Science and Technology in the White House, 1977 to 1980: Part 1

Frank Press

Summary. This is the first half of a two-part article on science and technology policy in the Carter White House. Written from the perspective of the President's Office of Science and Technology Policy (OSTP), the article describes specific activities and accomplishments in the context of the overall policy framework and institutional structure within which the office operates. This part of the article addresses policy issues related to strengthening the U.S. science and technology enterprise, fostering industrial innovation, enhancing relationships among government, industry, and universities, and improving the regulatory process. Part 2 will focus on OSTP activities related to national security and foreign policy, space, energy and the environment, health, and agriculture, and will discuss OSTP advisory mechanisms and planning efforts.

Most of the issues with which a modern President must deal have been greatly affected and complicated by rapid advances in scientific and technological knowledge and achievement. Indeed, for many issues, science and technology are critical elements of the policy alternatives the President faces. These issues include foreign policy, national defense, nonproliferation of nuclear weapons, economic revitalization, energy, space, health, agriculture, and environmental protection. To deal wisely with such issues it is helpful for a President to have broad technological literacy, but it is essential that he have strong staff support.

President Carter, at the outset of his Administration, recognized the pervasiveness of scientific and technological concerns and the need for direct support in these areas. For this reason, he followed the tradition of several of his predecessors, choosing to have a science and technology adviser as part of his senior White House staff. When the President selected me for this position, he also nominated me to become the director of the statutory Office of Science and Technology Policy (OSTP). The OSTP had been recreated by Congress, after a hiatus of several years, under the National Science and Technology Policy, Organization, and Priorities Act of 1976 (Public Law 94-282) and placed in operation during the last year of the Ford Administration by President Ford's science adviser, H. Guyford Stever (*1*).

I had never met Jimmy Carter, nor was I active politically before joining the Administration. Only after the President offered me the position did his chief of staff inquire about my political affiliation in order to inform the congressional leadership. Although there is something to be said for a prior political and personal relationship between a President and his science adviser, I have found it advantageous to be viewed primarily as a professional rather than political appointee, particularly in my dealings with Congress, industry, universities, and professional societies. There are political differences even within the White House staff and the Cabinet, and the credibility of my advice was enhanced by the apolitical and impartial image of OSTP. In my first interview with the President, he indicated that he chose me from a list of nominees submitted by leaders of American science and technology because my background served his priorities in energy, environment, resources, arms control, and relations with the U.S.S.R. and other countries.

President Carter retained OSTP as an integral part of the Executive Office of the President. At the same time, as part of his effort to streamline the expansive structure of the White House and its associated offices, OSTP was slimmed down and the President's reorganization authority invoked to transfer to other agencies certain staff-intensive responsibilities, such as writing prescribed reports for Congress. Other responsibilities in the national security and space policy areas, however, were assigned to OSTP (*2*).

We organized OSTP around three associate directors in order to enhance our ability to deal with the tremendous range of substantive issues we anticipated, and recruited a small staff of accomplished scientists, engineers, and other professionals with relevant policy analytical experience. On specific issues we have consulted intensively with experts from around the country. Use of individual consultants and ad hoc panels focused on well-defined, high-priority issues has proved an effective and flexible means of augmenting staff capabilities and obtaining the most knowledgeable advice.

The OSTP enabling legislation was important in providing the overall mission and the framework within which we sought to establish the office. However, President Nixon's elimination of a White House science and technology office had led to a distribution of its responsibilities to other parts of the Executive Office of the President and other Executive Branch agencies. OSTP would be faced with a natural bureaucratic resistance to reestablishing the influential roles its predecessor offices played under Presidents Eisenhower and Kennedy. For this reason, it was our early assessment that, in order to be effective and to have a significant influence on major policy and program decisions, we had to prove ourselves to be a valuable source of advice and had to operate in a manner consistent with, and complementary to, the policies and operating styles of the President and other members of his immediate staff with whom we would work on a day-to-day basis. Thus, we began by establishing personal and operating ties with the Vice President, the senior presidential advisers, and the staffs of the various White House offices—the National Security Council, the Domestic Policy Staff, the Office of Management and Budget, the Council of Economic Advisors, the Council on Wage and Price Stability, the Council on Environmental Quality, and others responsible for presidential personnel, appointments, and other functions.

