Annual Report to the Congress for 1978

March 1979



annual report

To The Congress for 1978

CONGRESS OF THE UNITED STATES

Office of Technology Assessment

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Section I

DIRECTOR'S STATEMENT

Section I
DIRECTOR'S STATEMENT

The Office of Technology Assessment is coming of age. Its record of producing authoritative, even-handed assessments of the social, environmental, economic, and political impacts of technological applications is increasingly attracting favorable attention, not only from Members of Congress, but from other Government and nongovernment organizations, private enterprise, the press, and from foreign countries.

Many changes have taken place at OTA during 1978: new quarters, new management, new organizational structure, a new method of establishing project priorities, a new ONE-PAGER digest of each report issued, greater outreach. and dinner-seminars. I'll touch briefly on these and other items of special note in this statement.

OTA moved into its new quarters at 600 Pennsylvania Avenue southeast of the Capitol just as I assumed the job as the second Director of OTA, succeeding Mim Daddario. The new offices have made it possible for staff members to work together more effectively and thereby bring their interdisciplinary skills to bear on our broad, comprehensive assessments.

When the year began, 24 members of the staff of 130 were reporting to the Director. Since then, OTA has been restructured into three major divisions, each headed by an assistant director who reports to me.

The three divisions have been designated as: (1) Energy, Materials, and Global Security; (2) Health and Life Sciences; and (3) Science, Information, and Transportation. The program areas which fall within each of these divisions are shown in the chart on page 75.

Lionel S. (Skip) Johns, formerly Energy Program Manager at OTA, was promoted to Assistant Director in charge of the first division. Dr. Joyce Lashof, a medical doctor who was formerly Deputy Assistant Secretary at the Department of Health, Education, and Welfare and, prior to that, Professor of Preventive Medicine at the University of Illinois and a member of the Governor's cabinet in Illinois, was named Assistant Director for the second division. A geophysicist, Dr. Eric H. Willis, accepted appointment to head the third division. He had been Deputy Assistant Secretary for Energy Technology at the U.S. Department of Energy, Assistant Administrator for Institutional Relations at the Energy Research and Development Administration, and Director of Nuclear Monitoring Research at the Department of Defense. Dr. Willis also has had experience directing research at the University of Cambridge and in industry as Vice President and Director of Research for Teledyne Isotopes.

This major reorganization was made easier by the increased authority given to the Director by the Board, Their cooperation has been essential in redirecting OTA's energies.

Renewed emphasis was placed on staff training. An employee orientation program has been developed using videotaped films featuring experienced OTA professional staff members who describe the overall OTA process. In-house training sessions are conducted to orient employees on the management of an assessment

project. Biweekly seminars were established to permit project leaders to submit the status of their current projects to the review of their peers. A senior editor was hired to upgrade the quality of our reports. To keep our OTA family better informed, a monthly newsletter was launched.

The OTA Congressional Fellowship Program, established in 1977 with the appointment of three Fellows in the health area, was broadened to include other disciplines. This year eight Fellows, selected from a nationwide competition, were assigned to various program areas. Among the disciplines represented are: physics, economics, oceanography, biochemistry, ecology, psychology, and the law. The Fellowship Program is designed to provide opportunities for individuals with outstanding ability in research or management to gain a better understanding of the way in which the Congress establishes national policy related to science and technology areas.

Until this year, nearly all assessments undertaken by OTA have been in response to requests from chairmen or ranking minority members of congressional committees. In an effort to fulfill to a larger extent our mandate to provide Congress with "early indications" of the beneficial and adverse impacts of technological applications, we undertook in the spring of 1978 a major program to develop a priority list of issues of critical concern to the United States and the world. From this list we will select items for specific project proposals for Board approval.

This priority-setting exercise involved soliciting suggestions from many sources in the broad community—from members of the Technology Assessment Board, from the Congressional Research Service and the General Accounting Office, from congressional committee staffs, from businesspeople, academicians, futurists, private citizens, as well as OTA staff members. The Technology Assessment Advisory Council played a principal role in the development of the list—defining criteria for selection, proposing projects, and reviewing and critiquing the list.

The more than 1,400 responses that were forthcoming were evaluated, summarized, and sorted out according to these criteria:

1. Does the assessment involve the impact of technology?
2. Is there congressional interest?
3. Does the technology have a significant impact on human needs and quality of life?
4. Would the assessment provide foresight?
5. Can OTA do the assessment?

By the year's end, OTA's first official priority list of 30 items had been compiled with short writeups on each one. The list appears on page 69 of this report. All items on the list are emerging technological issues that Congress is likely to face and that involve decisions affecting the lives of this and future generations. It is planned that the list will be revised at least annually.

To improve OTA's ability to respond to the needs of congressional committees, we have inaugurated the procedure of meeting regularly with the staffs of all committees. By year end, we had pretty much completed the first round of such meetings. Out of the closer relationship resulting from these meetings, OTA's important responsibility to committees can be more effectively met.

Seventeen new projects were initiated this year. The new projects cover a wide range of technological applications and take OTA into several new areas—telecommunications, the military, genetics, world trade, and space. A complete list of ongoing assessments is given on page 86.

A major broad study of the national R&D enterprise, which was previously directed by the Technology Assessment Advisory Council, was reassigned to the Director and focused on three studies: "Federal Regulations and Technological Innovation, " "Technology and Local Development, " and "The Impact of Technology on Inflation. Productivity, and Employ merit."

Fifteen assessment reports were completed during 1978. They are listed on page 87.

To assure that projects approved by OTA's Board are delivered on time, within cost, and with high quality and technical excellence, new management and budgetary accountability procedures have been set up. They require that once an assessment project budget has been approved by the Board, any significant change in the budget or time schedule must be taken back to the Board for approval.

OTA continued to be limited during 1978 to a ceiling of 130 salaried employees, plus 10 additional professionals for the alternative energy futures assessment. This provides for about 65 professionals for assignment to the assessments—too few to properly handle the many projects in widely diversified fields we are asked to cover. Each project leader with only one or two other professionals must define the project, sign up and work with an advisory panel of 15 to 25 experts from around the country, hire and supervise consultants and contractors, integrate the inputs from many sources—including other Government agencies—write the reports in an even-handed, comprehensive, authoritative, arid readable manner, and maintain close contact with the several congressional committees interested in the project.

In all, OTA obtains assistance from more than 600 advisory panelists, 140 consultants, and numerous contractors. I have been gratified to observe the high percentage of experts in the private sector who are eager to accept when invited to serve on our advisory panels. They describe OTA as an effective conduit for providing Congress with objective, nonpartisan information. and find participation in our holistic, long-term, integrative assessments a valuable learning experience, one that better fits them for decisionmaking in their own field. Thus, in the process of fulfilling its statutory assignment of advising Congress, OTA also appears to be speeding and strengthening the development of more holistic approaches to issues and problems in our pluralistic society.

Another important source of expertise, particularly on social values and attitudes, is obtained through broad public participation—providing citizens' groups and individuals who are likely to be affected by a technological application to have inputs to OTA's assessments. This year we conducted training courses and workshops for OTA staff members to help them better understand both the rationale and the methods of public participation, to define its objectives, and to provide the staff with adequate tools for carrying out this part of our assignment.

In appreciation of the great demand for the time of Members of Congress, we developed the technique of providing them with an OTA ONE-PAGER for each

report we issue, so that they and their staffs can see in 2 to 3 minutes what the report covers. This approach has markedly increased the awareness of our product and the demand for it.

The composition of the Technology Assessment Board has changed during the year. Senator Adlai Stevenson of Illinois was appointed to fill the vacancy left by the death of Senator Hubert Humphrey. Two others—Senator Clifford Case and Congressman Olin Teague—left Congress at the end of 1978 and were replaced early in 1979 by Senator Charles Mathias, Jr., and Congressman John Dingell.

One member of the Technology Assessment Advisory Council—Dr. Eugene Odum–resigned in 1978. The Board replaced him with Dr. James Fletcher, Whiteford Professor of Technology and Energy Resources at the University of Pittsburgh, and formerly Administrator of the National Aeronautics and Space Administration.

To provide better and closer communications with the Board members and committee staffs as well as the Technology Assessment Advisory Council, the OTA Liaison Office was established.

The extensive oversight hearings on OTA, which were begun in 1977 by the Subcommittee on Science, Research, and Technology of the House Committee on Science and Technology, were concluded in 1978. In its report, *Review of the Office of Technology Assessment and Its Organic Act,* the subcommittee summarized its hearings as follows:

> OTA has been set up to do a job for the Congress which is: (a) essential, (b) not capable of being duplicated by other legislative entities, and (c) proving useful and is already relied upon. OTA should retain its basic operating method of depending to a large extent on out-of-house professional assistance in performing its assessments. Continued Congressional support for OTA is warranted. *

The report does point to some problems that have been experienced during OTA's startup phase and makes recommendations on how they might be dealt with by the Board, Director, and Advisory Council. These recommendations will provide basic guidelines for OTA's future direction and development. The subcommittee's chairman, Rep. Ray Thornton, observed upon issuing the report that the survey "doesn't leave much doubt that the Office is a valuable asset to Congress. " We are encouraged by this evaluation of OTA's performance to date.

A series of dinner-seminars has been inaugurated at OTA to provide an informal setting in which Members of Congress, senior congressional staff, heads of congressional and executive agencies, and leaders from the private sector can interact. These dinner-seminars are funded by a trust account to which OTA staff members contribute honoraria received for lectures, speeches, and articles. During 1978, speakers at the seminars, included Joseph Slater, President of the Aspen Institute for Humanistic Studies; Dr. M. King Hubbert, energy expert and former research geophysicist with the U.S. Geological Survey; and Daniel Bell, Professor of Sociology, Harvard. One seminar in the fall centered on public interest organizations and

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*Subcommittee on Science, Research, and Technology, House Committee on Science and Technology. 95th Cong., 2d sess., report, *Reviews of the Office of* Technology Assessment and *Its* Organic Act, 1978, p.] 03

provided a forum for leaders of these organizations to bring citizens' views to the attention of decision makers.

None of us knows what the future will be like. But we can be sure that the decisions made today in Government and industry regarding the options for technological applications of our vast scientific knowledge will greatly influence the quality of life for this and for future generations. OTA has the assignment of providing guidance to Congress on the support, management, and regulation of technological applications, as well as advising Congress on the adverse and beneficial impacts of technological applications. In addition, OTA has the responsibility for advising Congress on alternative strategies for achieving societal goals other than technological ones. OTA needs to pose policy options for Congress in such a way as to make explicit how those options are likely to influence the course of technological change.

This assignment is both demanding and rewarding, and one in which members of the OTA staff derive much job satisfaction.

The growing need to restrain the growth of the Federal budget calls for increased attention to improved decisionmaking so that the dollars are expended more effectively. OTA has the potential to be a valuable tool in helping Congress to choose the right goals and programs for most effectively spending hundreds of billions of Federal dollars. In my view, the investment in OTA will provide a very high return to our country and especially to our children and grandchildren.

Working together with the Board and Advisory Council, with the other congressional support agencies, and with the committees of Congress, OTA anticipates in the year ahead further significant gains in providing Congress with the kind of authoritative, objective information required for sound decision making.



