

Section I

Director's Statement

The world has been vastly changed and enriched by the forces of science and technology in the two centuries since our nation declared its independence. Accordingly, it is appropriate, at the Bicentennial, to both revere and review the democratic values and institutions that so well have served us in the past, and to consider what steps may be needed to preserve our freedoms in the years ahead.

Two hundred years ago, in a predominantly agricultural society set upon a relatively isolated continent of abundant physical resources, Thomas Jefferson asserted the right of the American people to "assume among the Powers of the Earth, the separate and equal Station to which the Laws of Nature and Nature's God entitle them."

Today, as an industrial society grown strong through scientific discovery and technological application, our entitlement to independence as a free, self-governing nation is firmly established. In 1976, however, in a world of shrinking distances, burgeoning population, and increasing rivalry for resources, Jefferson's reference to the entitlements of "the Laws of Nature and Nature's God" takes on anew meaning.

As the United States enters its third century, our understanding of the laws of nature makes us increasingly aware of the fact that past economic growth has diminished many of the earth's nonrenewable resources and has caused disruptive environmental impacts. We also are more aware of the international responsibilities that we have inherited through the good fortune of the material well-being we have achieved.

The challenge of the next 100 years will be to marshal our intellectual and technological resourcefulness to forge new institutions and new mechanisms that will, within the latitudes and limitations of nature's laws, address social needs and preserve international comity in a world of rising population and rising expectations.

The creation by Congress, in 1972, of the Office of Technology Assessment (OTA) is one reflection of the nation's maturing realization of the need for new institutional approaches to assure that our nation's public policy is based, to the fullest possible extent, on a clear understanding of the potential consequences, beneficial and adverse, of the uses of technology.

The information-gathering and analytical resources provided to the Congress by OTA are a recognition by the Congress of the importance of independent sources of timely and pertinent data to enable anticipation

and consideration of the opportunities, as well as the problems, presented by the pervasive growth of technology in our society. In this Annual Report, the activities and organizational growth of OTA, during calendar year 1975, are reviewed.

More than 40 OTA assessment projects were under way in various stages during the report year. Although major assessments can require a year or more to complete, 14 final reports were issued in 1975, all of which were pressed into use by one or more Congressional Committees considering legislation involving technological issues. Of the OTA projects still in process at year's end, many had advanced sufficiently to have provided useful interim reports or briefings to Congressional interests. Also during the year, OTA received 38 new assessment proposals, bringing to 73 the total number of Congressional study requests received since the Office began its operation early in 1974.

Feedback from Members of Congress and staff personnel of the Committees which have utilized OTA reports, as well as comment received in several instances from Executive Branch agencies, has been gratifying. For example, OTA's assessment of automated guideway transit systems has been credited with playing a significant role in the restoration of funds, previously deleted by the House of Representatives, for continued research into potential urban use of new mass transit technologies. Further, the Administrator of the Urban Mass Transportation Administration has publicly credited OTA's report for a shift in his agency's research and development priorities.

Another example is provided by the response to OTA's work in analyzing the budget and program of the Energy Research and Development Administration (ERDA). The Administrator of ERDA, at a press conference, cited OTA's analyses as a basis for his agency's decision to afford stepped up priority to energy conservation research. And, in July 1975, the Chairman of a Congressional Energy Subcommittee wrote to say that OTA's analysis of key issues involved in the authorization of fiscal year 1976 funds for ERDA played an important role in House passage of "by far the most important energy bill the Congress has considered this year."

OTA assessment findings with regard to offshore oil and gas exploration and leasing practices were reflected in legislation passed by the Senate and were cited repeatedly during Senate floor debate over possible government involvement in the exploration process. Both proponents and opponents of an amendment to permit the government to conduct exploratory drilling under certain circumstances cited OTA's report as, in the words of one Senator, "an objective, bipartisan analysis."

One last example, from the Chairman of a Congressional Subcommittee on Surface Transportation, cited "the substantial contribution that OTA has made to developing what I consider to be the most significant piece of rail transportation legislation enacted in the last half century." Referring to three

OTA studies addressing issues in the Railroad Revitalization and Regulatory Reform Act, the Subcommittee Chairman said "a number of significant legislative decisions were made only after OTA had reported its findings to the Committee."

These and other responses, both formal and informal, indicate that technology assessment is proving to be a useful and effective tool for identifying policy options, and establishing objective perspectives, in a Congressional workload of ever-increasing technological complexity. OTA's assessments, through their use by Congress in hearings, committee reports, and debate—as well as through public dissemination and news media coverage—also help to increase citizen awareness and understanding of complex issues, which is essential if wise decisions are to be reached through democratic processes.

Technology assessment is not primarily an exercise in forecasting or prophecy. It is a process designed to ask the right questions, and to seek answers based as much as is possible—on hard, factual information which can be obtained through disciplined analysis. Where important data is unavailable, the need for additional research can be spotlighted. Technology assessment is an aid to, not a substitute for, the judgments which must be reached by elected officials in policymaking positions.

In order to meet Congressional needs, within the fluctuations of legislative time frames, the OTA staff maintains close liaison with Committee personnel to assure a free exchange of ideas and information. In keeping with policies set by the OTA Board, these interactions include individual consultations, formal briefings, presentation of hearing testimony, issuance of interim reports, and, upon completion of the assessment, publication and broad dissemination of the final report.

Each of the six original OTA priority areas—Energy, Food, Health, Materials, Oceans, and Transportation—broadened its activities and strengthened its staffing and advisory resources during 1975, developing a more comprehensive overall program capability. In the process, interrelationships were developed between programs to facilitate the handling of assessment projects involving overlapping issues. Overall, the Office's capacity to advise the OTA Board on matters of assessment priorities and identification of emerging issues was greatly enhanced.

Of significance in this regard was the approval of a new OTA assessment program addressing the subject of National Research and Development Policies and Priorities, which will provide added perspective for many of the other OTA programs. The OTA Advisory Council is playing a prominent role in the formulation of this important new program, which responds to requests from seven separate Congressional bodies. In addition to its developmental *role*, the Advisory Council will provide ongoing guidance for this central activity.

The OTA Board and the OTA staff are indebted to the members of the Advisory Council and many other individuals and institutions for their

contributions, during the past year, to the growth and achievements of the Office. Several other agencies of government provided personnel and technical support, among them, the National Bureau of Standards, Federal Power Commission, Bureau of Mines, U.S. Geological Survey, Food and Drug Administration, National Oceanographic and Atmospheric Administration, and National Science Foundation.

Special thanks are due to President Harold Brown of the California Institute of Technology, the first Chairman of the OTA Advisory Council, who has given generously of his time and provided wise counsel. A statement in letter form, issued by Dr. Brown at the conclusion of his two years of service as Chairman, is included as an appendix to this report along with a response from Congressman Olin E. Teague, Chairman of the OTA Board.

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This report covers the activities of the Office of Technology Assessment during calendar year 1975. The sections which follow describe the structure and organization of OTA, its operating procedures, the activities of the Advisory Council, and the assessment plans and programs within OTA's seven priority areas.

EMILIO Q. DADDARIO,
Director,
Office of Technology Assessment.

Section II

Organization and Operations

The Office of Technology Assessment (OTA) was created by the Technology Assessment Act of 1972 (86 Stat. 797) to help the Congress anticipate, and plan for, the consequences of uses of technology. OTA received funding in November 1973, and commenced operations with the convening of the 93d Congress, 2d Session, in January 1974.

The statute specifies that OTA shall consist of a bipartisan Congressional policy Board, an OTA Director, a Deputy Director, and such other employees and consultants as may be necessary in the conduct of the Office's work. In addition, the Board is assisted by a Technology Assessment Advisory Council comprised of 10 public members eminent in technological or educational fields, the Comptroller General of the United States and the Director of the Congressional Research Service of the Library of Congress.

The Congressional Board sets the policies of the Office and is the sole oversight body governing OTA. The OTA Director is the chief executive officer and is responsible solely to the Board, of which he is a member. The function of the Advisory Council is to advise the Congressional Board on such technology assessment matters as may be requested.

Six Senators and six Representatives, evenly divided by party, serve on the OTA Congressional Board. They are appointed respectively by the President Pro Tempore of the Senate and Speaker of the House. The current Board Chairman is Congressman Olin E. Teague, D.-Texas, and the Vice Chairman is Senator Clifford P. Case, R.-New Jersey. The two posts rotate between the Senate and the House in alternate Congresses. The Board members from each House select their own Chairman or Vice Chairman, as the case may be.