The leaders of the departments and agencies were also appointed during this

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time. My role in advising on those appointments particularly relevant to research and development helped establish early relationships with these key officials.

My dual role of personal adviser to the President and director of a staff office in the Executive Office of the President has allowed me to participate in policy deliberations and decisions across the full span of presidential responsibility and to have the staff capabilities necessary to conduct the timely, high-quality policy analyses needed to support that participation. My attendance at Cabinet meetings and senior staff meetings, along with the participation of the OSTP associate directors and staff in a substantial portion of internal White House activities, have made possible continuous interaction in the formulation of presidential policy.

Above all, it has been the personal interest of President Carter that has given scientific and technological considerations weight and significance in Executive Branch policy formulations over the last 4 years. The President has been highly accessible, seeking my advice and counsel on a wide range of issues and personally directing that I take the lead in specific instances. In this way, the scientific and technological perspective has become an integral part of the body of analysis that aids the President in making what are ultimately political judgments and, although the White House is a center of political activity, OSTP has come to be viewed primarily as a source of nonpolitical, expert advice. The evidence of that personal interest of the President has also made more effective the extensive interactions with the departments and agencies in carrying out presidential policy, in developing coherent policy across the government, and in mobilizing the departments and agencies to respond to special needs or issues.

The principal themes of the Administration emerged during the first year. My discussions in early 1977 with the President and Vice President led to a broad outline of Administration science and technology policies emphasizing growth in the support of basic research, an increased role for science and technology in regulatory decision-making, incentives for technological innovation, and an enhanced role for science and technology in international relations. Extensive conversations with representatives from the academic and industrial sectors helped to indicate the scope and magnitude of the problems faced by these sectors, and to clarify and refine the specific issues within the broader policy areas. The high-priority issues emerging from this process formed a working agenda for both the near-term and longer range policy initiatives that would be undertaken by OSTP. This policy framework; the personal and organizational relationships formed with colleagues in the agencies, the Executive Office of the President, and Congress; and a network of formal and informal consultants from disciplines and institutions have permitted this small policy office to have considerable influence on a wide range of scientific and technological issues of national importance (*3*).

In this two-part article, I will discuss some of our activities and accomplishments, focusing on the overall policy framework and government structure within which OSTP operates in the formulation of science and technology policy. Part 1 will describe activities aimed at strengthening U.S. science and technology, new government relationships with industry and universities, and regulatory reform efforts. Part 2 will describe foreign policy and defense-related activities, energy, health, and agriculture efforts.

Strengthening U.S. Science and Technology

Science and technology have become major factors in almost every facet of our lives. We increasingly look to scientific and technological advances to help solve the complex problems facing the nation and the world. We expect science and technology to improve our health, feed the world's growing population, find new energy sources, provide for our national security, and contribute to the health of our economy by generating growth, jobs, and productivity through innovation. Indeed, it is implicit in our nation's approach to the future that technologies will aid in the solution of many of the problems we face. Development and application of new technologies are viewed as a national imperative.

Fulfilling our ambitious expectations for technology will require a national commitment to research and development among the several sectors—government, industry, academia, and the public—that play complementary roles in the support and conduct of basic and applied research and of technological innovation, development, and application. Thus, early in the Administration, it became clear that critical tasks would be delineation of the role of the federal government in the support and conduct of research and development, clarification of the relationship of the government's role to the roles of academic and industrial sectors, and improved and increased cooperation among these three sectors in meeting the scientific and technological challenges of the future.

Over the last 4 years, my staff and I have devoted a major portion of our energies to defining and strengthening the federal research and development commitment, to working with our government colleagues in developing appropriate policies and programs, and to working with our academic and industrial colleagues to enhance government-university-industry relations.

Federal support for research and development. The federal government's support and conduct of research and development is critical to the overall advance of science and technology. The largest fraction of the federal investment serves areas for which the government has either total or major responsibility, such as defense, space, and health. Because of the technical challenges involved in meeting these national needs, there is a relatively large and broad federal investment across the entire spectrum of research, development, demonstration, and application.