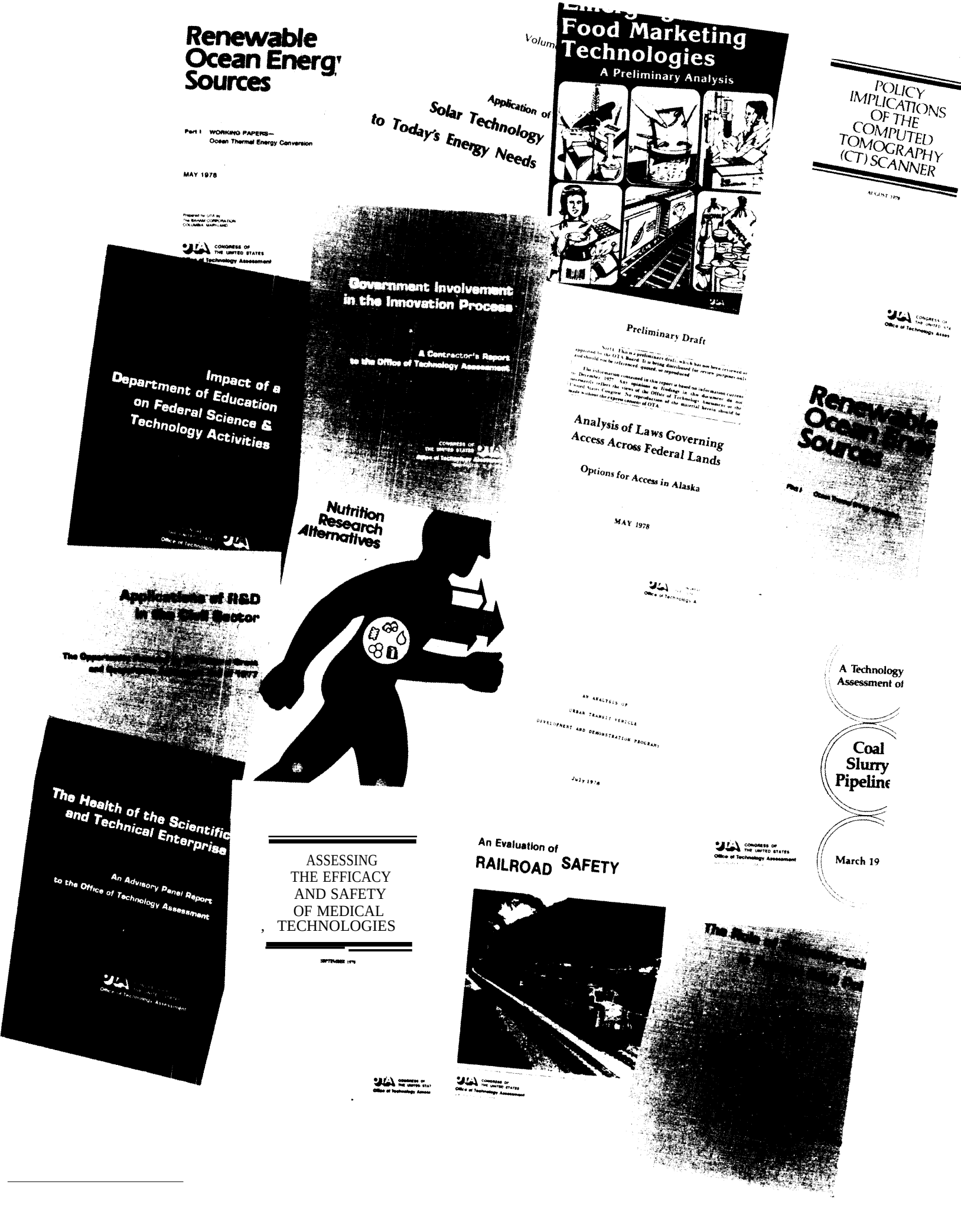
RUSSELL W. PETERSON
Director

Section II

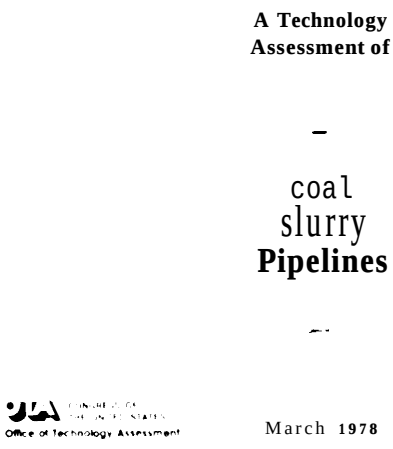
SUMMARIES OF OTA REPORTS COMPLETED IN 1978

The assessments carried out by OTA cover a wide spectrum of major national issues and examine a broad range of policy options and their possible consequent impacts on numerous and diverse interests. To provide examples of this range, depth, and breadth, summaries from the reports published by the Office in 1978 are presented in this section.

The reader is cautioned that these are summaries of the reports. They do not cover the full range of options considered or all of the findings presented in any individual report.


Renewable Ocean Energy Sources
Part I WORKING PAPERS—
Ocean Thermal Energy Conversion
MAY 1978
Application of Solar Technology to Today's Energy Needs
Food Marketing Technologies
A Preliminary Analysis
POLICY IMPLICATIONS OF THE COMPUTED TOMOGRAPHY (CT) SCANNER
Government Involvement in the Innovation Process
A Contractor's Report to the Office of Technology Assessment
Impact of a Department of Education on Federal Science & Technology Activities
Preliminary Draft
Analysis of Laws Governing Access Across Federal Lands
Options for Access in Alaska
MAY 1978
Renewable Ocean Energy Sources
Nutrition Research Alternatives
Applications of R&D in the 33rd Sector
AN ANALYSIS OF
URBAN TRANSIT VEHICLE
DEVELOPMENT AND DEMONSTRATION PROGRAM
July 1978
A Technology Assessment of
Coal Slurry Pipeline
March 19
The Health of the Scientific and Technical Enterprise
An Advisory Panel Report to the Office of Technology Assessment
ASSESSING THE EFFICACY AND SAFETY OF MEDICAL TECHNOLOGIES
An Evaluation of
RAILROAD SAFETY

Section II
SUMMARIES OF OTA REPORTS COMPLETED IN 1978



Coal Slurry Pipelines

Comparison of the costs of unit trains and slurry pipelines concluded that, depending on specific conditions of a given route, either mode can represent the least costly means of transporting coal if one ignores regulatory distortions and unquantifiable social impacts. Which mode is cheaper in a given instance can be determined only by a detailed economic and engineering evaluation,

Without the power of eminent domain at either the Federal or State level, coal slurry pipelines will have great difficulty competing with railroads. Without eminent domain, the pipelines would have to redirect routes, thereby increasing their costs and reducing their ability to compete successfully with established railroads.

On the other hand, if the pipelines are granted the power of eminent domain, they could enjoy significant advantages over the railroads because of regulatory restrictions on the latter's ability to enter into long-term contracts with selected customers.

Water availability is a central issue. Although transportation of coal by slurry pipelines will require much less of the mine region's water per ton of coal than onsite gasification or electric power generation, pipelines do represent a substantial potential demand on remaining unallocated resources. Sufficient unused quantities of suitable water exist, although they are not necessarily legally available, for the transportation of nearly 200 million tons per year from Western coal-producing areas. However. diverting water for slurry pipelines now would limit the options for future uses of that water. Eminent domain legislation could inadvertently alter the balance of Federal and State authority over water resources. Unless such alteration is intended, care should be taken to avoid that consequence.

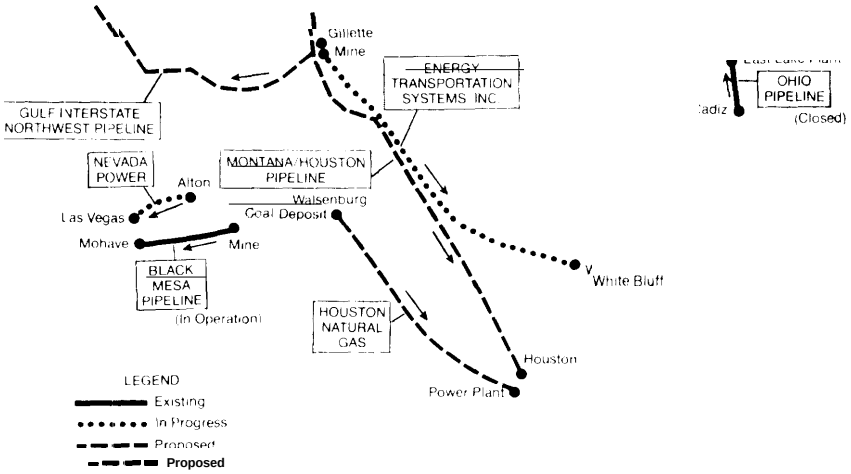
One environmental area of uncertainty involves the substances that will be present in the slurry water after it has been separated from the coal at the end of the pipeline. The Department of Energy is now sponsoring experiments to clarify this problem.

The environmental impacts of the water use, its discharge, and the construction of the pipelines must be weighed against the noise. land-use disruption, and rail-highway crossing accidents and inconvenience associated with moving the same coal by rail.

Railroad financial health probably would be affected less by a substantial pipeline industry than by adverse rate regulation or diminished productivity gains of railroads in the future.

Further, slurry pipeline development should have no significant impact on the achievement of projected levels of coal use on a national scale.

Figure 1—Present and Proposed Coal Slurry Pipelines



Source: Slurry Transport Association

An Evaluation of

RAILROAD SAFETY



Railroad Safety

An OTA study indicates that from 1966-74 track-caused train accidents per ton-mile increased by more than 100 percent. Although changes in data reporting made in 1975 make comparison with earlier data difficult, it is clear that the increase in track-caused accidents is continuing. This increase appears to relate both to an extensive and growing deferral of maintenance and to increased axle loadings.

The actual number of fatalities and injuries has decreased over a 9-year period by 29 and 19 percent respectively. However, when adjusted for changes in exposure, the casualty rate has remained relatively constant, except for a decrease in rail-highway grade-crossing accidents.

Track-caused train accidents are not likely to be reduced until the financial condition of the railroads improves. Substantial economic losses to the railroad industry resulting from accidents ag-

gravate the outlook for economic improvement. The cost of railroad accidents totalled $575 million and accounted for 3.5 percent of total industry operating revenue in 1975. During 1966-74. accident costs increased by 38 percent, casualty claims by 46 percent. and property and lading losses resulting primarily from train accidents by 21 percent

The legal framework is adequate for addressing railroad safety problems. However, Federal efforts to reduce casualties and property **losses** have been impaired because:

- Accident data have not been adequately used to analyze the nature. extent. and causes of specific safety problems, or in setting priorities for addressing these problems.
- Measures of effectiveness have not been designed into current regulatory, inspection, and R&D programs.
- Alternative approaches to the regulatory process. such as incentive programs, have not been systematically considered.
- Divided jurisdiction-–among Federal and State agencies, and the railroads — has impealed the administration of safety efforts.

The Federal Railroad Administration has failed to indicate how specific requirements or standards will reduce or eliminate particular hazards.

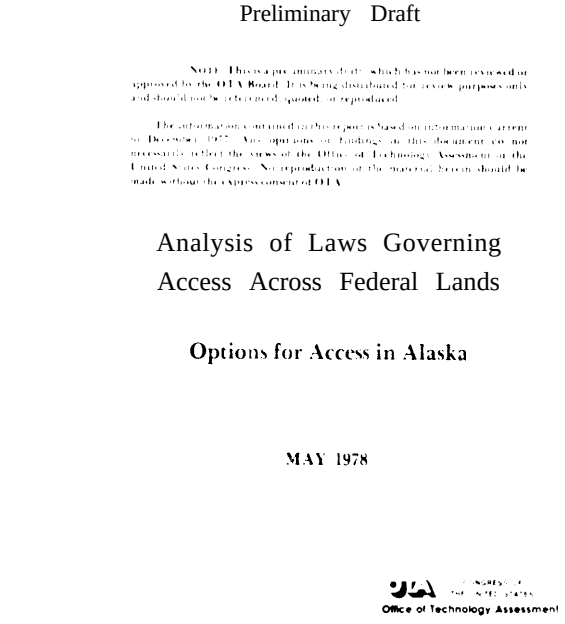


inspections, authorized by the 1970 Railroad Safety Act. do not appear to have affected the accident rate. Current inspection programs and strategies have not effectively dealt with the safety problems that they were established to address.