In providing assistance to the Congress, OTA is to: identify existing or probable impacts of technology or technological programs; where possible, ascertain cause-and-effect relationships; identify alternative technological methods of implementing specific programs; identify alternative programs for achieving requisite goals; make estimates and comparisons of the impacts of alternative methods and programs; present findings of completed analyses to the appropriate legislative authorities; identify areas where additional research or data collection is required to provide support for assessments, and undertake such additional associated activities as may be directed.

Initiation, processing, and flow of assessments.—The Office of Technology Assessment, by statute, is located within and is responsible to the legislative branch of Government. Accordingly, its basic mission is to provide Congressional committees with assessments or studies which identify the range of probable consequences, social as well as physical, of policy alternatives affecting the uses of technology. Requests for OTA assessments may be initiated by:

- (1) The chairman of any standing, special, select, or joint committee of the Congress, acting for himself or at the request of the ranking minority member or a majority of the committee members;
- (2) the OTA Board; or
- (3) the OTA Director, in consultation with the Board.

The authorization of specific assessment projects and the allocation of funds for their performance is a policy responsibility of the OTA Board. The Board has established priority areas of study, and has approved individual assessment projects within those areas. In arriving at these decisions, the Board considers recommendations and plans developed by OTA staff, and applies the following general selection criteria, developed in consultation with the Advisory Council:

- Is this now or likely to become a major national issue?
- Can OTA make a unique contribution, or could the requested technology assessment be done effectively by the requesting committee?
- How significant are the costs and benefits to society of the various policy options involved and how will they be distributed among various impacted groups?
- Is the technological impact irreversible?
- How imminent is the impact?
- Is there sufficient available knowledge to assess the technology and its consequences?
- Is the assessment of manageable scope—can it be bounded within reasonable limits?
- What will be the cost of the assessment?
- How much time will be required to do the assessment?
- What is the likelihood of Congressional action in response to the assessment?
- Would this assessment complement or aid other OTA projects?

The development and performance of each OTA assessment is supervised by a program manager, assisted by other staff professionals with expertise in the subject under study, and by a citizens advisory committee or panel, comprised of persons directly involved with major aspects of the study. Assessments are conducted by OTA program managers and staff with assistance, as appropriate, from panels of experts, consultants, contractors,

and other Congressional information agencies. The approach to a given assessment project can be determined in a variety of ways and may involve exploratory meetings or workshops of advisory panels, staff analyses, and consultant studies.

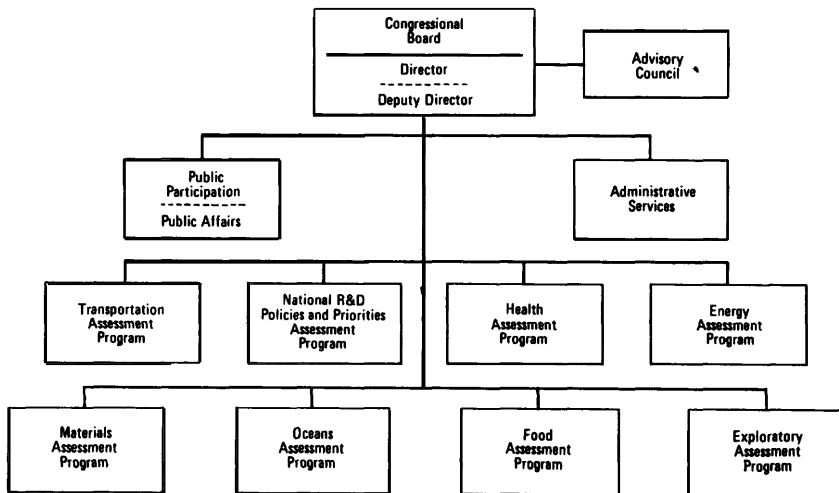
In most instances, assessments are directed by OTA personnel and utilize a task force approach or a series of workshop panel meetings, augmented by contract studies of specific aspects of the overall project.

For assessments which include the resources of an outside contractor, the OTA staff, working closely with its multi-disciplinary advisory group and representatives of the Congressional Committees requesting the study, develops a detailed request for proposals which includes "a statement of work" defining the task or tasks covered by the contract. Qualified parties are invited to submit competitive bids. All proposals received by OTA are considered in the Office's contractor-selection process.

As the assessment or study proceeds, responsibility for its management remains solely a function of OTA. The resources of the associated advisory committee or panel are utilized throughout the entire project. Members and staffs of the interested Congressional Committees also are kept informed on a regular basis of the progress and, as appropriate, the preliminary findings of the study. In many instances, such preliminary information assists Committee staffs in their legislative analyses and preparations for public hearings.

Completed assessments and studies are transmitted by the OTA Congressional Board to the Committee which requested the project, as well as to other interested Committees, and are printed for public dissemination. The Committees of the Congress have first access to OTA assessment results and findings. At the direction of the Board, printing and public dissemination of final OTA reports takes place at the earliest possible date in accordance with arrangements worked out with the requesting Committee (s).

Staffing and organizational structure. The OTA professional staff has been recruited from the academic community, from industry, and from government scientific and technical agencies. With the exception of those officers with overall administrative responsibilities, professional staff members are assigned to specific program areas according to their experience and training. Staff professionals have been drawn from a wide variety of disciplines and backgrounds, including the physical sciences and engineering, the social sciences, the law, and general administration. Skilled professional from Executive Branch agencies, detailed to OTA on a temporary basis, have made major contributions, as have participants in several Congressional fellowship programs. A chart detailing OTA's organizational structure accompanies this section.

OFFICE OF TECHNOLOGY **ASSESSMENT**

Financial and budgeting activities.—Administrative and financial aspects of OTA operations are overseen by an Administrative Officer who reports to the Director. Support functions provided by the Office of Administration include procurement and contracting, budget and financial accounting and control, office management and scheduling, payroll, personnel, travel, office space, security, accounts payable and receivable, reproduction and printing, and other miscellaneous administrative support services.

In response to the growth in demand for OTA assessments, the Technology Assessment Board approved submission of a budget request totalling \$8.5 million for fiscal year 1977. Estimated OTA expenditures during fiscal year 1976, which includes an added quarter to provide transition to an October 1-September 30 fiscal period, total \$8.1 million. A table providing details of OTA's budgetary growth, by program, since the inception of funding in November 1974, accompanies this section.

BUDGETARY HISTORY	Fiscal Year—			
	1974 actual	1975 actual	1976 estimate ¹	1977 request
[Dollar amounts in thousands]				
By program:				
Energy	\$322	\$433	\$1,233	<i>\$1,046</i>
Food	16	268	979	1,099
Health	162	69	1,200	1,040
Materials		1,257	1,083	1,150
Oceans	12	710	904	1, 102
Transportation	472	44)2	1,076	1,119
International trade		56	180	155
R. &D. policies and priorities			253	629
Exploratory	32	177	252	287
General and administrative	331	650	961	873
Total	1,347	4,022	18,121	8,500

¹15-month period, including transitional quarter.

Public participation.—Public participation in the technology assessment process is unimportant OTA objective. In addition to the wide use of citizen advisory groups and consultants, the Office seeks to disseminate information to the various parties at interest in the subject being assessed so they may become more effectively involved in public decision-making processes. In keeping with this objective, meetings of OTA's Congressional Board and Advisory Council are open to the public. Also, the OTA Director is advised by an officer of public participation as well as a public affairs officer.

The Office of Public Participation, reporting directly to the Director, coordinates an overall program of activities to facilitate citizen involvement in the technology assessment process, including the establishment of improved communications with business, industry, citizen/consumer, labor, public interest, professional societies and impacted groups; the creation of out-reach mechanisms; and the instituting of public education programs.

OTA's first full-scale public participation experiment has been conducted as an integral part of the OTA Oceans Assessment Program's regional assessment of the impacts of coastal effects of offshore energy systems for New Jersey and Delaware. Information has been gathered through citizen workshops and through responses to a widely-distributed informational brochure and questionnaire. These inputs are proving beneficial to the overall project by providing valuable insights into public perceptions of the technologies under assessment, while simultaneously increasing public understanding of those technologies. The end result of this activity will be to ensure that citizen viewpoints are considered in the final assessment report.

