defense Advanced Research Projects Agency (DARPA) should give Sematech $100 million a year for 5 years—a contribution to be matched by $100 million each year from the participants.

Sematech's research agenda was to be determined by the member companies in collaboration with DARPA. The assumption was that private investors would know which problems were most important to attack, and because they were paying half the bill, they would avoid waste. But the consortium was slow to organize. Rodgers claims that it actually blundered into two false starts—including a plan to build a mass-production plant for memory chips—before settling down to a sensible goal. The objective now is to build up U.S. manufacturing equipment suppliers.

Rodgers, who has strong antigovernment views, argues that Sematech did more harm than good at the outset. It would have been a mistake to follow Sematech's original strategy for investing in mass production of memory chips, he thinks, because the market was already jammed with competition in this field. Instead, he argues—and other experts now agree—that the better strategy for the U.S. industry has been to learn to make a variety of specialized chips in small batches, and to learn to shift quickly from one set of special requirements to another. Sematech's present emphasis is more in this direction. Rodgers also claims that Sematech's dues structure, among other things, discriminated against small companies, and he has evidence of a policy to withhold new technology from nonmembers. Some of these problems have been corrected, Rodgers says, but not all.

Sematech's spokesman, Buddy Price, claims that Rodgers has made "false" charges about hoarding technology, though he admits there was a clause in some R&D agreements requiring firms to wait a year before selling Sematech-funded devices to nonmembers. That rule has been dropped. All comers are now welcome to buy Sematech technology, after members have been served, including European and Japanese companies. According to Price, Sematech's goals for the 1990s include writing new computer programs for chip design and manufacture. Sematech hopes to create an entire "factory of the future" in one computer model, for example. It will also try to develop more reliable process control logic, because about 50% of machine failures in Sematech's test factory have been traced to software glitches.

But the big question remains: Has the nearly $1 billion invested in Sematech produced commensurate results? Erich Bloch thinks the question cannot be answered yet. "I object to people trying to judge success based on a couple or 3 years' effort when this is a 10 to 15 years' kind of problem," Bloch says. The "right question to ask," he believes, is: " 'Are we building an infrastructure or aren't we?' " ■ E.M.

But if the president's speech seemed light on substance, his budget message was heavily loaded with it. The section dealing with research begins with a pitch for "aggressive investment in both basic and applied R&D," and launches into a catechism of past deeds that "spur innovation and the movement of new products and processes from the laboratory to the marketplace." It spotlights some recent additions to the agenda, including the following:

■ **Advanced manufacturing.** In a preview of what's likely to come out of Bromley's manufacturing technology initiative, the Administration has already asked for a 27% increase in funding of nondefense manufacturing R&D this year, raising the total to $1 billion. The National Science Foundation (NSF) would get $105 million of this money for a special manufacturing program of its own, and the National Institute of Standards and Technology (NIST) would get $68 million for its Advanced Technology Program, which gives seed money to private joint ventures to develop innovative ideas. Congress created the Advanced Technology Program in 1990, and the Administration long resisted

putting any money into it. Now it's proposing almost to double the budget, from $37 million last year. The House science committee won't be impressed: It wants to spend several hundred million on the program.

■ **Critical Technologies Institute** (CTI). Senator Jeff Bingaman (D–NM), chairman of the Senate armed forces subcommittee on defense industry, led a congressional drive in 1990 to create an executive think tank that would focus on civilian manufacturing and R&D. His idea was to create a central office that would anticipate global trends in applied research and help get industry and the federal government working in concert to stay ahead of the curve. Although the Administration didn't like the idea, Congress inserted it into the Defense appropriations bill more than a year ago, and finally this month—according to Bromley—the creature will come to life when a management contract is signed. Congress wanted the CTI to operate under the aegis of the Office of Science and Technology Policy, but Bromley shifted the responsibility to the NSF because, he said, his office would otherwise lose its status as an independent evaluator of R&D policy. After lengthy negotiations with Congress, NSF will soon sign a contract with a private firm to run this think tank. The president's science adviser will be chairman of the board, which will include industry people.