R&D programs have emphasized reducing the causes of property damage rather than reducing the causes of casualties.

Increased cooperation among Government, industry, and labor would provide substantially greater opportunity for reductions in both property and casualty losses.





Preliminary Draft

NOTE: This is a preliminary draft which has not been reviewed or approved by the OTA Board. It is being distributed for review purposes only and should not be referenced, quoted, or reproduced.

The information contained in this report is based on information current as of December 1977. Any opinions or findings in this document are not necessarily to be the views of the Office of Technology Assessment or the United States Congress. No reproduction of the material herein should be made without the express consent of OTA.

Analysis of Laws Governing Access Across Federal Lands

Options for Access in Alaska

MAY 1978

OTA Office of Technology Assessment

Access Across Federal Lands in Alaska

Rarely has the conflict between resource development and protection of the natural environment been more severe than in Alaska. The largest State is a treasury of natural beauty, wildlife. and wilderness on a scale that does not exist in the rest of the Nation. At the same time, it has an abundance of natural resources that may be needed in the future. For decades, distance, climate, and lack of development combined to enforce de facto preservation of Alaska's natural treasures. The barriers that have protected Alaska's environment have been lowered by technology, by local development, and by an increased demand for resources.

Access across federally owned lands in Alaska is one of the keys to developing mineral and other natural resources in the State. The debate centers on how much mineral development is to be carried out and what is required to protect America's last virgin environment from such development. Resolution may require a combination of several access options—a combination that could be determined on the basis of priorities Congress establishes for the use and preservation of these lands.

OTA conducted a comprehensive analysis of Federal laws, regulations, and policies that currently affect access across federally owned lands to non-Federal lands (including State, Native, or private lands). OTA's report focuses on Federal land management laws, and particularly on those relating to access in Alaska.

Based on information about the location of mineral deposits, projected land ownership patterns, and transportation availability, it was found that the need for rights-of-way is a localized problem that is likely to occur infrequently. However, if mineral resources on State, Native, or privately owned lands are to be developed in isolated regions of Alaska, access across Federal land would be required.

Under existing Federal land management laws and policies, access is available across most units of the public lands and national forests, except designated wilderness and wilderness study areas. Access across units of the National Wildlife Refuge System is allowed if it does not pose a threat to protected wildlife. Because of the high degree of protective management afforded parks, wild and scenic rivers. and wilderness areas, use of these lands for access to non-Federal areas or for transportation routes is strictly limited. In park and refuge wilderness areas, an act of Congress would be required to allow any significant access. In all systems, but particularly the more protective, the availability of access may well turn on the factual issue of whether alternative routes or means of access exist.

In providing access across federally owned lands, Congress could: 1) apply existing access provisions to Alaskan lands; 2) defer action on access until mineral or transportation studies are completed; 3) provide limited right-of-way authority for access to non-Federal lands, or provide for land exchanges or realinement of borders to accommodate access needs; 4) authorize rights-of-way for future transportation systems, designate specific corridors, or establish a new Federal-State commission to review proposed rights-of-way; or 5) protect Alaskan lands over and above existing statutes by requiring specific congressional approval for access use.

Renewable Ocean Energy Sources

Part I Ocean Thermal Energy Conversion

CONGRESS OF THE UNITED STATES
Office of Technology Assessment

Ocean Thermal Energy Conversion

Ocean Thermal Energy Conversion (OTEC) is a concept for using the temperature difference that exists between warm waters at the surface of oceans and cold waters in the deep oceans to release stored solar energy to power a turbine.

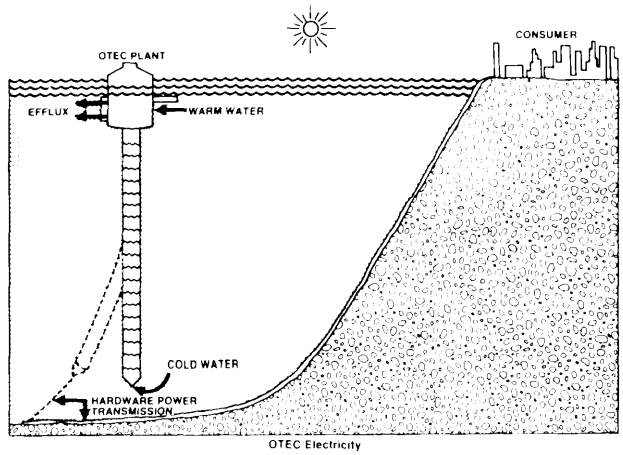
The number of sites where a sufficient temperature difference exists between the surface and a reasonable ocean depth is limited -–there are few off the continental United States—but at these sites the solar energy stored in the ocean is an abundant. renewable source of power. However, harnessing this energy requires complex and potentially expensive equipment of enormous size.

Research on OTEC has been underway since the early 19th century and has been funded by the U.S. Government since 1972. The concept has been touted as one which may be used to provide an important source of energy for the generation of electricity or power for manufacturing energy-intensive products such as ammonia and aluminum,

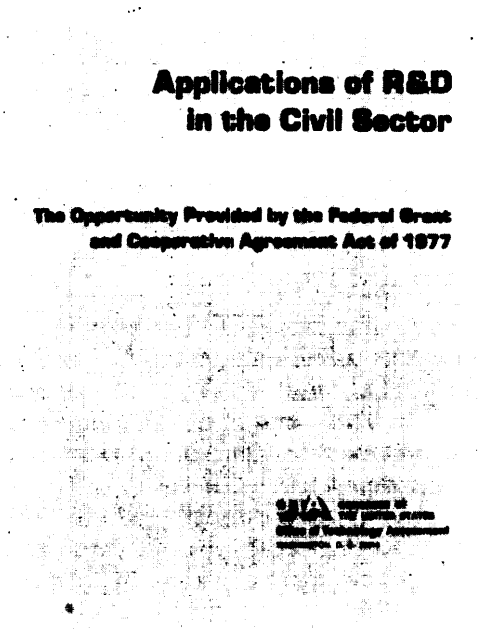
OTEC technology is not yet proven and probably could not become a viable part of the U.S. energy supply system in this century. Although the concept was demonstrated on a small scale in 1926. the technology is not developed to the point where acceptably precise estimates can be made about the technical feasibility of large-scale systems, potential products of those systems, the economics of the systems, or the social and environmental impacts.

No OTEC plant has been fully designed: many components of the system have not yet been proven in the hostile marine environment. No ocean energy plant of any size has ever been built and operated which generated more energy than was required to operate the equipment. The technical problems which must be solved are by no means minor, and satisfactory solutions to the critical engineering problems will require long-term laboratory and at-sea testing.

The relative value of OTEC depends heavily on the future price of alternative energy sources. At this time, OTEC offers no economically competitive product. The value of developing OTEC technology, however, cannot be measured by simple economic projections because in the long term alternative energy supply options could become much more critical to the United States and to the world. Sometime during the 21st century a renewable source of energy could become a necessity.



If the Government ceases to fund OTEC, little new information about it will be produced because of the lack of support from private industry. If funding is continued, fairly level research and development money in the tens of millions of dollars for the next 5 to 10 years could result in a program geared toward solving important technical problems. Large amounts of money, rapidly totaling billions of dollars, would be a high-risk approach which could result in the most rapid demonstration of one specific system but could also result in skipping essential long-term testing and environmental studies and making premature choices among concepts and possible uses.



Applications of R&D in the Civil Sector

Management of research and development by the Federal Government has not kept pace with new requirements established by Congress in recent years. Federal R&D designed to stimulate technological change in areas like energy, housing, and law enforcement are effective only if non-Federal users adopt the innovations produced. Federal management of such R&D must therefore differ from that appropriate where the Federal Government is the end user, as in defense and space R&D.

The recently enacted Federal Grant and Cooperative Agreement Act (Public Law 95-224) requires that in all transactions with non-Federal (civil sector) parties, Federal agencies distinguish between "procurement"--buying something for the Federal Government's direct use—and "assistance''—supporting or stimulating a non-Federal activity in the public interest. Transactions to support non-Federal R&D would generally be for the purpose of assistance. Yet, currently, much non-Federal R&D is funded through the Federal procurement process. The change required by Public Law 95-224 presents an opportunity to develop management perspectives and practices appropriate for cooperative Federal/non-Federal efforts to stimulate technological innovation.

To clarify Federal roles and responsibilities, the Act establishes uniform criteria for grants, contracts, and cooperative agreements. These uniform, Government-wide criteria have the effect of forcing Federal agencies to declare clearly which relationship with non-Federal parties is sought. Revealing the level of Federal involvement in assistance relationships emphasizes for Congress the issue of accountability in such transactions. Because of the inherent risk of failure in technological change, the interpretation of accountability—whether expenditures are ultimately effective or merely allowable—is a core issue for congressional consideration.

If Federal agencies are to become effective agents of change through support of R&D, they must involve those non-Federal parties—whether in the public or private sector—who have the incentive and capacity to go beyond the R&D stage and develop technological innovations for

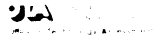
widespread use and public benefit. The cooperative agreement is a new legal instrument appropriate for such involvement. As in a joint business venture, Federal and non-Federal rights and obligations are negotiated in the process of reaching such agreements.

The Act mandates the Office of Management and Budget to make a comprehensive study of Federal assistance relationships and report to Congress in 2 years (i. e.. in early 1980). The study presents an important opportunity to develop the new perspectives and procedures appropriate for assisting technological innovation. Because the OMB study will largely determine how the Act is implemented. Congress required OMB to involve in the study a wide range of potentially affected parties, including Congress itself. Such involvement is essential in order to realize the Act's potential —which is still not widely recognized–for applying science and technology to a broad range of problems confronting the Nation.

Volume I

Application of

Solar Technology to Today's Energy Needs



Prospects for Onsite Solar Energy

By the mid- 1980's. energy supplied by small-scale solar equipment located at the point of use could meet a variety of residential, commercial, and industrial needs. Such "onsite" solar systems are technically capable today of providing energy for domestic hot water, space heating and cooling, industrial process heat, and mechanical and electric power.

With few exceptions, solar energy now costs more than energy from conventional sources. However, if expected reductions in the cost of some kinds of solar equipment (particularly solar electric equipment) and expected increases in gas, oil, and electricity prices occur, solar equipment could be competitive on a life-cycle cost basis in a variety of markets within 10 years. Solar hot water and heating systems are already competitive in some circumstances.

Onsite solar systems which rely on storage for backup can be designed to provide all of a building's energy needs, but generally are more expensive than systems relying on electric or gas backup. Systems relying on electric backup can be designed which would not adversely affect utility rates. Systems using oil and gas as a backup may be more attractive in some circumstances. Small electric-generating solar systems may find it preferable to sell electricity to a utility (if permitted to do so), even at reduced rates, than to store electricity.