Exploratory assessment program.—OTA screening procedures for evaluating assessment requests include smaller scale, exploratory assessments undertaken to provide a better basis for decisions by the OTA Board as to whether certain major study projects are warranted.

The OTA program of Exploratory Assessments is established to involve senior staff personnel and consultants in a systematic mechanism for defining and evaluating specific assessment proposals submitted to OTA which do not fall into other program areas. During 1975, preliminary evaluation of the feasibility and value of broadband communications in rural areas was conducted at the request of the Senate Committee on Agriculture and Forestry.

The Exploratory Assessments Program has begun an examination of the requirements and opportunities which science and technology present to the U.S. educational system. Following a three-month planning effort, begun in November 1975, a proposal was developed for a study of long-range trends and shifts in American society which may underlie changes needed in education, including both formal institutional and non-institutional learning, along with their public, private, and commercial aspects.

A third exploratory study was made during the year to design an assessment of the role of U.S. advanced technology as it influences the nation's position in international trade. Comprising a survey of literature and documents, a review of governmental activities, and interviews with public and corporate officials, the survey provided a foundation for structuring a proposed incremental assessment. As a result of this preliminary effort, and building upon the resultant comprehensive information base, plans have been made for specific assessments of the state of U.S. technological competitiveness and U.S. productivity, and the public policy options associated with these issues.

Information services.—OTA technology assessment activities are supported by an Information Services staff, which maintains an in-house library containing basic background materials and current data resources. In addition, this staff maintains liaison with the Library of Congress to facilitate OTA use of its extensive facilities and services.

The Information Services staff also provides on-line access to several computerized data-retrieval networks including: SCORPIO, a Library of Congress system which provides information on current policy-oriented literature and the status of bills introduced in Congress; TRIS (Transportation Research Information Service), a file operated by Battelle Memorial Institute which yields document citations on transportation-related materials; ATS (Administrative Terminal Service), an IBM program available on the Library of Congress Computer which is used for text editing and report generation; and INFONET, a commercial network through which OTA can generate and operate its own computational and analytical programs.

Other activities.—Evaluation of the technology assessment process, as it is being evolved within OTA and elsewhere, is an important concern of the Office. Toward this end, plans were set in motion for two complementary OTA activities to be carried out during 1976. First, an in-house review will be conducted of the various assessment methods and approaches employed by OTA during its first two years. Emphasis will be placed on identifying lessons to be learned from OTA's assessment experiences. Second, national hearings will be held by the OTA Board to develop information on technology assessment activities in the private sector and in other governmental agencies. This activity will build upon the record initiated by the Board during its 1974 hearings to ensure close liaison between OTA and the National Science Foundation.

Along with the Congressional Budget Office (CBO), the Congressional Research Service (CRS), and the General Accounting Office (GAO), OTA is a formal participant in an interagency research notification system, designed to facilitate the coordination of activities and exchange of information among the four organizations, and to avoid duplication of effort. Representatives of the four agencies meet regularly and each of the offices submits bi-weekly status reports on program activity for publication in a central directory of Congressional research activity.

Section III

Activities of the OTA Advisory Council

The OTA Advisory Council, under its Chairman, Harold Brown, and Vice Chairman, Edward Wenk, Jr., worked with the OTA Board and staff during 1975 to further *refine* the ways in which the Council might best contribute to OTA activities. In its role as a general advisory body, the Council presented observations and recommendations to the Board, with particular attention given to OTA assessment priorities, methodologies, and public participation mechanisms. These aspects of the Council's work are discussed in the exchange of correspondence (included as Appendix F to this report) between Council Chairman Brown and OTA Board Chairman Olin E. Teague.

The Council also increased its involvement in OTA program activities, including the planning and organization of the assessment of national research and development policies and priorities, the formation and manning of an ad hoc advisory panel on effects of nuclear warfare, and participation by individual Council members on the OTA program advisory committees for health and energy assessments.

During the report year, Council activities included regularly scheduled meetings of the full membership, joint meetings with the Technology Assessment Board, and special subcommittee and panel meetings. The Council held six regular business meetings in 1975. During such meetings Council members received briefings from OTA program staff and provided advice on ongoing and proposed assessment projects, as well as on more general issues involving OTA operations. Meetings with the OTA Board were regularly incorporated into the Council meetings.

During 1975, the Council continued its subcommittee activities. The priorities subcommittee, chaired by Jerome B. Wiesner, President of the Massachusetts Institute of Technology, issued its final report in May 1975. The report, forwarded to the OTA Board in June, represented 15 months of deliberations; regional and citizen group meetings; and expert panel reviews. The report contained recommendations on procedures OTA might employ in setting priorities among assessment topics, including selection criteria and procedures to involve sources in the private sector in the identification of longer-term issues.

The report also included a listing of specific issues which were brought up at the regional and citizen group meetings as important technology

assessment issues. Attendees at certain meetings stressed the need to look at the more general impact of technology on the political and social processes of the nation. However, the overwhelming majority of the issues fell within existing OTA program areas: food, energy, health, and materials. Other issues that were emphasized, which are not yet separate OTA assessment programs, include communications, land use, and crime control and human safety.

Another specific assignment undertaken by the Council was the establishment of an expert panel to assess Department of Defense estimates of civilian damage effects of a limited nuclear attack. In responding to a request from the Senate Foreign Relations Committee, two Council members played key roles in the panel activities. Wiesner, a former Presidential Science Advisor, established and chaired the panel for the first report. Council Chairman Brown, a former Air Force Secretary and Defense Department Director of Defense Research and Engineering, who is now President of the California Institute of Technology, also served on the panel.

The first panel, meeting in February 1975, concluded that the Department of Defense estimates did not consider all the likely effects of a limited nuclear exchange. The panelists stressed that civilian damage effects are only one element in a larger set of policy questions to be addressed in considering the concept of limited nuclear exchanges. The panel's report suggested that the interests of the Committee would best be served by a detailed request for further information and elaboration submitted directly by the Committee to the Defense Department rather than by having OTA undertake an independent assessment.

Upon further request of the Foreign Relations Committee, the Ad Hoc Panel on Nuclear Effects was reconvened under the chairmanship of J. P. Ruina, a former Director of the Defense Department's Advanced Research Projects Agency and now Professor of Electrical Engineering at Massachusetts Institute of Technology. A second report was issued, in May 1975, which expanded upon the panel's earlier observations and highlighted differences between the proposed Defense Department change in targeting doctrine and previous policy. The report also addressed a series of arms control issues raised by this doctrinal change.

The Advisory Council assisted the OTA staff in its planning for a program of assessments addressing national research and development policies and priorities. In response to a Board request for advice, Wiesner convened an ad hoc panel for a day-long meeting in June 1975, from which the Council developed recommendations as to ways that such an assessment might effectively be conducted through a series of manageable, interrelated studies. Wiesner agreed to assume leadership of a continuing Council role in the oversight of these activities.

Three study areas were identified and advisory panels are being formed: (a) the panel on the health of the scientific and technological enterprise, chaired by Harvey Brooks, Professor of Technology and Public Policy, at Harvard University; (b) the panel on applications of science and technology, chaired by Lewis Branscomb, Vice President and Chief Scientist of the IBM Corporation; and (c) the panel on research and development decision-making processes, chaired by Council Vice Chairman Edward Wenk, Director of the Program in the Social Management of Technology at the University of Washington. (This assessment program is also discussed in Section IV of this report.)

Other Advisory Council members individually involved in OTA program advisory panels based upon their own interests and expertise include J. M. (Levi) Leathers, Executive Vice President of the Dow Chemical Corporation, a member of the OTA Energy Advisory Committee, and Frederick C. Robbins, Dean of the School of Medicine at Case Western Reserve University, who is Chairman of the OTA Health Advisory Committee and who played a leading role in the planning and development of OTA's program of health assessments. Hazel Henderson, Co-Director of the Princeton Center for Alternative Futures, Inc., has provided advice on public participation techniques, in particular those employed by OTA's Oceans Assessment Program. .

At the end of the year there were changes in Council membership and leadership. Ronald R. Davenport, Dean of the Duquesne Law School, joined the Council as a replacement for the retiring Gilbert White, Director of the Institute of Behavioral Science at the University of Colorado. In December, 1975, Brown relinquished the Council chairmanship and subsequently Wiesner was elected by the Council to serve as the new chairman. With Wiesner assuming Council leadership, Brown agreed to direct the Council's participation in the research and development policy and priorities assessment program.