Similarly, the federal government undertakes research and development where there is a national need to accelerate the rate of development of new technologies in the private sector. This is especially true when the risk is great, costs inordinately high, or time particularly pressing, as with many aspects of alternative energy technologies. In such cases, the government may provide incentives such as direct grants and contracts, guaranteed loans, purchase contracts at guaranteed prices, joint ventures or, as a last resort, construction of government-owned facilities. Fusion research and development and the recently created Synthetic Fuels Corporation, which has these authorities, are examples of government involvement in an area of national need.

We look to the private sector, however, to finance research and development activities having near-term commercial payoff and to bear the major financial responsibility for required capital investment in such cases as synthetic fuels commercialization. Industry is more knowledgeable about the marketplace and sensitive to opportunities for commercialization of new technologies. This view is consistent with that of industrial leaders who ask the government for a climate that fosters innovation rather than for direct financial support of

research and development with commercial potential.

Underlying the achievement of both public and private sector objectives is basic research. Because such research typically does not lead to patentable results, usually pays off only in the long term, and is unpredictable, it is necessary and desirable that it be supported by public resources as an investment in the nation's future. This principle has been accepted in the United States over many years, and the nation has committed substantial resources to create and support the world's most productive scientific enterprise.

There are no established criteria and procedures for determining the adequacy of the existing science and technology base or for identifying an adequate level of support for research, especially basic research. Relevant factors include the levels of activity in various scientific fields and the anticipated benefits or costs of incremental changes in level of support; the potential opportunity costs of not funding given areas of research; the effects of past contraction of support on research capabilities, institutions, and facilities; the opportunities available to bright young scientists; the views of employers on the quantity and quality of new scientists and engineers; and the policies of other countries. The National Science Foundation's *Science Indicators*, as well as reviews and reports of the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, American Association for the Advancement of Science, and other professional societies, provide data useful in making these kinds of judgments.

Ultimately, however, policy-makers must decide on appropriate levels of research on the basis of imperfect indicators, information from many disparate sources, and many uncertainties. The Administration has used all available sources of advice and information, relying particularly on the views of experienced individuals in the academic and business communities. Early in the Administration, we concluded that government support for basic research had declined seriously in the preceding decade and required sustained real growth above inflation. Perhaps even more important from the policy viewpoint was the President's decision to view basic research as an investment rather than an expense (*4*). This decision became the basis for the strong support for research and development in the President's budgets and the major science and technology initiative in the economic revitalization program announced by the President on 28 August 1980 (*5*). The latter included the provision of $600 million in new funds for fiscal years 1981 and 1982 to achieve 3 percent real growth above inflation in basic research for those 2 years and to support several other steps designed to stimulate research and innovation. Taken together with earlier commitments, this recent initiative, if adopted by President-elect Reagan and Congress, will bring real growth in basic research over fiscal years 1978 to 1982 to 10 to 11 percent. Thus, as a result of the last two Ford budgets and the Carter budgets, the previous decade of decline in the support of basic research will have been reversed and a new all-time peak (in deflated dollars) achieved.

Frank Press and President Carter in Air Force 1 on the way to Mount St. Helens, 1980.

The budget process. The budget process is the most influential and comprehensive policy tool in the government. Our efforts to assess the adequacy of government research and development programs and to initiate appropriate actions have been effective largely because of our excellent working relationship with the Office of Management and Budget (OMB). I have found the senior officials in OMB to have a keen interest in science and technology and a thorough understanding of its national importance. In addition, we have been perceived by these officials and by others in the Executive Office to be a highly professional office supportive of the President's needs rather than a nonobjective representative of science and technology constituencies.