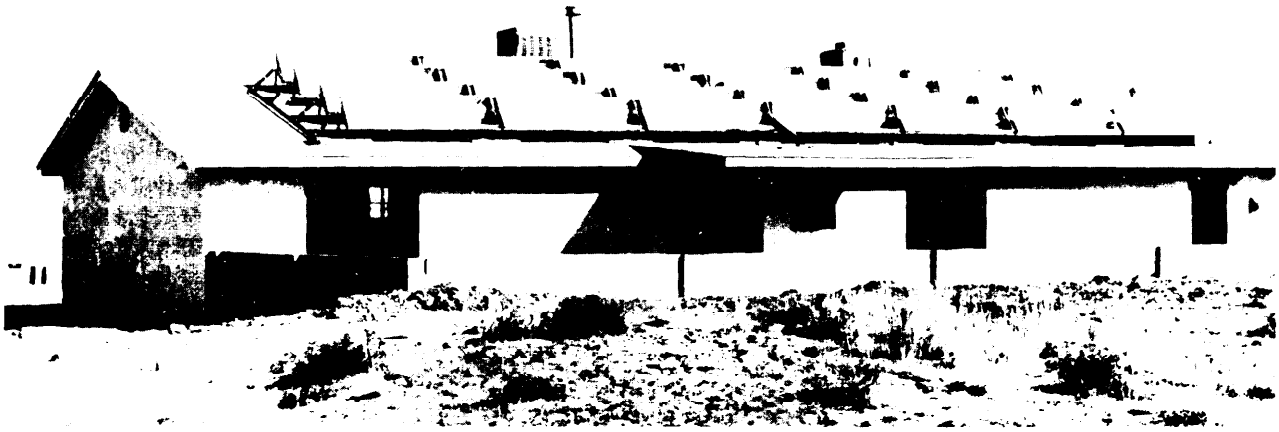
Small solar systems offer a number of technical and economic benefits. They do not require long-range planning and large investments in single plants. Most solar components, except storage, are modular and thus do not offer economies of scale. Solar energy could create new jobs, particularly in the construction trades: re-

duce world competition for fossil fuels: and improve U.S. balance of trade. In most cases, solar equipment can deliver energy with minimal harm to the environment.

Markets for smell-scale solar equipment will develop without Government assistance. However, without Government help, solar energy is unlikely to make a significant contribution to U.S. energy supplies before the year 2000. Existing Federal programs controlling fuel prices and subsidizing nonsolar energy sources have created a situation where. without compensating subsidies, solar energy is uniquely disadvantaged.

A program to accelerate the widespread use of solar energy could include: 1) allowing energy prices to rise to marginal replacement cost; 2) establishing tax credits, loan subsidies, or other incentives for both consumers and manufacturers of solar devices; 3) supporting a balanced program of research, development, and demonstrations on a wide variety of solar concepts: 4) resolving legal and regulatory barriers, particularly utility law and "sun rights;" 5) encouraging international cooperation in solar research and demonstrations. especially in areas where solar energy may be commercially attractive before it enters U.S. markets; and 6) ensuring that adequate standards are established.





Urban Transit Demonstration and Development Programs

Three research and development projects sponsored in the early 1970's by the Urban Mass Transit Administration (UMTA)-–TRANSBUS. State-of-the-Art Car (SOAC), and Advanced Concept Train (ACT) –demonstrate some problems confronting the Federal Government in incorporating new technology in mass transit vehicles. TRANSBUS was designed to replace the standard city bus and improve passenger comfort and access: SOAC incorporated available technology in existing railcar design: and ACT combined new subsystems with a new railcar design.

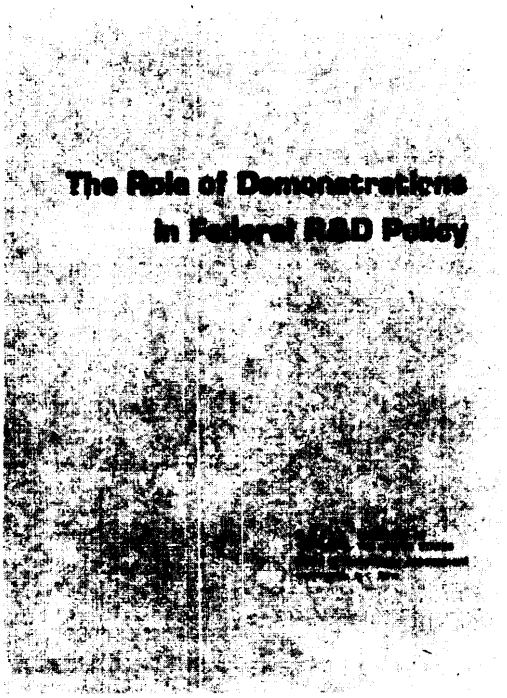
Initiated in 1971, the TRANSBUS project resulted in the fabrication and testing of three prototype buses featuring new components. improved access, and a low floor. However, insufficient emphasis was placed on development of key components, resulting in several unresolved technological and operating problems. Government and industry concern for promoting competition in the manufacturing industry complicated the R&D program and may have delayed introduction of a new bus. TRANSBUS did show the feasibility of low floors, allowed easier bus entrance and exit, and demonstrated the use of gas turbine engines.

Also initiated in 1971, the ACT project was plagued by low cost estimates, late deliveries, and management problems. The OTA study indicated that development and evaluation of new subsystems prior to incorporating them in new vehicles may be a more effective R&D strategy than simultaneously developing both a new car and new subsystems.

Demonstration of SOAC at five different locations in 1974-75 gave impetus to the concept of standardization in rail cars. Several transit operators incorporated SOAC features in their specifications for new cars. The SOAC project demonstrated that standardization could reduce costs and increase product reliability.

Standardization of components in mass transit vehicles appears to be a more realistic approach than standardization of total car design. It would allow transit operators greater flexibility in adapting vehicles to local conditions, reduce lifecycle costs, and improve the reliability of vehicles. However, inflation and the limited market for mass transit products may have greater influence on overall costs than standardization by itself.

Successful Federal R&D programs for mass transit require involving transit manufacturers, operators, and the riding public throughout the R&D process; otherwise, the results of R&D may not be acceptable. Extensive evaluation and demonstration of R&D results is required if new federally developed components and vehicle designs are to be mandated for commercial service. The relationship between development and deployment, as well as alternative policies to achieve specific goals. needs to be clearly defined before development results are adopted.



The Role of Demonstrations in Federal R&D Policy

Demonstrations have become increasingly popular as responses to a broad spectrum of national problems. Federal expenditures for demonstration projects, including social program demonstrations, have grown to more than $1 billion annually. Yet their effectiveness has been limited.

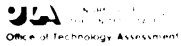
For Congress to effectively evaluate demonstrations, a set of realistic expectations for a demonstration's outcome would be useful. Toward this end, OTA reviewed the extensive experience with demonstrations, including both social and hardware demonstrations, and developed both a conceptual framework for viewing demonstrations and a detailed set of guidelines to assist evaluation of individual demonstration proposals.

The purpose of a demonstration is to generate information for decisionmaking. The information generated may be for either of two purposes: to test an innovation for formulating policy or to promote adoption of an innovation. Policy-formulating demonstrations provide information to Federal decisionmakers about the technical and administrative feasibility of an innovation, and the expected economic, environmental, and social impacts of that innovation. Demonstrations to promote the use of an innovation provide information to non-Federal decisionmakers on an innovation's costs, reliability, demand, and the feasibility of implementing it on the user's site.

Ambiguity of purpose in demonstration projects has frequently led to disappointing results. Whether intended as an innovative policy response to a complex national problem, or to move R&D results from the laboratory to use in the real world. demonstrations tend to generate different expectations from the different parties involved—congressional committees, funding agencies, performers, potential users, and various interest groups. Some may view demonstrations as a test of an innovation, others as a promotion of an innovation, and still others as primarily a means of expressing concern for a national problem. These different objectives and expectations make the evaluation of a demonstration difficult and necessarily judgmental.

Demonstrations designed to promote the adoption of an innovation are more likely to be successful when: 1) consensus is obtained among key non-Federal decisionmakers on the information sought from a demonstration: and, 2) when potential adopters perceive the results to be reproducible. For soft technologies, such as education and law enforcement, the perception of reproducibility is often lacking, and successful replication at several sites may be needed to induce others to adopt the innovation. In areas like energy. on the other hand, there is frequently controversy concerning what constitutes desirable and timely innovations. Such controversy complicates getting consensus on the information sought from a demonstration.

POLICY IMPLICATIONS OF THE COMPUTED TOMOGRAPHY (CT) SCANNER



Policy Implications of CT Scanners

The computed tomography or CT scanner is a diagnostic device that combines X-ray equipment with a computer and television-like tube to produce cross-sectional images of the body. Developed in Britain in the 1960's, some 1,000 scanners were installed in the United States between 1973, when first introduced in the United States, and the end of 1977. CT scans provide highly accurate diagnoses of certain medical conditions as well as previously unavailable information. Compared to older technologies. such as pneumoencephalography, CT scanning often improves the safety and comfort of patients.

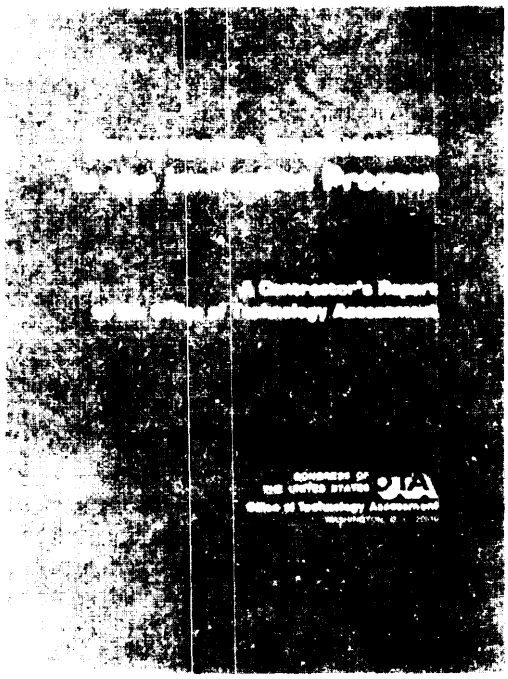
However, CT scanning represents one element in the great increase that has occurred in recent years in technological capability, diagnostic testing, and rising medical costs. Because of their rapid adoption and high purchase price (averaging a half million dollars each), CT scanners raise important policy issues for Government and private policy makers.

Neither public nor private sector agencies now systematically assess medical technologies for their efficacy. The widespread adoption of CT scanners, for instance, occurred prior to an evaluation of their place in medical practice or relationship to other medical services. Thus, planning agencies, Professional Standards Review Organizations, third-party payers, and the medical community lack an adequate basis for judging the use of technologies.

While third-party payers have sometimes made payment for CT scans dependent on planning approval and an evaluation of efficacy, gaps in Federal and State laws dilute these provisions. These laws often encourage placement of CT scanners and other expensive equipment in locations, such as doctors' offices, that are exempt from review. Further, the law linking Federal payments to planning approval does not apply to operating costs or to physicians' charges, which together comprise about two-thirds of the cost of a CT examination.

Current public and private methods of financing medical services in effect promote the use of expensive technologies. They offer little incentive to doctors to consider using alternative technologies which may be cheaper or more beneficial, or to operate equipment at a level of use at which costs per treatment are minimized. The use of third-party payers insulates both patients and doctors from the costs involved. Further, doctors have come to rely heavily on extensive testing because of their training and of their concern for malpractice suits.

The Federal Government could influence the use of costly but potentially effective medical technologies by means of three basic, but not mutually exclusive, sets of alternatives. These are: 1) establish a process to develop information on efficacy and safety; 2) expand the role of Federal agencies to regulate the acquisition and use of, as well as payment for, technologies; and 3) change the methods of financing medical services to better promote the efficient use of technologies and provide more cost-effective care.



Government Involvement in the Innovation Process:

A Contractor's Report to OTA

Innovation is defined as the commercial introduction of new technologies, goods, or services. Vital to productivity and economic growth, innovation includes the entire series of events from an original concept taken through research and development to the marketplace. Although important, research alone is not enough to ensure successful innovation. More important are the decisions made by corporations, as well as external influences, that facilitate or inhibit the movement of new technology into the market.