SECTION IV

ASSESSMENT ACTIVITIES

OTA assessment activity has progressed in seven principal areas; energy, food, health, materials, national research and development policies and priorities, oceans, and transportation. During the report year, more than 40 projects were under way in various stages and, in addition to numerous interim reports and Congressional briefings, 14 final reports were issued—11 as OTA documents and three as Congressional Committee Prints. An additional assessment report received final approval by the OTA Board for issuance as a multi-volume set early in 1976. (See Appendix B for complete listing of OTA reports published through 1975.)

During 1975, OTA received 38 new assessment proposals, (see listing in Appendix E, bringing to 73 the total number of Congressional requests received since the inception of the Office. Most OTA assessments are structured to address issues raised in more than one request. Resources available to OTA during 1975 permitted program activity in response to 29 requests, and planning activity for future response to 12 others.

ENERGY PROGRAM

In its consideration of alternatives for increasing the efficiency of national energy consumption patterns, and decreasing the nation's dependence on diminishing supplies of exhaustible fuel resources, the Congress must judge the potential of a large number of energy-related technologies.

The OTA Energy Assessment Program has developed a framework of priorities among several groups of energy issues so that Congressional assessment requests in this subject area can be met in an orderly and effective manner. In addition to analyses of research and development and environmental programs, projects have been undertaken in four principal areas; energy conservation, fossil fuel utilization, nuclear power issues, and renewable energy sources (such as power from the sun).

OTA's program of energy assessments has been designed to seek answers not only to questions regarding the feasibility of various technologies, but also regarding the social, economic, and environmental implications of various options for shifting the nation's heavy dependence upon petroleum and natural gas to alternative energy sources which may prove to be renewable *or* more abundant.

Executive Branch positions on energy issues are, to a large extent, reflected in the program priorities proposed by the new Energy Research and Development Administration (ERDA). Accordingly, the Congressional role in the formulation of national energy policy requires major attention to oversight of ERDA. The OTA Energy Assessment Program has played an important role in developing information and analyses to assist the Congress in evaluating of ERDA's programs and objectives.

OTA also completed an analysis of the impacts of projected natural gas curtailments for the winter of 1975-76, briefed relevant committee staffs, and participated in hearings in November during the drafting of House legislation addressing the natural gas situation.

In December, OTA was asked to assess the Environmental Protection Agency's 5-year R&D plan, in time for budget hearings early in 1976. Patterned after the ERDA analysis, this project was assigned to the OTA Energy Group. For this analysis, OTA planned an intensive examination by workshops of specialists, with the synthesis and final analysis completed within OTA. This project includes an assessment of the environmental agency's socioeconomic research.

The analyses of Executive Branch energy research planning and budgeting served to supplement OTA efforts during the year to set priorities for Con-

gressional energy assessments. A framework of OTA energy program priorities was established, based on recommendations requested from energy-policy study centers at the Massachusetts Institute of Technology, the University of Oklahoma, and the University of Texas, recommendations from the OTA Energy Advisory Committee, and an analysis of the requests from Congressional Committees for assessments of various energy technologies and issues.

Subsequently, OTA began an assessment of technologies for enhanced recovery of oil and gas, and prepared plans to meet Committee requests for assessments dealing with nuclear power safeguard issues, residential and commercial energy conservation, and direct coal utilization technologies. These projects, as well as OTA's ongoing solar electric project, form an increasingly comprehensive program to provide information upon which the Congress can rely in selecting among critical energy options.

Solar/electric.—This assessment, requested by the Senate Committee on Aeronautical and Space Sciences, is concerned with small-scale, on-site use of solar energy in the generation of electricity. It is directed toward determining whether electricity generated in this fashion can be a significant contributor to U.S. energy supplies. Two methods of generating electricity are under assessment: using sun-heated fluids to drive conventional generators, and converting the sun's energy directly to electricity in photovoltaic cells. Both methods can yield waste-or left-over—heat which can be used for heating and cooling.

The assessment, which has provided baseline information useful in other energy assessments, is being performed by OTA with the assistance of contractors and a panel of advisors on solar energy issues. During 1975, the initial drafts of contractors' reports were completed and reviewed by the Solar Assessment Advisory Panel and OTA staff. Changes and revisions to develop specific sets of additional data were undertaken at the recommendation of the reviewers. This project is scheduled for completion in mid-1976.

ERDA budget and program analyses— The House Committee on Science and Technology and subsequently the Senate Committee on Interior and Insular Affairs and the Joint Committee on Atomic Energy have called upon OTA for assistance in assessing the budgetary requests and program planning of the new Energy Research and Development Administration (ERDA). Early in 1975, on a very short time basis, OTA, with the assistance of an ad hoc panel of experts and a team of consultants, prepared an analysis of ERDA's initial budget request.

The report, "An Analysis Identifying Issues in the Fiscal Year 1976 ERDA Budget", published in March, provided background facts and critical questions pertaining to a wide range of energy research issues. During the course of this project, the OTA assessment team worked closely with the staffs of the three requesting Committees and provided briefings to key Committee

members. Two additional House Committees, Appropriations and Interstate and Foreign Commerce, requested and received briefings by OTA staff on this study.

Following the intensive analysis of the ERDA budget, OTA was asked to assess ERDA's long-range plan and program for energy research, development and demonstration. This document, submitted to Congress in July, was analyzed by OTA with the assistance of six study panels, structured to provide a balance of expertise in the fossil, nuclear, advanced technology, conservation, and environmental areas. The sixth panel was formed to address overview issues. OTA staff support was supplemented by contracts with three universities and by consultants to provide additional information on selected topics.

The analysis was begun in July and completed in September. An extensive report, "An Analysis of the ERDA Plan and Program", was published in October and was widely circulated. The report has been utilized in the ERDA oversight deliberations of the Congressional Committees which also had used the earlier OTA analysis of the ERDA budget. In addition, many individual members of the Congress have requested copies of this study, as have Executive Branch officials and a large number of private citizens.

As a follow-on, OTA was requested to prepare a comparative analysis of the revised ERDA plan and program document, submitted to Congress early in 1976, and the ERDA budget request for fiscal year 1977.

Gas curtailment.—This assessment, requested by the House Committee on Government Operations, examined the impacts and extent of the projected curtailment in the delivery of natural gas to consumers in the winter of 1975–76. The assessment was conducted with the assistance of an advisory panel and task force comprised of persons familiar with, and representing industries reliant upon, natural gas supply. Begun in August, the report was completed and forwarded to the requesting Committee in November, at which time it was used in hearings by both that Committee and the House Committee on Interstate and Foreign Commerce. The OTA project staff provided testimony at Committee hearings, in addition to providing briefings to Committee staff personnel.

Enhanced recovery of oil and gas.— This assessment, which began late in 1975, will examine potential means to enhance recovery of known domestic oil and gas resources. The study will include consideration of secondary and tertiary recovery methods applicable to abandoned, existing, and future oil production areas. It will consider economic and institutional aspects of the petroleum industry and its operating environment. The assessment was proposed by Senator Ted Stevens of the OTA Board and is responsive to requests received from the Senate Committee on Commerce, the Senate Committee on Interior and Insular Affairs, and the House Committee on Science and Technology. The final report will identify potential policy options to maximize oil and gas recovery.

Nuclear powerplant fuel safeguards.—Requested by the Senate Committee on Government Operations, this assessment will examine means of providing physical security for the fuel by-products of nuclear power generating plants. The assessment will include an evaluation of other studies inquiring into possible safeguards against unauthorized dispersion of nuclear materials, including those which could be used to produce nuclear weapons. The objective is to provide Congress with an evaluation of alternative safeguard and accountability strategies. Policy alternatives regarding both domestic and exported nuclear power technology will be examined to assist Congress in taking informed and appropriate legislative action. Planning for this assessment began late in 1975.

EPA research and development Plan. —The request for this assessment was received from the House Committee on Science and Technology in December 1975 and, therefore, was in the planning stages as the report year ended. The project will analyze the five-year R&D plan of the Environmental Protection Agency in terms of the effectiveness of the plan as it relates to Federal environmental R&D goals, Congressional mandates, and the regulatory requirements of the agency. The assessment will also examine, for the House Committee on Interstate and Foreign Commerce, the extent to which socioeconomic research is incorporated by EPA into their overall R&D program. Assessment findings were readied for presentation at Congressional Committee hearings in February 1976 with publication of a final report set for late spring.