The OMB budget process begins in the spring with a review of major issues and continues with agency budget submissions in September, agency-OMB negotiations later in the fall, and presidential decisions in late December. The President submits the budget to Congress in January, and subsequent congressional action is expected that spring. OSTP participates in every step of the process, advising OMB and the President and helping to defend the budget before Congress. In addition to advising on the appropriateness of proposed levels of support for agency research and development programs, we identify and analyze specific budget and policy issues. These include special opportunities presented by recent scientific discoveries or by new techniques, processes, or instruments; the potential for addressing a national need more effectively by reprogramming or expanding funds within or among federal agencies; or problems with agency proposals that are technically flawed, misplaced in priority, or more properly a role of the private sector. During budget sessions with the President, we have sided with OMB or the agencies, or have taken an independent position, depending on the merits of the issue. Examples of issues that have received special attention because of new opportunities, previous underfunding, or national need are microelectronics, computer sciences, engineering sciences, physical science and mathematics, defense research and development, alternative energy supply technologies, the Space Shuttle, climate research, food and agricultural research, basic biomedical research, environmental research and control technologies, and toxic substances and hazardous wastes.

After individual agency budget deci-

sions have been made, we have worked with OMB and the President to adjust the overall level of government research and development. In the last three budgets, funds were added to individual agency budgets through a process of cross-agency proposal ranking by OSTP and OMB in order to bring government-wide research support up to the level of real growth above inflation set by the President. This process has proved to be an effective method for carrying out a systematic overview of research and development, particularly of basic research. Despite the difficulties inherent in assessing and comparing diverse programs, and in projecting inflation and other economic behaviors, I feel that this OMB-OSTP process is an important development. The close working relationship that has emerged between OMB and OSTP is one of the high points of my service in Washington.

Other research resource issues. Nonfiscal resources must also be considered as major factors in the strength of the U.S. scientific and technological enterprise. These include equipment, facilities, and manpower. As director of OSTP, I have been made increasingly aware of (i) the steady decline in the quality of scientific instrumentation and facilities for research and teaching within our research universities and engineering colleges and (ii) the need for objective analyses of the need for trained scientific and engineering professionals.

Over the last 3 years we have worked with federal agencies to identify ways to alleviate these problems consistent with current budget realities. For example, the National Institutes of Health (NIH) and the National Science Foundation (NSF) have received some additional resources in the President's budgets for upgrading research equipment. In addition, they have explored ways to encourage time- and cost-sharing of valuable scientific resources. Although the President's economic revitalization program of 1980 will undoubtedly be replaced by President-elect Reagan's own program, we hope that the proposed long-term emphasis on upgrading university science and engineering instrumentation and facilities will receive bipartisan support.

Another critical resource is, of course, scientific and engineering personnel. Because of the rapidly changing needs for various scientific disciplines and engineering specialties and the lag times inherent in the educational process, predicting demand and influencing the supply of professional personnel have proved particularly difficult. For this reason, and at my suggestion, the President commissioned a study by the Department of Education and the NSF to assess the current and projected supply of and demand for science and engineering personnel, and the quality and appropriateness of science and engineering education. The recently completed report (*6*) points up serious problems in this nation's engineering schools and shortages of manpower in key engineering fields, and expresses concern at the deterioration of mathematics and science education in our primary and secondary schools. On the basis of the report, a strong case can be made for new programs involving joint efforts by the government, industry, and educational institutions to address these problems.

We are particularly proud of having initiated a program with a potentially large impact on minority representation in the nation's scientific and engineering professions. As the result of the President's strong interest and of cooperation among OSTP, OMB, and all agencies with significant scientific and technical programs, 1300 summer placements were created for minority high school students to give them hands-on research experience under the tutelage of an experienced investigator in a university or government laboratory. We are planning for the Minority Research Apprenticeship Program to grow to 2000 students next summer.

We have also worked with OMB, the agencies, and Congress to bring more stability to the research community through longer term research planning and through negotiation of a dependable base of research support. Continuity and stability of support will facilitate the training of needed scientists and engineers, maintenance of high-quality research teams, and conduct of significant, long-term scientific investigations. For example, the Administration has proposed annual budget growth sufficient to support a stable number of biomedical research projects and provided for stable, predictable growth of funding for high-energy physics based on the priorities of that community.

In addition, the Administration and Congress explored the possibility of establishing multiyear research budget authorizations. The annual budgetary, authorization, and appropriations process has become so complex and unwieldly that it can have serious negative effects on the conduct of research. Specific legislation has been proposed by Representative Don Fuqua, chairman of the House Committee on Science and Technology, and enacted by the House of Representatives; however, action on this bill will probably not be completed during the 96th Congress.