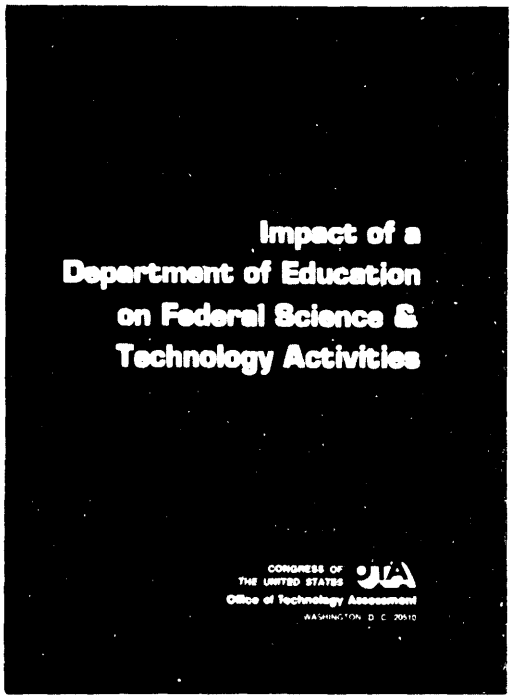
Governments in all modern industrial countries seek to promote and shape technological development, particularly where market forces are clearly incapable of achieving defined national objectives. Private companies tend to support those research projects whose results they can control. But, only the larger companies can afford extensive R&D programs. Also, Government action may be necessary to correct market failures or substitute national policy, such as pollution control, for market allocation of resources.

Taken as a whole, innovation is influenced by a variety of factors whose complex interactions make the process difficult to comprehend. These include Government incentives and funding for basic research; tax, patent, procurement, and antitrust policies; and regulatory policies. The rate and extent of innovation is also affected by inflation, tax credits and subsidies, and by the formation of capital. Technical skills as well as marketing and management expertise directly influence the innovation process.

However, innovation is a subject of straightforward action and experimentation in several foreign countries, including West Germany and Japan. There, innovation is treated as a component of national planning. Thus, policies supporting the advancement of new technologies are closely tied to economic policies. These include direct Government support for private R&D, support of basic research, Government procurement of new products to strengthen demand, support for firms introducing new technologies, and emphasis on industrial change, manpower training, and exports.

Yet, the means for applying such policies in the United States have not been devised. Further, it is not clear whether the Federal Government should support commercialization of new technologies through changed roles for national laboratories, through risk reduction for new businesses, through the support of technical information networks, or by any other conceivable means.

Studies of selected industries have shown that Government programs and incentives that help new firms and ventures get started have frequently led to innovation. Where Government has provided a market for new technologies or supported R&D directly, firms have often changed products or processes. Also, Government action that complements normal competitive pressures for change have effectively stimulated the introduction of new technologies.



Federal Reorganization of Science and Technology Education:

A Contractor's Report to OTA

Congress is now considering an administration initiative to create a new Cabinet-level Department of Education separate from the current Department of Health, Education, and Welfare. OTA examined the proposal for its potential impacts on the science education and educational research and analysis programs now run by the National Science Foundation (NSF) and other Federal agencies. Some of these programs have been proposed for transfer to the new department.

Some scientists and educators have expressed concern that advanced training programs for scientists and engineers would be damaged by such a transfer. These programs are seen as being vital to the Nation's ability to direct technology towards solving problems or creating opportunities. While the dollar support for these programs is small (about $56 million per year) compared to the total NSF budget or that of the proposed new department, their impact on the course of science and technology is considerable.

According to the administration plan, a single department would combine all Federal education programs in one office, expand the Federal impact on the quality of science education, and create a single administrative focus for education programs for minorities. women, and the handicapped. On the other hand, a single department would eliminate the value that stems from locating education programs in Departments such as Agriculture, Defense, and State that have a strong interest in furthering education pertinent to their functions.

In evaluating the impacts of an education department on Federal science and technology activities, several criteria need to be considered. These include the importance of: 1) locating education programs in an education department instead of mission-oriented agencies: 2) developing education programs for scientists within a science agency rather than in an education department which is focused on training educators: 3) past successes in established science education programs; and 4) a high visibility for science education programs in the scientific and technological communities.

The education programs at NSF can be kept where they are now or transferred in part or whole to the new department. Or, transfer could wait until the education department is operating, thus permitting more informed decisions concerning which programs to transfer. The Education Directorate at NSF now administers programs on science and society, science education research, faculty improvement, institutional support to upgrade undergraduate science teaching, and advanced science training.

If graduate science and engineering training programs are transferred to the new department. care is needed to ensure that they do not suffer by being located in a department whose primary focus is on elementary and secondary education. Similar to other Federal agencies that have R&D programs related to their missions, an education department would benefit from having education research and analysis programs transferred to it.

ASSESSING THE EFFICACY AND SAFETY OF MEDICAL TECHNOLOGIES



Efficacy and Safety of Medical Technologies

As the role of science in medicine has increased in recent decades, medical practice has become heavily, and increasingly, dependent on technology. Yet. many medical technologies have not been assessed for their efficacy or safety prior to being used. Indeed, several technologies that have been widely adopted, such as gastric freezing, have later been shown to be of limited usefulness.

Assessments for efficacy and safety would help ensure that the benefits of a technology were commensurate with its risks and would help guide its appropriate use. However, such assessments are only starting points in evaluating the overall utility of a technology. Well-informed decisions concerning medical technologies might also require evaluations for cost-effectiveness, cost-benefit, and the social impacts of the technology.

Efficacy and safety depend on the type and probability of benefit and risk, the medical problem giving rise to use of a technology, the population affected, and how the technology is applied. Both can be determined by some combination of clinical experience, epidemiological studies, or controlled clinical trials, followed by development of a formal consensus. No technique is universally applicable; each has its strengths and weaknesses. For instance, controlled clinical trials may draw on many cases and complex statistical techniques, but also may raise ethical questions in that a control group must be denied the possible benefits of the new technology.

Federal law requires evaluations for efficacy and safety of most new drugs and medical devices. While some private doctors and medical facilities conduct evaluations, such activities are fragmented and uncoordinated. Further, the efficacy and safety of medical and surgical procedures need not be demonstrated before they can be used, although some in fact are tested by various Government and private groups.

Because large numbers of people use or are affected by medical technologies, well-validated, relevant information on their efficacy and safety is needed. However, no formal or well-coordinated system exists for identifying technologies needing study or for disseminating information derived from such studies. New technologies are studied more often than existing ones because no agency, public or private, has a mandate to validate existing technologies. Questions have also been raised concerning the adequacy of funding for controlled clinical trials.

The Federal Government could help develop and disseminate information on the efficacy and safety of medical technologies either by stimulating private sector action or through its own agencies and programs. The latter could be accomplished either by existing agencies, such as the National Institutes of Health (NIH) or the Food and Drug Administration (FDA), or by a new office of health technology. The task of identifying technologies for study could be assigned to an existing Federal agency, the Institute of Medicine of the National Academy of Sciences, or specially created commissions.



Nutrition Research Alternatives

Significant changes have occurred in recent decades in the eating habits and lifestyles of Americans. At the same time, obesity and degenerative illnesses, such as heart disease and cancer, have replaced malnutrition and infectious diseases as the major cause of ill health in the United States. Epidemiological studies indicate that, among other factors, diet may contribute to the incidence of and mortality from degenerative diseases.

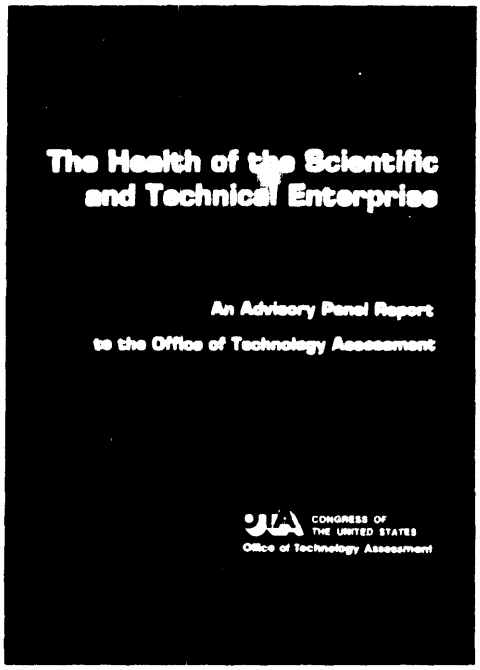
Yet, the Federal Government has failed to shift its research priorities from traditional concerns with deficient diets and the biochemical functions of nutrients to the relationship between nutrition and health. Greater emphasis is needed on research on how diet contributes to the development of chronic diseases. Progress in developing dietary measures for the prevention and treatment of chronic diseases will depend on that research as well as on integrating our knowledge about nutrients, educating consumers on nutrition, and monitoring changes in patterns of food consumption.

A reoriented research strategy would lead to a sharper focus on learning how patterns of food consumption, as well as food additives and contaminants, among other factors, affect the health of Americans. Such a strategy might include research on new food processing techniques, nutrient fortification and reformulation, and selection of alternative foods by consumers. This strategy would, however, not preclude or mitigate Federal programs to eliminate hunger and malnutrition, particularly in less-developed areas of the world.

Nutrition research in the Federal Government is complicated by being conducted in 7 different departments encompassing 14 separate agencies. Each agency establishes its own research goals and priorities. Further. no agreed-upon definition exists on what constitutes nutrition research. Thus, research efforts are fragmented and lack a coherent strategy for the solution of diet-related health problems. The focus now lacking in Federal nutrition research could be achieved by defining the scope and goals of research, specifying priority areas in line with the goals, and determining the expertise needed to achieve those goals.

A pluralistic approach appears to be the best means of coordinating Federal research efforts, rather than consolidating all nutrition programs in one agency. Such an approval could produce the kind of creative competition that would enhance research efforts. Undesirable overlap and problems of definition could be minimized by an interagency committee, perhaps with a rotating chairmanship, or other such coordinating mechanism. Such a committee could also improve the storage and dissemination of research results by linking the information systems now in use.

In addressing these issues, Congress could take no action while awaiting administration proposals for reorganizing Federal nutrition programs; or, Congress could act now and clarify the designation of a lead agency for research on nutrition. Congress could also develop goals and priorities for the Department of Health, Education, and Welfare to complement those set out for the U.S. Department of Agriculture in the Food and Agriculture Act of 1977.



The Health of the Scientific and Technical Enterprise:

An Advisory Panel Report to OTA

National security, the economy, and the American style of life depend, at least in part, on science and technology. Thus, attention should be given to the concern expressed by many informed observers about the state or health of the scientific and technical enterprise in the United States.

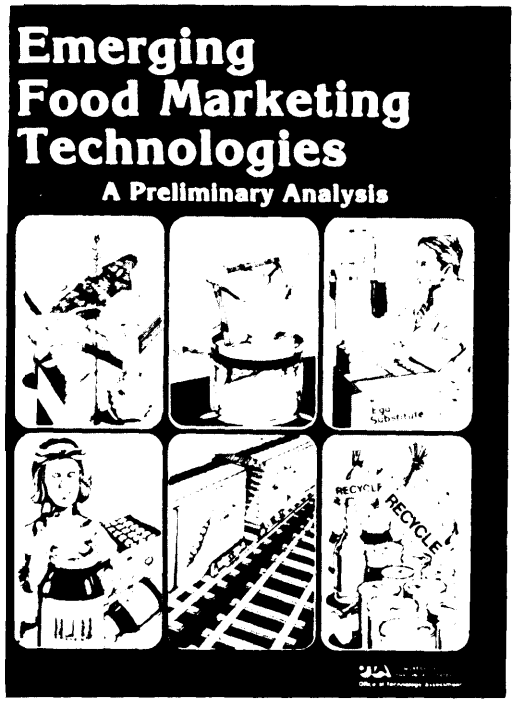
As part of a broad study of national research and development policies and priorities in the United States, OTA established an advisory panel of experts to examine the scientific and technical enterprise. Because of the ambiguity and oftentimes deceptiveness of the indicators commonly used, this report does not attempt to judge the health of the enterprise. Rather, it defines the enterprise and presents a framework of analytical questions which will help policy makers to determine the appropriate indicators with which to assess its health

In its broadest sense, the scientific and technical enterprise consists of those activities which place new and existing knowledge and skills at the disposal of society, and which use technology to maintain society and produce changes in the way things are done. Thus, it is closely related to and depends to a large extent upon the innovation process. Innovation refers to the process by which new knowledge is generated and applied to the operation of society.