Residential and commercial energyconservation.— Undertaken at the request of the Senate Committee on Commerce, this assessment was in the project definition stage at the end of 1975. Its objective is to determine the potential for conserving energy in residential and commercial buildings, and the impacts of various incentive policies which might be pursued by the Congress.

Direct coal utilization technologies.—This assessment will evaluate and compare the impacts of different technologies for burning coal. The entire coal energy system will be examined from the resource base through extraction, coal cleaning, transportation, direct combustion, and end energy utilization. An important part of the assessment will focus on technologies, available or being developed, which can increase efficiency and reduce pollutants and undesirable by-products, as well as short-range R&D projects designed to correct problems associated with commercial coal burning. The assessment, in the project definition stage at the end of the report year, is being undertaken at the request of the House Science and Technology Committee.

This assessment complements and will be coordinated with related projects under consideration in OTA's Transportation and Materials Assessment Programs, including assessments of coal slurry pipelines and domestic minerals accessibility.

FOOD PROGRAM

A program of assessments designed to address the informational needs of the Congress in the area of food policy has been developed with guidance from the OTA Food Advisory Committee. Specific assessment activities relate to two significant Congressional concerns: (1) how to identify options available for the better management and use of production technologies and resources; and (2) how to gauge the impact of US. food policies on the nutrition and health of consumers at home and abroad.

OTA's initial assessment surveyed U.S. and worldwide food, agriculture, and nutrition information systems and helped to clarify and place in perspective a number of food-related issues with high legislative priority. This process contributed to planning conducted during 1975 for Congressionally requested assessments which will address:

- Food grading, dealing with issues and policy options regarding the performance of food grading systems as aids to consumer decision making.
- Agriculture research and development, assessing alternative ways to fund and organize high-priority agriculture research and development in such areas as photosynthesis, nitrogen fixation, and plant genetic manipulation; and the implications of increased U.S. support of research in developing countries.
- Food processing, examination the implications of the transfer of food processing technologies to developing countries, including identification of legislative options and alternatives through which the United States might more effectively match technological exports to the needs of developing countries.

Late in the year the OTA Board, at the request of an OTA Board member and three Congressional Committee chairmen, approved an assessment to evaluate options for Congress to consider as it moves toward the formulation of a comprehensive U.S. food policy. This project will address three principal objectives: (1) to prepare and comment upon a statement of the components of a national food policy; (2) to identify, select, and analyze policy and technological issues of concern to Congress in the production, marketing, and nutrition areas of the food system; and (3) to identify, analyze, and apprise Congress of emerging food policy and technological issues.

Plans are under review for an assessment of nutritional status and monitoring to determine the extent of available knowledge about human requirements for nutrients, how these can be measured, and how they relate to

human food-consumption patterns. Also during the year, OTA responded to a request to assess the options for introducing rice-blended foods into the Food for Peace Program.

Food information system.—OTA's food information system assessment explored the elements, such as data on grain production and demand, which are central to policy decisions on resource requirements, domestic food consumption patterns, and nutrition. The study explored the functions of existing information systems, identifying and explaining the relevant data-collecting and data-processing institutions: how they function, how they use technology, how they coordinate with one another, where gaps, bottlenecks, redundancies, and deficiencies exist, and what alternatives might be pursued by Congress to improve them. These options include:

- (1) Strengthening the accuracy and timeliness of the U.S. food and agricultural information systems;
- (2) Expanding the U.S. role in a world food information system;
- (3) Increasing Congressional analytical capabilities;
- (4) Integrating nutrition and consumer interests into the U.S. food information system; and
- (5) Making use of advanced technologies for the management of agricultural resources.

The final report of this assessment, undertaken at the request of Senator Hubert H. Humphrey of the OTA Board for the use of the Senate Committee on Agriculture and Forestry, is scheduled for completion in June 1976. One volume of the report will include comments and recommendations elicited during four days of hearings conducted by the OTA Board, which focused on findings and recommendations of the OTA Food Advisory Committee.

Interest in the results of this assessment has been expressed by five other Congressional Committees: the House Committee on Agriculture, House Committee on International Relations, Joint Economic Committee, Senate Committee on Foreign Relations, and Senate Select Committee on Nutrition and Human Needs.

Alternatives in U.S. food policy.— *This assessment responds to needs expressed by the chairmen of the Senate Committee on Agriculture and Forestry, Senate Select Committee on Nutrition and Human Needs, and the House Committee on Agriculture, who endorsed the original study proposal developed by Senator Humphrey of the OTA Board. The objective of this assessment, approved by the Board in December, is to identify and evaluate a range of options in U.S. food policy. Focus will be on three key sectors of the food system: (1) production, covering requirements from resource inputs to the output at the farm gate; (2) marketing, including processing, wholesaling, and retailing; and (3) nutrition and consumption. The relationship of the policy and programs affecting each element of the system*

will be examined, as will the tradeoffs involved in trying to resolve conflicts that arise between competing goals.

Rice-blending options— OTA Food Program staff-work during the year developed the foundation and refinement of plans for a 1976 assessment of rice-blending options. The project arose out of an initial request from the House Committee on Agriculture that OTA assess the potential for using rice-blended foods in the Food for Peace Program. The preliminary in-house analysis examined the benefits to be derived from a more complete exploration of the social and economic implications of potential changes in U.S. rice policies and programs.

HEALTH PROGRAM

Applications of scientific knowledge in the health field embrace a wide range of technologies which address a variety of medical objectives; diagnosis, disease prevention, therapy and rehabilitation, organization of services, and support of patients. These technologies take the form of both hardware (equipment and facilities) and software (methods and skills). In developing a comprehensive program of assessments dealing with health issues, the OTA staff has defined medical technology as "the set of techniques, drugs, equipment, and procedures used by health professionals in delivering clinical medical care to individuals and the organizational systems within which such care is delivered."

Following completion of an assessment of technological issues related to the bioequivalence of drug products, the OTA Health Assessment staff identified five study areas pertinent to concerns of the Congress and deemed of high priority by an ad hoc panel of advisors concerned with many aspects of medical practice and health care delivery. These areas, in which applications of technology have a bearing upon the cost and quality of health services, are: medical technology development, drug utilization and effects, medical record-keeping and health information systems, technological involvement in medical malpractice, and the utilization of medical technologies in hospital outpatient departments.

The OTA program of health assessments responds to increasing Congressional concern over rising costs and uneven quality in the delivery of medical services. In assessing health technologies, emphasis is placed on both technical issues, including the safety and efficacy of the measure or system under study, and social issues, which can result from special features of the technology itself or from the economic burden it imposes on society. The OTA program staff and advisory panels work closely with other Legislative and Executive Branch agencies and utilize appropriate information which they are able to provide.

Development of medical technologies.—This assessment, originally requested by the Senate Committee on Labor and Public Welfare, addresses concerns that costly new medical technologies and procedures may be put into use without adequate justification or full understanding of their impacts. The assessment will consist of four parts: (1) a study of biomedical research and technology development, to explore the feasibility of assessing the social impacts of medical technologies in formative stages; (2) an assessment of a specific technological innovation—the computerized axial tomography

(CAT) scanner—recently introduced into use; (3) a study to determine whether *new* methods or mechanisms are needed to assure the effectiveness of new medical technologies, and (4) a study of means to weigh the projected costs of medical technologies against the value of their expected uses.

The Committee asked OTA to examine questions as to the effectiveness, appropriateness, cost, and risk to patients, of medical technologies, the development and application of which increasingly involve Federal funds. Typical of such questions is the choice of a proper balance between measures which may, in the long-term, preserve health and prevent illness for many, and those which may save lives and postpone death for a comparatively few persons seriously ill at present.

The first of the four studies, dealing with the feasibility of assessing developing technologies, was scheduled for completion in mid-spring, 1976. The second assessment, examining the CAT Scanner, was requested by the Senate Finance Committee for the use of its Health Subcommittee, and was scheduled for completion in early summer, 1976. The remaining segments of the assessment were projected to be completed during 1977.

Drug utilization and adverse drug effects— Requested by the House Committee on Ways and Means, this assessment will examine major factors leading to the inappropriate use of perhaps the most pervasive of medical technologies—drugs. The study will focus on prescribing practices of physicians, labeling and instructions included in the packaging of drugs, and consumer responses to prescriptions and professional advice about the use of medication. The assessment also will devote special attention to adverse drug effects, their origin, their incidence, and prospective approaches for more effectively controlling them.