We have also worked outside the budget process to strengthen government research and development programs. It will be recalled that basic research in the mission agencies had declined sharply over several years, especially following enactment of the so-called Mansfield Amendment (*7*). One of our first steps in analyzing the adequacy of federal support for research and development was to assess the basic research programs of several mission agencies. Early in the Administration, OSTP initiated reviews for the Department of Defense and the Department of Energy at the request of their Cabinet officers. High-level study panels were established comprising individuals with a range of perspectives and backgrounds and with experience in industry, academic science, and administration. In their final reports, both panels recommended that mission goals would be more readily achievable if the departments reversed earlier declines and gave greater emphasis and more coherent management attention to research and development, particularly basic research (*8*). The Cabinet officers agreed and have taken steps to implement the panel recommendations. Both agencies have included members of the original panels in continuing efforts to monitor basic research and both followed panel recommendations to strengthen ties with the university communities. Subsequently, OSTP initiated similar reviews of priorities and management in the Departments of Agriculture, Transportation (*9*), and Health and Human Services, and in the Environmental Protection Agency (EPA).

Industrial Innovation

In the first few months of my tenure as science and technology adviser and director of OSTP, I began meeting with small groups of industry executives. A dominant theme of these meetings was the impact of government policies on industrial innovation. It clearly was a question of national importance. United States imports of manufactured goods each year are on the same order as our oil imports. As the world's most technologically advanced nation, we have a positive balance of trade in research and development-intensive manufactured products, but we suffer a trade balance deficit in products that are not research and development-intensive. Our rate of productivity increase is among the lowest in the industrialized democracies.

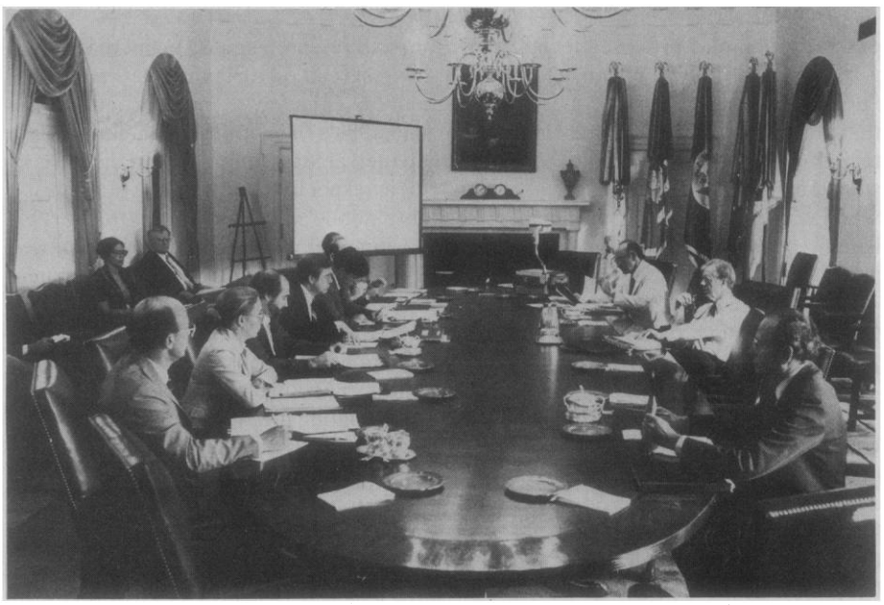
These facts, together with high inflation, aging capital plant in many industries, and other indicators of a change in relative position between the United States and foreign countries, show the need for improving competitiveness through increased productivity. These conversations led me to recommend to the President that he initiate an examination of government actions to encourage innovation. While there had been previous studies of innovation, these had not directly engaged Cabinet officers and the President.

I worked with Domestic Policy Adviser Stuart Eizenstat, the then Secretary of Commerce Juanita Kreps, and Assistant Secretary of Commerce Jordan Baruch (who was asked to manage the study), in organizing the review. We recommended a new policy review format, the domestic policy review (DPR) system, somewhat analogous to a long-established procedure used by the National Security Council. The system offered an improved method of bringing diverse points of view to bear on complex issues at the presidential level. The DPR on industrial innovation involved some 20 government agencies, as well as hundreds of outside groups and individuals. The Departments of Justice and Treasury were heavily involved as well as the OMB.