■ **National Technology Initiative.** Secretary of Energy James Watkins is the main force behind this new push to share federal lab technology with private industry. Watkins and other cabinet officials kicked it off at the Massachusetts Institute of Technology in Cambridge, Massachusetts, during the week before the New Hampshire primary, and the campaign will take top officials from Department of Energy and the National Aeronautics and Space Administration, among others, to 10 cities to advertise the government's willingness to work closely with industry on critical technologies. Some congressional aides think it looks suspiciously like a political campaign, but Bromley says the aim is merely to spread the word that federal labs are eager to share their knowledge.

■ **FCCSET initiatives.** Bromley has used his office to launch "cross-cutting" reviews by the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), getting many departments to focus on a single theme. Bromley likes to point out that each of the initiatives he has chosen so far have afterward won extra funding in the president's budget. Recent drives emphasized industrially oriented research by promoting, among others, high-performance computing, biotechnology, and advanced materials and processing. It's no illusion that so many of these budget initiatives tilt in the same direction. Robert Grady, the chief science specialist in the Office of Management and Budget, told *New Technology Week* recently that applied research "is appropriately an area of greater focus" in the 1993 budget.

Congress will surely agree, but it is likely to be far less pleased with the Administration's treatment of civilian technology programs at the DOD. Indeed, an aide to Senator Bingaman argues the progress in other agencies could be "wiped out" by cutbacks that the Administration wants to make at the Pentagon this year. The complete "rescission list" has not been handed over to Capitol Hill as yet, but Bingaman's staffer notes that the Administration has already identified more than $200 million worth of manufacturing technology projects Congress added to the military budget, which the White House now intends to drop.



Turnaround. *The White House is plugging programs it was once fighting, says Rep. George Brown.*

The 1993 budget request also proposes a number of cuts in already-approved technology programs: about $30 million to be taken from Air Force civil R&D projects, including funds earmarked for the National Center for Manufacturing Sciences near Ann Arbor, Michigan; $30 million from other defense manufacturing technology programs; $30 million from a new manufacturing education program that was to be carried out jointly with the NSF; $60 million from targeted research on high-definition video screens at the Defense Advanced Research Projects Agency (DARPA); and $70 million from x-ray lithography work at Brookhaven National Laboratory and other places.

Many of these projects belong in a category that Bingaman and Senator Sam Nunn (D–GA), chairman of the Armed Services Committee, call defense "diversification" programs, designed to shift the fiscal mass of the Pentagon into peacetime activities. (Congress is avoiding the term "defense conversion" as too radical-sounding.) Now that military competition with the Soviets has ended, they think the Pentagon should seize the hour, restructure its procurement and R&D methods, and move away from specialized military designs to those that can use off-the-shelf technology. They also think the military budget should be used to promote advanced gadgetry that nondefense firms would find useful.

Despite the proposed cuts, Bingaman thinks the Pentagon will eventually move in the direction he would like, because it will have to rely more and more on civilian sources for military technology. One promising move, for example, is that the DOD's manufacturing technology office, in an unusual step, is giving $2 million this year to the NSF to support a joint manufacturing R&D program.

Leaders in the House would like to accelerate such moves. Representative Brown, for example, proposed a complete overhaul of the weapons labs at the American Association for the Advancement of Science meeting in February. He called for cutting nuclear weapons R&D and testing by 20% a year for the next 4 years. The $1.5 billion saved should be spent instead, he thinks, on civilian technology investments. The Livermore lab would stop all nuclear weapons work and become a critical technologies center. Sandia would specialize in technology transfer and arms control verification. And Los Alamos alone would carry on the traditional work in nuclear weapons design.

Some of these proposals for military diversification may be wrapped into a big congressional plan for stimulating the economy this spring, Brown believes. It is likely to balance defense cuts with increases in support for civilian technology. But Brown grumbles that because of its fragmented structure, Congress is "inept" at running this kind of campaign; he wishes the Administration would take the lead.

That's not likely, for the moment. Although the Administration is moving in a similar direction, it is still treading cautiously. This caution is likely to persist, especially as conservatives like Patrick Buchanan keep up the attack. Buchanan would reduce the government's involvement in industry to a minimum, avoiding joint projects.

This suggests that Congress, by default, will continue to set the pace this year in the debate on funding applied research. Just what will finally emerge is hard to know. "We are right in the middle of this whole swirling cloud of gas up here," says an aide to Brown, speaking of a package of economic proposals now taking shape. "We are hoping it reaches density and forms a star," he says. ■ ELIOT MARSHALL