The objective of the assessment is to examine alternative actions or strategies for achieving safer, more effective, and more economical utilization of drugs and medication administered for therapeutic purposes. Included among the policy alternatives to be studied are peer review mechanisms for health professionals, drug utilization review systems, expanded dissemination of information about drug effects and proper drug usage, and improved monitoring systems for documenting the incidence of adverse drug reactions.

The assessment will concentrate on the use of prescription drugs, with lesser attention given to the role of drug products sold “over the counter,” without prescriptions. For purposes of this study, the abuse of alcohol and illegally obtained drugs will not be considered.

This assessment is scheduled for completion in mid-1976.

Hospital outpatient services.— At the request of the Senate Committee on Finance, OTA is undertaking an assessment of the various types of medical technologies employed in hospital outpatient departments, the utilization and costs of such technologies, and their effect on total costs and efficiency of health care delivery.

As an initial step, the OTA staff conducted a critical review to determine the adequacy of available information about the prevalence, utilization, and costs of outpatient department technologies, and to identify research needed to improve understanding of this phase of hospital care. Additionally, the staff examined possible methods for reducing costs or improving efficiency through dispersing or decentralizing certain hospital-based services.

Among the issues to be assessed are the ways that patterns of outpatient care are influenced by Federal health care financing programs. The study will seek to identify options, including possible changes in the reimbursement structures of Medicaid and Medicare, for making more efficient and effective use of medical technologies commonly employed in hospital outpatient departments.

An initial report is planned in the fall of 1976, with completion of the project expected in mid-1977.

Medical records and health information.— This assessment, requested by the Senate Committee on Labor and Public Welfare, will examine technological advances in automated medical recordkeeping and health information systems and their potential for enhancing the quality of medical care.

The study will include consideration of information systems needed for health care research, planning, and management at various institutional and governmental levels.

The assessment will examine the need to safeguard the privacy of individuals, as well as other considerations and possible constraints which might effect the achievement of maximum benefits, and most efficient use, of medical and health recordkeeping systems and technologies. This project is scheduled for completion in the latter part of 1976.

Medical malpractice.—This assessment will examine the extent to which applications of medical technology result in medical injuries and subsequent malpractice litigation and will seek to identify and analyze alternatives for reducing the incidence of such technology-related injuries. The project also will evaluate the cost and appropriateness of so-called “defensive” applications of medical technology, employed primarily in the interest of avoiding malpractice litigation. At year's end, staff was being recruited for this project, “ which is to be performed in response to a request from the House Committee on Ways and Means.

MATERIALS PROGRAM

Activities of the OTA Materials Assessment Program in 1975 were carried out in accordance with a comprehensive plan based on Congressional requests ranked in priority by OTA, with the advice of its Materials Advisory Committee. The program centered on materials information systems; national stockpiling policies; domestic minerals accessibility; resource recovery, reuse, and recycling; and materials conservation through reduced wastage.

A second series of materials assessments, scheduled for start-up in 1976, will focus on projected demands for various critical commodities, and alternative approaches for meeting those demands or dealing with shortages which may result from them.

A major assessment, under the heading, "Alternative Responses to Materials Shortages," will examine the consequences of various policy responses to specific potential shortage situations. Among the types of responses to be considered are short-term dependence on stockpiles; development of substitutes; development of domestic sources, and political actions to assure availability of imports.

A second key assessment will assess the potential impacts of materials limitations on near- and long-term solutions to the nation's energy problems. Many future energy systems will present major materials demands for such purposes as construction of mines, oil and gas fields, transport systems, refineries and coal conversion plants, electrical conversion and distribution networks, and energy storage facilities. Thus, information as to the availability or limitation of materials is essential to national energy policy decisions.

Two other assessments will focus on specific areas of materials technology which will be of increasing importance in meeting future needs. One will examine ways to alleviate import dependencies through the development of substitute materials or processes. The second will focus on mineral exploration technologies, such as drilling, seismic, remote-sensing, or other techniques which may be required to enhance the *recovery* of domestic resources not now accessible.

Planning was initiated during 1975 for five additional materials assessments which will deal with the following topics: recovery of metals from low grade ores; oceans mineral recovery; marine disposal of wastes; industrial energy conservation, and materials limitations in transportation systems.

Because of overlapping concerns and capabilities, the planning and execution of materials assessments is being undertaken in close coordination with other OTA assessment programs. Current plans of the Materials group include cooperative assessment projects with OTA's Energy, Transportation, Oceans, and National R&D Policies and Priorities program groups.

Guidance in the development and monitoring of these assessments has been afforded by the OTA Materials Advisory Committee with additional support provided by professional societies in the materials field, the Congressional Research Service, and background studies by the National Commission on Materials Policy and the Committee on Materials Science and Technology of the National Academy of Sciences.

Preliminary results from OTA's materials assessments have been made available, through background briefings, to interested Congressional Committees and the four Congressional Members of the National Commission on Supplies and Shortages.

National stockpiling policies.—This project assessed the possible use of a national materials stockpile for broader purposes than national security in order to avoid future economic dislocations. The assessment analyzed the causes of materials shortages and identified eleven specific public purposes which stockpiling might achieve. For the five policies judged most important, a new type of cost/benefit model was developed and used to estimate the gains or losses in domestic economic welfare which might result from implementation of a given stockpiling policy. Complementary analyses examined social, political, environmental, and legal impacts.

Undertaken at the request of the House Committee on Science and Technology, the assessment was managed by OTA with the assistance of contractors. The final report is due early in 1976, and is expected to be useful to the National Commission on Supplies and Shortages, as well as to the House Committee on Banking, Currency, and Housing and the Senate Committee on Banking, Housing, and Urban Affairs in their deliberations on economic stockpiling legislation.

Conservation through reduced wastage— This project will assess the potential for materials conservation by extending the durability of products with focus on technologies to control corrosion and wear processes. The scope of the initial assessment is limited to certain primary materials (iron and steel, aluminum, copper, chromium, and nickel) and products (automobiles and automobile spare parts, major consumer appliances, bridges, metal cutting machinery, and tools, aircraft, reaction vessels for the chemical industry, heavy construction equipment, and railroad rolling stock).

The assessment, requested by the Senate Committee on Commerce, is being conducted in two parts, and is scheduled for completion in the fall of 1976. The first part of the assessment, begun in 1975, centers on engineering analyses to define the state of the technology. A workshop on wear reduction to provide a forum for the presentation of information and view-

points from a mix of technologists, consumers, industrial representatives, manufacturers, retailers, academicians, and professional societies was held in February 1976. The second part of the assessment will comprise a public policy analysis including legislative options and their associated impacts.

Domestic minerals accessibility on Federal lands— This assessment was requested by Senator Ted Stevens of the OTA Board for the use of the House and Senate Committees on Interior and Insular Affairs. The objective of this project is to examine Federal and State influences on access to minerals located on Federal lands. Further objectives include determining the potential contribution of Federal lands to domestic mineral supply, formulating alternative legislative strategies and options, and assessing the impacts of these strategies. The staffs of the interested Congressional Committees were briefed at regular intervals during 1975 and a formal, first phase report was scheduled for publication in early 1976.

Materials information system.—Requested by the House Committee on Science and Technology, this project assesses optional methods which could provide decision-makers with earlier and more complete information on the supply and potential shortages of materials critical to the economy of the United States. The assessment examines the needs, character, institutional structure, and effects of a materials information system which spans the technologies of supply, processing, and use.

During 1975, briefings were provided for the requesting Committee and two other Congressional Committees with interest in the subject: the House Committee on Banking, Currency and Housing, and the Senate Committee on Commerce. OTA staff also briefed the staff of the National Commission on Supplies and Shortages on the progress and interim results of the assessment. OTA testimony, derived from this assessment, contributed to Senate consideration of the National Resources and Materials Information Act.

Resource recovery, recycling, and reuse— This assessment, requested by the House Committee on Science and Technology, also will serve the interests of the Senate Committee on Public Works, the House Committee on Interstate and Foreign Commerce, and the House Committee on Ways and Means. It is examining the technological, economic and institutional barriers to resource recovery and management of solid waste, and will assess the impacts of pursuing various legislative options for surmounting those barriers.