Those who participated recognized that there is much that the government needs to do through positive actions as well as removal of disincentives to innovation. Accordingly, the President took a number of steps to effect changes in policies in order to stimulate, or remove or reduce barriers to, innovation. The President's decisions were announced in a message to Congress delivered in October 1979 (*10*). These first initiatives included:

- Expansion of government efforts through the National Technical Information Service to transfer to industry—particularly small firms and businesses—technological know-how generated in universities, government laboratories, and industrial laboratories from work under government grants or contracts.
- Increase of government research and development for technologies of special value to industry, including generic technologies that underlie many industrial sectors (such as welding and joining, corrosion prevention and control, and robotics), as well as "compliance technologies" designed to help small industries comply with environmental, health, and safety regulations.
- Expansion of the NSF program to foster industry-university cooperative projects. This program would also pay for university participation and up to 90 percent of small business participation.
- Strengthening of the patent system by establishing a uniform government-wide policy that gives title to universities and small businesses and exclusive licensing rights to large companies that develop patents with government funds.
- Clarification of antitrust policy concerning prospective cooperation in research, including cooperation among companies in a given industrial sector. An antitrust guide for use by technical and legal experts in industry, universities, and government has been issued (*11*).
- Expansion of the NSF Small Business Innovation Research Program, which provides funding to small companies for development of new products and demonstration of technical feasibility.
- Establishment of several state and regional Corporations for Industrial Development, which would assist in starting up firms that wish to develop and bring to market a promising but high-risk innovation; provide guidance and management advice; and, when qualified, act as recipients of economic development assistance funds for the state or region.

These and other programs to stimulate industrial innovation are not costly. For the most part, the government plays a role not through direct budgetary outlays (except for the benefits flowing from government-supported research and development), but through nonbudgetary policy. Perhaps the most significant result of the innovation review was to sensitize policy-makers at all levels of government to the effect of their actions on industry's ability to innovate. However, we realized that from industry's point of view, the most important factor affecting industrial innovation is economic policy, particularly federal tax policy. The 1979 innovation initiatives were viewed as first steps, to be followed by tax incentives for innovation and productivity as part of future tax proposals.



Budget meeting with President Carter, OMB director James McIntyre, and OMB officials, 30 July 1980. On the President's right is Alfred Kahn; on the President's left, Frank Press.

The economic revitalization program announced by the President on 28 August 1980 proposed the next steps the government should take to stimulate industrial innovation and productivity. As well as the commitment of the additional research funds to ensure real growth of 3 percent in federal support for basic research over the next 2 years, the program includes:

- An accelerated and simplified depreciation schedule in business taxes to encourage rehabilitation of existing facilities and investment in new plant and equipment. (Accelerated depreciation was the highest priority recommendation of the industrial advisers to the DPR.)
- A partially refundable tax credit to benefit those businesses—distressed firms in industries such as automobiles and steel as well as small businesses just starting up—which have no earnings, yet have substantial investment needs.
- A variety of measures to increase exports.
- Initiatives proposed by the White House Conference on Small Business to help in the starting up and operation of small businesses.

At the final decision meeting on the ec-

onomic program, I proposed inclusion of a research and development tax credit. Others, however, argued successfully that direct expenditures represented better tax policy than tax credits. As a result, the research enhancement package was included instead, at an augmented level.

Government-Industry-University Cooperation

There is growing realization that the United States requires much closer cooperation between government and industry if it is to meet the competition offered by other countries. Because of their research and development capabilities, universities must also be a partner in that cooperation. With this in mind, OSTP stimulated the development of two research initiatives that can provide a precedent and a model for cooperation between government and industry, foster greater cooperation within industrial sectors, and exploit more effectively the scientific capabilities of this nation's research universities. In each case, the objective has been to plan new activities that have a substantial prospect for long-term payoff but would probably not be undertaken without collective cooperation within an industrial sector and between government and industry.