Innovation can be seen as working in two ways. In the first, basic research generates knowledge, applied research relates that knowledge to specific goals, decisions are made to use the knowledge, and that knowledge is then applied in the form of new products, processes, services, or Government actions. In the second, a problem, need, or demand is identified, a decision is made concerning what kind of technology is needed to meet it, the needed technology or scientific knowledge is generated, and the technology is then applied to solve the problem or meet the need. While neither model adequately describes the innovation process, both recognize that what is needed is to match skills and know-how with needs and desires.

The scientific and technical enterprise also consists of performing, training, and communicating functions and organizations. The organizations may be universities, business or industrial companies, Government agencies, or various independent institutions. While research and development is at the heart of the enterprise, the communication of a wide variety of information about the scientific and technical enterprise is vital to its effective functioning and ultimate success.

The enterprise's health can best be analyzed by raising and answering appropriate questions rather than by attempting to define what is meant by its health. Three levels of analysis seem appropriate. These are: the present state of affairs, indications of trends and future health, and an assessment of the system relative to its potential and idealized goals. The great unmet need is for predictive indicators of how well the enterprise will be doing in the future. The problem is that society cannot agree on what science and technology ought to be trying to achieve.



Food Marketing Technologies: A Preliminary Analysis

Emerging technologies for marketing food products offer consumers the possibility of more nutritious foods, a reduction in the steady rise of food prices, and greater convenience. However, since technology may also have undesirable or unanticipated consequences, identifying those technologies now will help us plan for dealing with their impacts.

OTA examined several emerging technologies for marketing food for their current status of development, their probability of being adopted, the extent to which they are or will be used, their expected impacts, and the policy issues they raise. They were also examined assuming, first, a continuation of recent socioeconomic trends, and second, major changes in the social and economic environment for technological change.

Food marketing refers to those activities that take place between when food leaves the farm to when it is purchased by the ultimate consumer. It includes processing, wholesaling, retailing, transportation, and food service. Taken together, these activities comprise more than we-thirds of the $180 billion U.S. consumers spent on domestically produced food in 1977.

OTA distinguished for further study those technologies that would produce engineered or fabricated foods, improve food safety, provide new food packages, reduce food loss, and develop electronic means for marketing food. Specific technologies include the reportable pouch (a multilayered plastic bag in which food can be stored without refrigeration and cooked before opening), railroad cars designed to carry food products exclusively, electronic checkout at retail stores, and texturing, binding, and flavoring processes that modify existing foods or produce new ones such as meat and dairy substitutes.

While these technologies may save money, produce more nutritious foods, and provide more food by cutting losses, their impacts need further study. Food substitutes and additives raise questions about the safety and nutritional content of food products. Railroads may need financial assistance or incentives to add special cars for carrying foods. Electronic checkout in stores may improve labor productivity and inventory control, but could cost many foodstore workers their jobs.

A variety of social and economic factors may affect how and whether emerging food marketing technologies will be adopted. The availability and prices of energy and raw materials will determine whether many technologies are practical or economical. Rising incomes and growing populations, particularly in developing countries, will increase the demand for food, thus contributing further to rising prices. Concern over food additives could hinder development of engineered or fabricated foods. Conversely, rising food prices could be a major incentive to enhance and develop technologies that help stem that rise.

National Crime Information Center and the Computerized Criminal History System: A Preliminary Assessment

The National Crime Information Center (NCIC) run by the Federal Bureau of Investigation (FBI) raises broad questions concerning constitutional rights, Federal-State relationships, and the administration of justice. Through NCIC, the FBI maintains and disseminates information on stolen property, missing persons, and wanted persons to local FBI offices, other Federal agencies, and State and local governments.

Since 1971, NCIC has included arrest and other criminal records in a Computerized Criminal History (CCH) system. Citing high costs and lack of State interest, the FBI has proposed to decentralize CCH by giving these records back to State and local agencies that supplied them originally, and to provide a message-switching service that routes inquiries and responses between States. This could, under the pressure of new needs, raise the spectre of a "dossier society" if improperly designed or managed.

Many view the rapid exchange of information throughout the country as vital to identifying and prosecuting criminals. Studies show that 30 percent of those with criminal records have been arrested in more than one State, usually in neighboring States. Exchange can help reduce disparities between sentencing and granting bail or parole among different jurisdictions by applying national standards. However, there has been no analysis to show whether using records collected in one State benefits criminal justice decisions in another.

While there is strong interest in protecting the privacy, confidentiality, and security of criminal records, they are available under many States' freedom of information laws. Inaccurate, incomplete, or improperly disclosed information could damage the reputation and limit job opportunities of people who have been arrested. Studies show, for instance, that 50 percent of the FBI's arrest records lack information on the disposition of the case, although that situation is now improving. More information is needed, other than personal anecdotes, to assess the actual danger to constitutional rights posed by CCH.

Traditionally, State and local governments have compiled and maintained most criminal records in the United States. On the other hand, many experts argue that national standards are necessary for joint Federal-State information systems to function effectively. Failure to accommodate the needs and interests of State and local governments, as well as the public interest, have hampered development of CCH.

In any review of NCIC and CCH, alternative means for sharing arrest records and other criminal information need to be considered. Administrative alternatives need not be limited to Federal law enforcement or criminal justice agencies. Some experts question whether the FBI is the proper agency to operate NCIC, given its principal role as an investigatory body. Technical alternatives for switching messages as well as decentralizing records, including regional data bases, also need examination.

Section III

ASSESSMENT GROUP ACTIVITIES

OTA assessments are programmatically structured in three principal areas: energy, materials, and global security; health and life sciences; and science, information, and transportation. Within these areas, OTA conducts **studies in energy, food, genetics and population, health, materials, national security, oceans, R&D priorities and policies, technology and world trade, telecommunications and information systems, and transportation.**

In 1978, 15 assessments were completed and delivered to Congress. Additionally, one assessment report was delivered to Congress in prepublication draft form. More than 50 projects were in progress during the year, including 17 new studies.

In the remainder of this section, the broad concerns in each program group are sketched, along with a description of OTA activities to address these concerns. The program groups are organized by their appropriate division.

Section III
ASSESSMENT GROUP ACTIVITIES

ENERGY, MATERIALS, AND GLOBAL SECURITY DIVISION

Energy

Although the increasing use of energy in the United States has slowed substantially in recent years, and the decline in domestic petroleum production has been at least temporarily halted. the Nation is still faced with major energy problems. We are now importing 45 percent of our oil and still need to transform the U.S. economy over the next several decades to one based on renewable energy resources. This is a complex problem involving use of coal to ease the transition, extensive energy conservation, and development of new energy resources such as solar and, perhaps, fusion.

To assist Congress in dealing with this transition, the Energy Group carries out assessments analyzing the major components of energy supply and demand. This is based on a plan developed in 1975 to lay the groundwork for a comprehensive policy analysis of the Nation's energy future. Over this period, assessments have been performed or are underway on fossil fuels, solar and nuclear energy, and energy conservation.

In 1978, OTA completed three assessments in this series. One analyzed the economic and environmental aspects of using slurry pipelines to transport coal. A second evaluated the potential for using enhanced recovery methods in existing oil reservoirs to increase the Nation's petroleum supplies. The third examined the entire range of onsite solar energy systems with emphasis on their economics and their interaction with existing utility networks.

Two other studies are being prepared for delivery to Congress in 1979. One analyzes the technical, environmental, health, safety, and labor issues of mining and using coal. The second is concerned with the institutional and technical issues of using energy in residential buildings more efficiently.

Two studies were initiated in 1978 that consider potential energy resources for the future. One examines the potential for obtaining energy from plants and plant wastes (or bioenergy conversion) and its impacts. The second assesses the feasibility, cost, and environmental impacts of delivering solar power by microwave beams from satellites in space.

Finally, OTA initiated in 1978 a major study of the Nation's energy future. Drawing upon all of the assessments currently underway in the Energy Group as well as those studies previously completed, this assessment is examining 10 possible energy futures covering a wide range of demand scenarios, and analyzing their relative impacts on the economy, the environment, and society. The purpose is to analyze alternative policies that would aid the transition from the current reliance on oil and gas to a future based on renewable energy.

Coal Slurry Pipelines

In recent years, Congress has debated the feasibility of transporting coal by slurry pipeline. Slurry pipelines pump finely ground coal suspended in water or another liquid (a "slurry") from where it is mined to where it will be used, often over great distances. While supporters claim the pipelines are more economical than competing forms of transportation, others argue that they will take business away from the railroads, use water intended for other purposes, and then pollute that water.

At the request of the House Committee on Interstate and Foreign Commerce and the Senate Committees on Energy and Natural Resources

and on Commerce, Science, and Transportation, OTA analyzed the costs as well as the social, environmental, and economic impacts of coal slurry pipelines. OTA also examined legal and regulatory issues relating to rail and pipeline competition, water rights, environmental protection, and eminent domain. (A summary of this report may be found in section II.)

The draft report was presented to the requesting committees in January and the final report published in March 1978. Congressional action on legislation had previously been delayed pending the OTA report. The report's findings were used in hearings held by the House Committee on Interior and insular Affairs, and House Subcommittees on Transportation and Commerce and on Surface Transportation. The report also played a key role in House floor debates on a bill to grant the pipelines the right of eminent domain. Both proponents and opponents of the bill cited OTA's work in support of their positions.

Onsite Solar Energy

The search for nonpolluting and renewable sources of energy to replace dwindling supplies. of oil and gas has focused in recent years on the Sun. Solar energy is abundant, in effect inexhaustible, and nonpolluting since no mining or burning process is required to obtain it. However, economic projections have shown gas-, coal-, and nuclear-fired powerplants to cost less than large-scale solar energy facilities for generating electricity.

But, what if, instead of large, centralized facilities, solar energy systems were located in residences, commercial buildings, or factories–that is, at the actual point where the energy would be used? To determine the feasibility of such a concept, OTA conducted a comprehensive 3-year assessment of the economic and technical prospects for so-called onsite solar energy systems. OTA also examined legal and regulatory problems, energy storage requirements, and the economic, environmental, and political impacts of onsite solar energy.

The study resulted in the publication in 1978 of a two-volume, 1,300 page report, *Application of Solar Technology to Today Energy Needs.* Volume I discusses the feasibility of onsite solar energy systems, their impacts, constraints on widespread adoption, and alternative Federal policies for supporting the development of this technology. Volume 11 includes 517 tables comparing the cost and energy efficiency of various onsite solar components and systems with conventional heating and cooling equipment. (A summary of this report may be found in section II.)

Requested originally by the Senate Committee on Aeronautical and Space Sciences, a draft report was delivered to Congress in 1977 for use by Members in considering President Carter's National Energy Plan.

The Direct Use of Coal

The only domestic fuel whose use can be greatly expanded without major discoveries or technological breakthroughs, coal is expected to be the foundation of the Nation's energy future. Never easy to produce or use, coal has taken a grim toll of the men who mined it, their communities, and the environment where it was burned, Recent legislation has addressed many of these problems, but the projected increased use of coal leaves a wide range of uncertainties in estimating what effects that will have. This same legislation has also raised impediments to using coal that bring the attainment of these projections into question.

In this study, OTA is seeking a broad understanding of how coal is used and its role in meeting energy needs, as well as determining the environmental and social impacts that will result. These two perspectives will be linked to two themes: how can production be increased and what will be the impacts; and, how can those negative impacts be reduced and how will that affect production.