The project is being conducted in two phases. During the report year, OTA staff analyzed the barriers to resource recovery and completed substantial work on the description of legislative options. The report on this phase of the work is scheduled for the spring of 1976. The second phase will examine the impacts of the options described in the first, and is to be reported late in 1976.

NATIONAL R. & D. POLICIES AND PRIORITIES PROGRAM

The Federal Budget for fiscal year 1977 calls for \$24.7 billion in expenditures for research and development activities and facilities. In addition, it is estimated that the private sector may spend upwards of another \$20 billion on R&D during this period. The significance of these expenditures to the economy and society, however, far exceeds the dollars involved, because R&D expenditures have a large multiplicative effect in stimulating economic activity.

For these reasons, the Committees and individual Members of Congress require increasing knowledge about the effects of Federal R&D expenditures, about Executive Branch policies with regard to R&D priorities, and about legislative options for maximizing R&D benefits to the nation. Accordingly, OTA has received requests for, and expressions of continuing interest in, this assessment from seven Congressional units: the House Committee on the Budget, the House Committee on Science and Technology, the Joint Economic Committee, the Congressional Budget Office, the Senate Committee on the Budget, the Senate Committee on Commerce, and the Senate Committee on Aeronautical and Space Sciences. In addition, several members of the Technology Assessment Board strongly urged the initiation of this program.

Because of the extremely broad scope of these issues, the Board requested the OTA Advisory Council to make an intensive study and recommend whether such an assessment was feasible and how it might best be structured. The Council's deliberations on this subject included the convening of a panel of leaders from education, industry, government, and public interest groups to discuss approaches to such a study. The Council transmitted its formal recommendations to the OTA Board which took action in October to authorize an assessment program in this area.

The following program approach was approved by the OTA Board: (1) The National R&D Policies and Priorities Program was established as a continuing OTA core assessment program which is expected to help integrate and reinforce OTA's other assessment programs in specific areas. (2) Because of the central role of this assessment in the performance of the OTA mission, the Advisory Council will provide general guidance and oversight for this program. (3) In addition, three advisory panels are being established to concentrate in detail on three major R&D issues:

Ž The health of the scientific and technical enterprise.

- The applications of science and technology.
- The decision-making processes for establishing R&D policies and priorities.

An initial series of studies in 1976 will establish OTA's data base in this field and build an OTA professional team with competence in dealing with these issues. The assessment team is to include OTA staff, panelists, special consultants, and contractors. It is intended that full use will be made of existing data resources provided by the Congressional Research Service, the General Accounting Office, the National Science Foundation, the National Bureau of Standards, and other public organizations, as well as available data resources in the private sector.

OCEANS PROGRAM

The traditional roles of the oceans, as providers of food and pathways for world shipping, are growing increasingly complex as new technologies evolve, not only in the areas of fisheries and marine transportation, but in the active field of exploration and recovery of energy and mineral resources.

The multiple demands now being made on the oceans' resources are reflected in the overall OTA Oceans Assessment Program, which was broadened during 1975 to meet Congressional needs for information affecting a wide range of marine-related legislative issues. Oceans assessments now under way or planned will interrelate, as appropriate, with activities of OTA's Energy, Food, Materials, and Health programs.

Two projects planned for initiation early in 1976 will involve cooperation with the OTA Energy Assessment Program. One will examine alternative technologies for extracting energy from renewable resources. Such technologies span a wide range of new and proposed systems for harnessing the tidal and thermal gradients of the oceans, tapping the potential in salinity differentials, or converting artificially raised kelp to energy and power. The second will assess the demand for new energy facilities and the factors associated with their siting, particularly in the coastal zone. It will examine the long-range impacts of energy facilities on the geographic distribution of population growth. This project is the first stage of an incremental approach to the assessment of national growth policy, as recommended by the OTA Advisory Council.

Since the oceans are a major source of protein, an assessment of fisheries technologies was initiated during the year and plans were made to extend this study, with support from the OTA Food Assessment Program, to include a broader set of aquiculture issues.

As land-based supplies of certain key hard minerals decline, there is increasing interest in identifying potential ocean mineral resources. Large beds of manganese nodules, some of which are rich in copper and nickel, have been identified in the deep ocean, and major supplies of other minerals may be identified in the shallow waters of the continental shelves. The Oceans Assessment Program, with support from the OTA Materials Assessment Program, plans an assessment of ocean mineral recovery, to begin late in 1976,

Another important oceans issue being examined for possible assessment is the increasing use of the seas as a repository for wastes. Plans for such a study call for it to be conducted with support from the OTA Health Assessment Program.

OTA's initial series of ocean assessments focused on energy-related issues; offshore oil and gas recovery, coastal-siting of floating nuclear power plants, and deepwater ports for large oil tankers. An on-going study of the coastal effects of offshore energy systems, brought near to completion at the close of 1975, provided basic information sources for three subordinate assessments completed during the year to support legislative and oversight activities of various Committees of the Congress. These projects dealt with oil transportation by tankers, the separation of offshore oil exploration from development, and impacts of accelerated leasing of outer continental shelf oil and gas locations.

Fisheries technologies.—This assessment begun in September 1975, is examining the probable impacts of extending from 12 miles to 200 miles the limit of U.S. fisheries jurisdiction. An interim status report, completed at year's end, served as a basis for further definition of the scope of the study and further refinement of plans for its conduct. The assessment is scheduled for completion in September 1976, with a follow-on study on aquaculture. The aquaculture assessment will examine the probable effects of developing and implementing new technologies for farming the ocean, in both coastal and more distant offshore regions. This assessment was requested by the House Committee on Merchant Marine and Fisheries and the Senate Committee on Commerce.

Coastal effects of offshore energy systems.*This* assessment is examining the impacts to be expected from the potential introduction of three offshore energy technologies; deepwater ports, offshore oil and gas exploration and development systems, and floating nuclear power plants. The assessment focuses on the New Jersey-Delaware coastal area, a densely populated region concentrated with industry and shoreline activity. (The Baltimore Canyon Trough, located in the Atlantic Ocean some 60 to 100 miles off the coast of the two states, already has been selected as a prime area for new oil and gas exploration,)

The assessment is being performed for the Senate National Ocean Policy Study and the Senate Commerce Committee. During the year, the requesting committees were informed of interim findings from the assessment and an initial report was scheduled for publication early in 1976. A project on public participation was carried out as an integral component of this assessment to assure that no factors considered relevant or important by citizens in the affected region were omitted from the scope of the study. Information about the assessment was made available via news media, a special brochure, and workshops, and citizen views were solicited for consideration in the parent assessment.

Outer Continental Shelf oil and gas development.—Two reports, based in large measure on information developed for the assessment of coastal effects of offshore energy systems, were made available to the Congress during 1975. Both addressed issues raised by Executive Branch plans to acceler-

ate offshore oil and gas leasing, including the question of how best to assure a proper return to government from the leasing of resources on public lands. OTA Oceans Assessment Program personnel worked with the staff of the National Oceans Policy Study to produce a study entitled, "An Analysis of the Department of Interior's Proposed Acceleration of Development of Oil and Gas on the Outer Continental Shelf," which was published in March and used by the Senate Committee on Commerce in hearings on that subject.

A second report, published by OTA, examined and compared several alternate systems of exploring for and developing offshore oil and gas resources. Requested jointly by the Senate Committees on Commerce and on Interior and Insular Affairs, the assessment sought to examine the feasibility of obtaining more complete information about the extent and location of Outer Continental Shelf petroleum reserves, prior to the fixing of production commitments. Such information is needed for State coastal zone planning, for Federal energy policy planning, and for calculating an equitable return from the leasing of public lands. The report, "An Analysis of the Feasibility of Separating Exploration From Development of Oil and Gas on the Outer Continental Shelf," was completed in May for use in Committee briefings. Its findings were cited during Senate floor debate in July on a bill to amend the OCS Lands Act.

Marine oil transportation by tankers.— This assessment investigated various impacts and problems resulting from oil transportation by tankers in U.S. waters, and identified legislative options to promote tanker safety and reduce pollution. Requested by the Senate Committee on Commerce for use in its oversight of the Ports and Waterways Safety Act of 1972, a report was published in July and used by the Committee in planning hearings set for early 1976. The report "Oil Transportation by Tankers-An Analysis of Marine Pollution and Safety Measures," examines the consequences of proceeding with existing technologies, training programs, and government regulation of tankers, and identifies alternative courses of action.