The first of these is the Cooperative Automobile Research Program (CARP). In May 1979, the President met with the chief executive officers of the automobile industry and set forth guiding principles for a jointly funded program of basic research related to automobile technology. CARP is intended to increase the level of basic scientific research underpinning automotive technology, and thus to contribute to the design of automobiles in the 1990's and beyond for more economic manufacture and operation, greater fuel efficiency and safety, and reduced pollution.

CARP-supported research will be carried out at universities, at private and government research laboratories, and in the industry's own research centers. Areas of investigation will include combustion, structural mechanics, electrochemistry, aerodynamics, materials science and processing, tribology, and catalysis. The large-scale involvement of universities represents a new opportunity for that research community to make a significant contribution to a major industry.

Both government and industry recognize that the national effort in basic automotive research should be increased and have agreed on a planning target of $100 million annually to be reached by the mid-1980's. The industry amount will be divided among companies on the basis of their respective percentages of domestic automobile sales. The commitment is for 5 years and will presumably be renewed if the program is successful. Government agencies and individual companies will select and manage research projects independently to ensure freedom of decision in pursuing new ideas. However, a coordinating mechanism will be used and the research results will be widely distributed, subject to appropriate patent provisions. All five major automobile manufacturers in this country have agreed to participate in this program, and Congress has approved funding for the first year, fiscal year 1981.

A second program for government-industry cooperation is a joint venture with the oil industry, the Ocean Margin Drilling (OMD) program. The program will involve frontier research and technological development. It will enable us to characterize by deep-sea drilling the passive and active continental margins. The history of the early continental breakup and the subsequent evolution of continental shelves is contained in the thick sedimentary deposits of the margins. The project is therefore of great research interest to university and industry scientists, and it also makes possible assessment of hydrocarbon resources in these regions. Ten major oil companies have joined the program and Congress has approved the first year of federal funding.

In my dual role as member of the President's staff and director of OSTP with a statutory mandate to coordinate interagency programs, I was able to organize the participation of several government agencies and to clear the programs through the White House. There are many other opportunities for similar sectoral collaboration that will stimulate research and development in a manner consistent with established federal policies. The CARP and OMD programs may serve as models for joint ventures in other sectors that have similar attributes—a high degree of shared private and government interest, a need to organize cooperation among the major firms of an industry in ways that do not impede competition, and a long-term but high rate of return to joint investment (*12*).

Administration efforts to enhance basic research and stimulate industrial innovation have also focused attention on the importance of formal university-industry cooperative relationships in science and engineering. OSTP has (i) encouraged discussion among the government, academic, and industrial sectors of the status of, and potential for, university-industry research consortia and research partnerships and the current and prospective roles of the federal government in stimulating such relationships, and (ii) supported budgetary and programmatic initiatives designed to stimulate a diversity of university-industry linkages (*13*).

Regulatory Reform

Discussions of industrial technology and innovation invariably turn, at some point, to the regulatory system. Indeed, one of the most striking changes that has taken place in our governmental system over the past two decades has been the rapid growth of regulation to achieve socially desired objectives. In many cases, regulation involves important technological decisions. Air and water pollution control, energy conservation, hazardous waste disposal, occupational health and safety, aircraft safety, and nuclear power safety are prominent examples. It was clear to us early that regulatory matters would be of major concern to OSTP.

In the past 4 years, a number of steps have been taken to improve the regulatory process and reduce unnecessary regulation. These include the promulgation of Executive Order 12044 (*14*) requiring that regulatory agencies publish analyses to ensure that regulators and the public are well informed about the costs and benefits of individual regulations; creation of a Regulatory Council, which is intended to help bring coordination and consistency into regulatory programs across sectors; and publication of the Regulatory Calendar to provide a complete picture of the government's major regulatory activities. In addition, the White House established a Regulatory Analysis Review Group (RARG), presided over by the Council of Economic Advisers (CEA), to improve the quality of regulatory analysis by ensuring that the most important regulations have a thorough economic, technical, and policy review. OSTP was a participant in the discussions that led to these steps and is a member of RARG.