Specifically, the project is studying the technologies and practices involved in and the impacts of mining and burning coal. The Federal Government has already implicitly established policies for coal production and use through the Clean Air Act as amended in 1977, the Surface

Mine Control and Reclamation Act, and the Mine Safety and Health Act, among others. In addition, the use of coal in existing and future utility and industry boilers is being promoted by the National Energy Act and the Energy Supply and Environmental Coordination Act. Thus, the framework governing coal production and use is largely in place. Policy decisions will be largely aimed at achieving an optimum balance between its importance as a fuel and its negative impacts.

This assessment was requested by the House Committee on Science and Technology. It is scheduled for completion early in 1979,

Residential Energy Conservation

Prior to the 1973 oil embargo, little attention was paid to the supply of energy for residences. Fuel costs were, for the most part, minimal, and service was reliable, Awareness of future energy shortages generated by the embargo, and the particular impact of rising energy costs. were emphasized for homeowners by two unusually severe winters. In response, Congress has begun several programs and regulatory initiatives designed to reduce energy consumption in residences. Also, many new technologies are being explored and a substantial private effort is underway to increase the efficiency of home energy use, principally through adding insulation,

[n this assessment, OTA is studying the trends of energy use in residential buildings, the role of energy prices in encouraging conservation, and the opportunities for promoting energy savings in Federal housing programs. OTA is examining the effectiveness of conservation programs run by the U.S. Department of Energy as well as the role of State and local governments in promoting efficient energy use. The impacts of reduced energy use in residences are also being identified. Finally, the project is analyzing research and development projects on energy conservation and the opportunities for technological advances.

The study was requested by the Senate Committee on Commerce, Science, and Transportation, Information developed in the course of the study has been used by the Senate Committee on Energy and Natural Resources. It is expected to be completed early in 1979.

Bioenergy Conversion

In the search for renewable and nonpolluting sources of energy, many experts see a potential for obtaining energy from plants or plant wastes. Commonly referred to as biomass, this process is potentially a renewable source of solid, liquid, and gaseous fuels, as well as of chemical feedstocks. On balance, biomass may pollute less than the use of fossil fuels. In addition, biomass appears to be especially appropriate for developing countries.

Although theoretically the resource base for biomass is very large, there are many nonenergy calls on, as well as the many practical problems to exploiting much of, that base. On the other hand, the resource base can be expanded by changing forest management and agricultural practices, by exploiting marginal lands with specially adapted plants, and by growing plants in the ocean or on waste waters.

Obtaining energy from biological processes encompasses a number of sources. conversion processes, and end uses, Some conversion processes are technically and economically feasible now, or are on the verge of feasibility. Others require research and development before technical and/or economic feasibility can be attained.

At the request of the Senate Committee on Commerce. Science, and Transportation, OTA is analyzing the potential for and impacts of biomass. This project will sort out the various conversion processes, analyze policies that could accelerate commercialization, and examine what R&D is still needed. The net energy balances of conversion processes will be investigated, particularly for the production of liquid fuel and chemical feedstocks.

OTA is also examining the end uses of biomass-derived fuels or chemicals. Emphasis will be given to the possible uses of liquids and the technical, economic, and systems tradeoffs between possible uses. Finally, since not much is known about the social impacts of obtaining

energy from biomass, OTA will summarize the state-of-the-art knowledge and lay the groundwork for anyone planning to assess social impacts.

This assessment is scheduled for completion in mid- 1979.

Solar Power Satellites

Recently, considerable congressional interest has been shown in using satellites to convert solar radiation to microwaves and beam them to Earth for conversion to electricity. Such a system would have the advantage of not requiring storage because the satellites would be almost constantly exposed to the Sun. If solar power satellites could be constructed economically, they could be a major source of essentially inexhaustible energy.

Because of this interest, legislation was introduced in Congress in 1978 setting up a 5-year research program preparatory to determining the feasibility of solar power satellites. To assist Congress in evaluating such programs. OTA was asked to look at the concept and compare it to other potentially inexhaustible energy systems.

Several issues need clarification and eventual resolution if the feasibility of solar power satellites is to be determined. These include the cost of constructing the satellites, their reliability, the effects of microwave beams on life forms and the ionosphere, the institutional arrangements between the utilities and the Government, the potential vulnerability of satellites to hostile actions, and the degree to which solar power satellites would lead to increased economic centralization.

The OTA study will follow two parallel paths. First, a series of workshops will identify the major problems and the criteria for their resolution. This will assist congressional oversight of programs already underway as well as those that would be started if Congress passes the legislation described above. Second, a more indepth assessment will explore the implications of solar satellites and compare them with other "inexhaustible" energy sources. This will build upon and evaluate work now being done by the National Aeronautics and Space Administration and the Department of Energy.

This study was requested by the House Committee on Science and Technology. It is scheduled for completion in mid- 1980.

Alternative Energy Futures

Confronted by seemingly intractable issues and competing claims regarding the future supply and demand situation for energy, Congress in 1978 turned to OTA for assistance. A letter signed by 44 House Members and 10 Senators asked OTA to examine various scenarios for energy supply and demand in the future, as well as how alternative Government policies would affect those scenarios.

In particular, concern was expressed that no study had adequately addressed issues such as the relationship between increased energy use and balanced economic growth, the effect of energy resources on national security. the relationship between energy and environmental goals. and potential constraints to the development of energy supply and demand technologies. Although these issues have been addressed in studies conducted by OTA and others of particular technologies, none considered various energy futures and the tradeoffs that would exist between them regarding these issues.

Begun in late 1978, this study has two objectives. The first is to provide a comprehensive picture of future energy supply and demand patterns and their social, economic, and environmental effects. The second is to analyze the various paths by which a transition from our present dependence on dwindling fossil fuels to a system fueled by renewable energy sources could take. The study will provide the basis for responsible formulation of public policy by identifying and analyzing the critical issues that must be resolved.

Specifically, OTA will examine 10 energy scenarios that are prescribed to have certain characteristics in the year 2000. These include three possible levels of energy demand as well as conditions such as intensive electrification, high use of synthetic fuels, energy self-sufficiency, or high

solar energy use. The study will establish the requirements needed to meet the energy demands for each of the 10 scenarios in a general way and then determine the energy efficiencies and resources needed to meet those demand structures. The economic, environmental, and social effects, as well as the technical requirements of meeting each. will then be analyzed, Additionally, the energy system that would exist as a result of the several scenarios will be compared to various eventual energy futures (e. g., all solar, all fusion) to see how the transition will work.

To conduct this assessment, Congress voted OTA a $1 million supplemental appropriation for FY 1979, plus authorization for 10 additional staff positions. The expected completion date is in early 1980.

Alternative Energy Futures—Liquefied Natural Gas

As part of the assessment of alternative energy futures, the Senate Committee on Finance asked OTA to address the economic and national security implications of importing large quantities of liquefied natural gas (LNG). The administration is now developing a policy statement on LNG, which has created intense interest in Congress, in light of the Nation's experience with imported oil. because it implies dependence on foreign natural gas supplies, An OTA assessment of imported LNG consequently will assist Congress in evaluating this major energy policy proposed by the administration.

This project focuses on the economic justification for the projected costs of LNG imports, the possibility of curtailed supplies or large price increases, and the effect of imported LNG on the development of long-range energy sources and more efficient use of fuels. The OTA study will also evaluate the likely consequences of possible Government actions, including limiting imports, incremental pricing. separate allocation from domestic natural gas, standards for price, and other contractual arrangements with supplying countries, as well as indirect incentives.

This study will build on the assessment of issues related to the safety. facility siting, and transportation of LNG completed by the OTA Oceans Group in 1977, as well as those by others. Other completed and continuing OTA assessments on global trends in energy supply, solar energy. coal, Devonian gas. and residential energy conservation will also provide useful information. [n addition, an understanding of industrial fuel use, North American gas resources, and the development of long-term alternative energy supplies, all of which are critical to the broader assessment of energy futures, will be required.

This study is expected to be completed early in 1980.

Materials

The exploitation of natural resources through technology has traditionally been depicted by the materials cycle—a continuum from raw materials to finished goods to reuse and eventual disposal. Associated with the cycle are industrial and economic activities that depend upon a continuous supply of materials and energy. Thus. a growing U.S. and worldwide economy gives rise to demands for expanded development of resources and new, and sometimes untested, technologies.

But as the demands for resources have increased, so have the concerns about the environmental and safety impacts associated with producing. using, and disposing of minerals and materials. Materials issues are pervasive and cut across the jurisdictions of many congressional committees.

In 1978, the OTA Materials Group delivered three draft reports to Congress. Work also con-

tinued on four other projects. Two of the projects address the need to conserve materials by using them more efficiently. One assesses the potential for and barriers to recovering materials and energy from municipal solid wastes. The other evaluates options for conserving metals in the design, manufacture, use, and disposal of products.

Three projects nearing completion in 1978 assess issues and problems stemming from the exploration for and utilization of minerals and other natural resources. The first analyzes the effects of Federal land management on access to minerals on non-Federal lands. The second examines laws, policies, and practices that affect access to minerals on Federal lands. The third assesses the value of pas-t and future mining activity on existing Federal coal leases.

Two other projects deal with the future supply of minerals and materials in the United States. The first examines the future availability of materials for which the United States depends on imports. The second assesses the prospects for and implications of recovering commodities, particularly shale oil, from marginally economic resources. Work on the latter project is being coordinated with the OTA Energy Group.

Access Across Federal Lands for Minerals Development

The need to develop natural resources to support our technological economy and the desire to preserve and protect the environment have come into conflict with each other in recent years. Rarely has this conflict been more severe than in Alaska. There, a treasure of natural beauty, wildlife, and wilderness coexist with an abundance of natural resources. The barriers that have protected Alaska's environment have been lowered by technology, local development, and an increased demand for resources.

During 1978, Congress deliberated over the assignment of Federal lands in Alaska to different conservation systems. At issue was how much Federal land would be designated as parks, wildlife refuges, national forests, and wild and scenic rivers, and how much would be available for development of natural resources. The congressional deliberation was called for by section 17(d)(2) of the Alaska Native Claims Settlement Act of 1971.

To lay a basis for congressional consideration, OTA addressed the effects of Federal laws, policies, and practices governing access across Federal lands to natural resources located on non-Federal lands. The OTA assessment analyzed laws governing Federal land management systems, the major environmental and land-planning policies that affect access across these land management systems, and the laws specifically applicable to Alaskan lands.

No previous study had been made of access through Federal to non-Federal lands for minerals development. Faced with this lack of information, OTA interviewed more than 500 knowledgeable persons in five Western and three Eastern States to evaluate the nature, scope, and seriousness of access problems. Representatives of disparate interest groups in both the public and private sector were contacted. These included landowners. users, and developers; managers of the environment. of natural resources. and of transportation networks; conservationists and environmentalists with local and national involvement; and representatives of State and local governments. OTA used these interviews to identify issues, analyze problems, and generate policy alternatives.

Requested by the OTA Board, preliminary findings and working papers from the assessment were made available in 1978 to the House Committee on Interior and Insular Affairs for its work on the Alaska National Interest Lands Conservation bill.

Prepublication drafts of the report were distributed to the Senate Committee on Energy and Natural Resources and other Members of Congress in June. By the end of the year. the final report was being published for use when Congress reconvenes in early 1979. (A summary of the draft report may be found in section II.)

Management of Minerals on Federal Lands

In recent years, a number of issues relating to the regulation and disposal of Federal lands have

come before Congress. Constituting about one-third of the Nation, Federal lands contain significant mineral and other natural resources. Particular concern has been expressed over the constraints on and effects of mineral exploitation on these lands.

OTA analyzed Federal land management laws and practices that govern access to and utilization of minerals on Federal lands, and the interaction of Federal laws and practices with State and local controls and payment requirements.