Much information for this project was developed in the core assessment on coastal effects of offshore energy systems. The Senate Committee circulated the report to coastal state officials in order to elicit their views and concerns about pollution and other problems attendant to tanker operations. The OTA Oceans Assessment Program staff completed this assessment with the assistance of an ad hoc panel of representatives of the technologies and public interests involved.

TRANSPORTATION PROGRAM

Congressional concerns about the safety, economic, and energy implications of the nation's systems for moving people, goods, and information formed the basis for a program of ten OTA assessments during 1975 dealing with the efficiency and effectiveness of various transportation alternatives and their related planning processes. Preparations were made for additional assessments to begin in 1976.

The range of transportation questions being addressed by OTA extends from the interrelated issues of private automobile and public mass transit use in urban areas, to broad issues of the future functions of such diverse modes and alternatives for movement as automobiles, railroads, pipelines, and telecommunications technologies.

Work was completed in 1975 on a group of four assessments dealing with separate urban public transportation issues; new hardware technologies which operate on "automated guideways", potential impacts on energy demand and the economy, community planning, and the state of the art of automated controls for rail transit systems.

A group of three reports, completed by OTA in 1975, addressed the economic problems and the need for rehabilitation of the nation's railroads. These assessments figured prominently in House and Senate deliberations on, and are cited in the legislative history of, the Railroad Revitalization and Regulatory Reform Act, which became law on February 5, 1976.

The automobile is the subject of two OTA studies, one a short-term analysis of the need for further data on the causes of injuries in auto accidents, and the second a comprehensive project to explore potential changes in the role and use of the automobile and its physical characteristics in both the near and distant future. The study on automobile collision data was completed in 1975 and contributed to Congressional action approving funds for improved methods of data collection. The comprehensive automobile assessment was begun late in the report year.

Anticipated future activity of the OTA Transportation Program includes expanded study of potential strategies for reducing travel needs through increased exchange of information and ideas via telecommunications. Other OTA assessments under consideration for 1976 would address the transportation of coal slurry by pipeline, the related topics of railroad productivity and the shipment of freight via large trucks, and a joint effort with the OTA Energy Assessment Program to investigate possibilities for energy conservation within the transportation field.

Automated guideway transit.—The objective of this assessment was to assess the potential for personal rapid transit (PRT) and simpler forms of automated guideway transit (AGT) systems to provide passenger service in urban areas of the United States.

The assessment defined three classes of AGT systems and analyzed experiences with, and impacts of, such systems here and abroad. Special emphasis was given to technical feasibility and the social and economic impacts of these new technologies. The assessment was performed by OTA with the assistance of five panels of knowledgeable individuals. A staff member from the Congressional Research Service of the Library of Congress participated in the assessment. OTA's Urban Mass Transit Advisory Panel reviewed the study.

The final report was completed in May. The five panel chairmen, consultants, and OTA staff testified in June before the Transportation Subcommittee of the Senate Committee on Appropriations, which requested this assessment. The Urban Mass Transportation Administration (UMTA) responded to the report in hearings before the same Committee in July. The Senate Committee restructured UMTA's budget for new systems research and development in accord with one of the alternatives presented in the OTA report, and a House-Senate Conference accepted the suggested changes at a lower funding level.

Community planning for urban mass transit.— This assessment examined the processes by which communities select or reject, plan for, and implement rail rapid transit systems in conjunction with other transportation forms, both public and private. The assessment, completed in November, was based on nine metropolitan area case studies: Atlanta, Boston, Chicago, Denver, District of Columbia, Los Angeles, Minneapolis-St. Paul, San Francisco, and Seattle. A comparative analysis was conducted which yielded findings on Federal transportation policy, technical planning guidelines, financing, and local and regional organization.

An interim report on mass transit financing was completed in March 1975 for use by the Senate Committee on Appropriations in hearings on a supplemental budget request from the Urban Mass Transportation Administration. The final report will be reviewed during special hearings set by the same Committee. In addition, the assessment included a review of proposed Administration policies for mass transit investments and provided background information for the House Committee on the District of Columbia in its oversight of the Washington METRO transit system. The Senate and House Budget Committees have requested the study for their analyses of urban transportation budgetary issues.

Energy, the economy and mass transit.— At the request of the Senate Appropriations Committee, a short-term study was derived from the Community Planning assessment which addressed: (1) the interrelationships between the cost and availability of fuel and transit patronage; (2) the effect

on unemployment of increased expenditures for transit; and (3) the interrelationships between transit incentives and disincentives on automobile use.

OTA assessment participants provided testimony before a special hearing of the Senate's Transportation Appropriations Subcommittee in June. A summary report was prepared to support those hearings and was used by the Senate Committee on Public Works to strengthen its hearing record for the extension of the Federal Highway Act Authorization. The Senate Committee on Budget has made use of this study in reviewing urban transportation financial issues. The final printed report has been circulated widely.

Automatic train control for rail rapid transit.—This Assessment, requested by the Senate Appropriations Committee on behalf of its Transportation Subcommittee, examined the extent to which various levels of automation may be technically feasible, economically justifiable, or other wise appropriate for rail rapid transit. The assessment analyzed and evaluated development, testing, and operation of automatic train control (ATC) systems with respect to safety, security, reliability, maintainability, role and function of the human operator, economics, performance, and costs.

The assessment report was completed in December. In addition to the Senate Committee on Appropriations, the House Committee on the District of Columbia has also requested the report to provide background for oversight hearings on the Washington METRO system. Washington METRO was one of the transit *systems* analyzed in the report.

Railroad assessments.—Three related assessment reports were completed during the year in response to requests from Congressional Committees involved with legislation addressing the health of the nation's railroads. A report, "The Financial Viability of ConRail," provided for the House and Senate Commerce Committees, examined the plan prepared by the United States Railway Association for reorganizing the bankrupt Northeast Railroads. A second report, "Rail Rehabilitation Approaches," requested by the Senate Commerce Committee, was prepared as a companion to the ConRail analysis and identified alternative approaches for stimulating needed railroad improvements. A third report, "National Railroad Issues," prepared for the Senate Commerce Committee and the House Interstate and Foreign Commerce Committee, examined a broad range of national railroad issues, analyzed existing rail legislation, and summarized the findings of a number of prior rail studies. Besides being used in hearings on the Rail Revitalization Act, all three reports have been utilized by the Appropriations and Budget Committees of the House and Senate. Although none of these reports is a complete technology assessment in itself, the group provides a basis for a more comprehensive assessment of the role to be played by railroads in meeting the nation's overall transportation needs.

Automobile collision data.—The assessment on Automobile Collision Data was requested by the House Committee on Appropriations on behalf of its

Transportation Subcommittee to determine the need for better data relating collision forces with occupant injuries. Alternative data gathering programs, including those proposed by the National Highway Traffic Safety Administration, were assessed for appropriateness, effectiveness, and efficiency. The study was performed by OTA with the assistance of a contractor. A two day workshop in Washington drew together academic, industry, public interest, and government participants to evaluate existing automobile collision data and methods for collecting additional information of pertinence.

The final report, submitted in March 1975 for use by both the House and the Senate Committees on Appropriations, provided documentation which supported appropriations for additional automobile collision research.

Changes in the use and characteristics of automobiles.— At least eight Congressional bodies, including the House and Senate Commerce, Public Works, Appropriations, and Budget Committees, have expressed interest in OTA's "Assessment of Changes in Use and Characteristics of Automobiles" begun in December 1975 in response to a request from the Senate Commerce Committee's Subcommittee on the Environment.

The design of this assessment, which will attempt to identify and evaluate the impacts of potential changes in the automobile and its role in society, between now and 1985 and in the post-1985 time period, was developed in a 5-month OTA planning study begun in July 1975. The automobile transportation system as it now exists in the United States will be examined, and comparisons will be made with foreign systems. Such factors as the future availability of fuels and materials, and possible shifts in public attitudes, will be studied in connection with public policy alternatives which might affect the automobile and its use.

In carrying out this project, the OTA Transportation Program staff will be assisted by personnel from OTA's Energy and Materials Assessment Programs as well as by consultants and panelists representing a wide range of interests, including the automobile and petroleum industries, public safety officials, consumer advocates, environmentalists, and urban planners. The National Science Foundation will cooperate in the study.