OSTP has focused on improving the quality of scientific and technological data and upgrading the methods of risk assessment used in the regulatory process. This focus is particularly important in regulatory decision-making since the

fundamental political, and indeed adversarial, nature of the process does not provide an ideal environment in which to pool and objectively examine technical data from diverse sources. In many cases, the time pressures set by statutes, court decisions, or other events do not allow the orderly resolution of technical conflicts. As a result, regulatory decisions are an excellent example of issues in which scientific and technological knowledge and judgment must be effectively joined with economic and other perspectives in reaching policy conclusions (*15*).

For example, an issue of major significance is regulatory treatment of potential carcinogens. As our instrumentation and diagnostic capabilities have improved, we have increasingly discovered that many man-made substances introduced into our environment may be carcinogenic. However, government policies for dealing with this situation have often been inconsistent. An OSTP study was therefore undertaken to analyze the scientific principles underlying carcinogen risk assessment and lay out a framework for identifying and characterizing chemicals that might pose a carcinogenic risk. The resulting report was a factor in establishing a uniform government policy for controlling chemical carcinogens (*16*).

Another example arises from one of the most dramatic developments in all of science—the application of recombinant DNA techniques to many problems of basic biology and to production of needed hormones, vaccines, chemicals, and other pharmaceutical and agricultural products. Four years ago the public was alarmed by controversy within the molecular biology community over the safety of such research. A determined effort led by Donald Fredrickson, director of NIH, and joined by an effective interagency committee, including OSTP, brought public health insights, risk assessment experiments, new data, and a more objective attitude to policy discussions. Congressional hearings helped to air all sides of this complex issue and promote a reasoned assessment of the putative risks. The prudent course undertaken has allowed very rapid progress in this work, permitted university and industrial efforts to grow and flourish, and assured workers and environmentalists that great care is, indeed, being exercised through the NIH guidelines and through educational efforts on industrial applications.

Evolution of sound technical policies for areas of prospective future regulation has also been a focus of attention by OSTP. For example, OSTP has worked extensively on government policy regarding the introduction of diesel engines into the passenger car fleet. The prospective rapid movement toward increased use of diesels raised serious policy issues in 1977 and 1978, when it appeared that particulates emitted by diesel-powered vehicles might be carcinogenic. Although particulate emissions standards were required under the Clean Air Act, it appeared to some that more severe regulatory restrictions might be necessary to deal with the possible carcinogenicity problem. The EPA quickly mounted a substantial multiyear research program aimed at providing some policy resolution before manufacturers made large investments in diesel engine production capacity. During 1978, various White House staff members realized that the specter of carcinogenicity would influence a major technology decision in the automotive sector—one with substantial national energy and economic implications. After a series of meetings with the major automobile manufacturers, the concerned government agencies, and a range of other experts, two actions were initiated. First, OSTP encouraged the Department of Energy to accelerate and expand its planned diesel health effects program as a complement to EPA's program, and worked with OMB to obtain the necessary funds. Second, OSTP, with strong support from other White House offices, suggested that the Departments of Energy and Transportation and EPA jointly fund a study by the National Academy of Sciences to analyze a range of federal policy alternatives and to ensure the soundness of the research programs in both the public and private sectors.

In March 1980, after a detailed White House review led by staff from OSTP and the Council of Economic Advisors, EPA released its diesel particulate standards. These standards, based on the technology for controlling total particulate emissions, effectively regulate the installation of devices to trap and oxidize particulates from large diesel passenger cars beginning in 1985. Whether other measures will be necessary to deal with the possible carcinogenicity of the diesel exhaust will be determined next year, when the Academy's report is completed and the research programs are further along. I believe that external reviews such as this should play an increasing role in the years ahead to improve the technical basis for and credibility of government regulatory decisions.

Conclusion

During the last 4 years, science and technology have played a key role as the Administration addressed the national agenda. I have described something of the operating environment of OSTP and some of its major initiatives: strengthening the national science and technology base; enhancing research efforts in the mission agencies; initiating government actions to stimulate industrial innovation; improving the technical basis for regulatory policy; and fashioning new institutional relationships among government, industry, and universities. Other aspects of the Administration's science and technology policy dealing with energy, agriculture, health, space, national security, and international relations will be discussed in part 2.

References and Notes

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