The assessment focused on the role of Federal lands providing natural resources. It examined the mining process, the role of various participants in the process, and the history of Federal laws governing mineral exploitation on Federal lands. Specific issues being addressed include: 1) coordinating mineral exploitation undertaken by different individuals and firms, 2) reconciling mineral exploitation with non-mineral values, and 3) coordinating regulatory and payment requirements imposed on mineral exploitation by different agencies of the Federal and State governments.

In 1977, as part of this assessment, OTA analyzed the effect of legislation to reorganize Federal responsibility for energy on the management of public lands. The Senate Committee on Governmental Affairs and the House Committee on Government Operations used the analysis to draft a more precise bill, spelling out the transfer of certain miner-al leasing functions to the new Department of Energy and the continued control by the Department of the Interior over the allocation and management of multiple use lands.

Requested by the OTA Board, a draft report was completed in 1978 and delivered to the staffs of interested committees. Sections of the report were used in the President's National Nonfuel Minerals Policy Review. Also, the Senate Committee on Governmental Affairs used the analysis of payment requirements under existing laws in its consideration of the Energy Impact Assistance Act. The final report is expected to be published in early 1979,

Conservation Options for Reducing Metal Losses

The supply of metals can be extended through appropriate conservation measures such as waste reduction, recycling both metals and metal products, substituting plentiful for scarce metals, reducing dissipative uses, extending product life, redesigning products, and reducing corrosion and wear.

At the request of the Senate Committee on Commerce, Science, and Transportation, OTA has examined the materials cycle, from mining through product disposal. to identify and quantify waste and loss. To provide focus, the scope of the assessment was limited to selected metals (iron, chromium, nickel, copper, alum in urn, manganese, tungsten, and platinum) and certain products, such as autos and refrigerators, buildings and bridges, lathes, tractors. and cars.

Data developed by OTA in this assessment have been used by the Senate Committee on Commerce, Science, and Transportation in evaluation of research and development alternatives, procurement policies. and product regulations. The House Committee on Armed Services has used the data to review objectives for stockpiling materials, and by the Senate Committee on Public Works in reviewing the Resource Conservation Act of 1976. The Senate Committee on Commerce, Science. and Transportation also used background data from this assessment for a corrosion workshop held in October 1978.

A prepublication draft report was completed during 1978. The final report is scheduled for publication in early 1979.

Materials and Energy From Waste

Waste disposal is a rapidly growing problem in many areas of the country—more than 135 million tons of municipal solid wastes are generated annually in the United States. Local governments are finding such traditional disposal methods as open dumping, landfill, uncontrolled burning, and ocean burial too expensive or environmentally unacceptable. At the same time, this waste

contains about two-thirds of the paper and glass, more than one-fifth of the aluminum, and nearly one-eighth of the iron and steel consumed nationally. If burned, flammable wastes could supply somewhat more than 1 percent of the Nation's energy needs.

The recovery, recycling, and reuse of resources from waste can help solve waste generation and disposal problems, contribute to the wise and efficient use of materials, conserve energy, preserve the environment, and reduce the Nation's dependence on certain imported natural resources. The economic success of resource recovery depends on the cost of processing waste and of adequate landfill, as well as on the availability of markets for recovered materials and energy,

At the request of the Senate Committee on Commerce, Science, and Transportation and the House Committee on Science and Technology, OTA has studied the potential for and the barriers to recovering and recycling resources from municipal solid wastes. OTA has also identified and analyzed the effectiveness and impact of policy options toward resource recovery and reuse.

The assessment examined: 1) markets for such recovered goods as paper, aluminum, ferrous metals, glass, and energy; 2) source separation for materials and energy recovery; 3) the economic and technical feasibility of using centralized facilities for recovering resources; 4) the effect of freight rates on the movement and sale of recovered goods, 5) economic policies to stimulate resource recovery and recycling; and 6) the effectiveness and impacts of mandatory deposits on beverage containers.

The OTA staff testified on the preliminary findings of the assessment before the Subcommittee on Transportation and Commerce of the House Committee on Interstate and Foreign Commerce at hearings held May 28. 1977, on the implementation of the Resource Conservation and Recovery Act. Testimony was also given by OTA before the subcommittee on the status of centralized resource recovery on March 8, 1978, and on OTA's analysis of the implications of mandatory deposits on beverage containers on August 10, 1978.

A draft report was delivered to Congress in 1978. Publication of the final report is expected in early 1979.

Recovering Commodities From Subeconomic Resources— Case Study of Oil Shale

The continued depletion of many materials has focused attention on the development of technologies for exploiting alternative or submarginal resources to meet future needs. OTA is assessing the costs and benefits of processing such resources, using oil shale as a case study.

Oil shale contains a complex organic substance called kerogen that when heated produces oil, gas, and residual carbon. Oil shales are found in many countries of the world, but by far the most extensive concentration is located within a 17,00(J-square-mile area in Colorado, Utah, and Wyoming. Within this region, there may be more than a trillion barrels of oil in shales rich enough to be of potential commercial interest. However, various technological. environmental, and economic uncertainties associated with processing oil shale must be resolved before it can make a significant contribution to the Nation's energy supply.

Accordingly, OTA is investigating technologies for and impacts that may accompany development of oil shale. The potential impacts include the environmental effects, the availability of water for mining and processing, and the industrialization of heretofore almost exclusively rural areas. OTA is also analyzing the economic and technological factors that prompted industry interest in oil shale and those that have brought about a subsequent decline in interest.

This assessment, requested by the Senate Committee on Energy and Natural Resources, is expected to be completed early in 1979.

Federal Coal Development Rights

The Administration's National Energy Plan calls for expanded coal production to offset the

rising prices and uncertain availability of other fossil fuels. More than one-half of the Nation's coal reserves are found in the Western States. and the Federal Government owns about two-thirds of those reserves In 1974. an estimated 15 billion tons of Federal coal reserves were under lease, seemingly more than enough to meet future demand.

Yet, less than 50 million tons of coal per year has been produced from these leases. To meet the goal of 1.2 billion tons of coal in 1985, production must increase nearly 80 percent over 1976 levels. Production goals for Federal leases call for a sixfold increase to approximately 300 million tons per year in 1985.

Low coal production has raised suspicions that some leases were being held for speculation and would not begin production in time to meet national energy demands. In 1973, in response to charges of speculation and mismanagement. the Department of the Interior imposed a moratorium on further leasing. The coal industry, however, has advocated increased Federal leasing to meet projected 1985 production goals.

In August 1976, Congress directed OTA to analyze all outstanding Federal coal development rights, which include more than 500 leases and 200 preference-right lease applications then in effect. This assessment is examining all mining activities on Federal leases and determining the present and potential value of the outstanding coal development rights, It is also estimating revenues to the Federal Government, and analyzing the feasibility of using deep mining technology in leased areas.

Completion of this study is expected in early 1980.

U.S. Dependence on Imported Minerals

The oil embargo and shortages of commodities in 1973-74 irreversibly altered long-established relationships between mineral-producing and industrialized nations. Increased energy costs have led the less industrialized countries to raise prices for their resources to pay for imported energy and remanufactured goods. The success of the energy-producing countries in limiting supplies, embargoing shipments, and driving up world oil prices provided a model for creating cartels for other scarce resources, such as the Council of Copper Exporting Countries and the International Bauxite Association.

These developments may portend increased competition among nations for world supplies of critical materials or. conversely, increased cooperation in an interdependent world. Further, they raise questions about the opportunities and vulnerability of the United States regarding imported minerals. As both an importer and exporter of nonfuel minerals, the United States benefits from a healthy world trade in natural resources. For some minerals. such as manganese and cobalt. the United States is almost totally dependent on foreign sources.

OTA is assessing U.S. dependence on imported nonfuel minerals. The study examines the future availability of selected mineral imports, the role of these commodities in the domestic and international economies, and the public policy implications of dependence on imported minerals. Various policy alternatives for dealing with these situations are being explored. During 1979, OTA will identify and clarify critical issues associated with dependence on imported non fuel minerals.

The study was requested by the House Committee on Science and Technology. Interest in the study was also expressed by the House Committees on International Relations, Interior and Insular Affairs, and on Banking, Finance, and Urban Affairs, and the Senate Committees on Foreign Relations, on Energy and Natural Resources. and on Commerce, Science, and Transportation. It is expected to be completed early in 1980.

National Security

A number of national security issues that trouble Congress and the public pose difficult questions about the significance of technological changes. For instance, Congress has expressed a continuing interest in ensuring that defense programs and arms control objectives are compatible. It repeatedly questions the implications of new technologies for stimulating or dampening arms competition. Congress is also concerned about the implications for U.S. foreign and defense policy of advances in the level of military technology (whether through purchase or indigenous development) in other countries, particularly the Soviet Union.

While much information about these questions is provided by the executive branch, the implications are obviously matters of concern to Congress even before the executive branch has formulated its views of what the opportunities, costs, and risks of new military technologies may be. Similarly, the way in which emerging technologies may create opportunities or difficulties (or both) for arms control and for other international security arrangements is a fruitful subject for study. There may also be existing technologies whose implications, in the broadest sense, have not been examined in a balanced way.

To provide Congress and the public with independently-derived information on issues such as these, OTA created the National Security Group late in 1978. Studies undertaken by the Group will focus particularly upon unintended consequences, unexplored opportunities, and societal implications of defense-related technologies. They will go beyond the questions of costs and benefits that dominate the executive and congressional budgetary process.

OTA began work in late 1978 on an assessment of the effects of nuclear war. Additionally, preliminary planning was begun for further studies in the areas of peace technology and military equipment of the future.

Effects of Nuclear War

Nuclear war is not a comfortable subject. It is paradoxical that over the years most Americans have come to worry less about it, while at the same time the continuing growth and modernization of strategic arsenals has made the consequences of an actual war far more severe than they would have been in the past. Moreover, U.S. policy is founded on the belief that the very horrors of a nuclear war make its deterrence more feasible. It follows that a clear understanding of our own policies requires us to know something about these horrors.

Thus, OTA is building upon its 1975 analysis of the effects of limited nuclear war to study the effects of a wider range of possibilities, This assessment is seeking to put the abstract measures of strategic power into more comprehensible terms. It is concentrating on the impact that various levels of nuclear attack would have on the populations and economies of the United States and the Soviet Union, and the effects of large attacks upon other nations of the world as well.

The study is focusing on the wide range of effects that nuclear weapons would produce. These include not only the immediate damage caused by blast and radiation, but also the effects of fires and fallout, the longer term effects of economic damage and societal disruption, and medical and genetic effects.

OTA is investigating the way in which the effects of nuclear war may vary depending upon the magnitude and the purpose of a nuclear attack, as well as how effectively civil defense programs might mitigate those effects. To the extent possible within the limitations on available information, OTA is identifying differences between the effects on the United States and those on the Soviet Union.

Finally, OTA has observed that there is a tendency for military analyses to focus upon areas of

relative certainty — a military planner is concerned with whether the effect of a nuclear weapon is adequate to destroy his target. In contrast, OTA will attempt to identify and discuss areas of particular uncertainty,

Requested by the Senate Committee on Foreign Relations, this study is expected to be completed by mid-1979.

Technology and World Trade

Technology and the impacts of technological applications are an increasingly important factor in U.S. foreign and world trade policies. New technologies have changed the competitive position of many U.S. industries on world markets. Trade in technology is itself assuming major importance in international commerce. Advances in communications, transportation, and space technologies have ‘opened unprecedented opportunities for international cooperation. Further, many of the most critical world problems facing U.S. foreign policy have, to a significant degree, a technological origin and will require technological solutions. These include population growth, world food supplies, pollution, the development of sustainable energy sources, and conservation of depletable resources.

Unfortunately, technological progress has frequently outdistanced the efforts of diplomats and international institutions to ensure that technology is used to promote world stability instead of increasing international tensions. OTA projects in this area will determine that technologies are likely to have the greatest impact on U.S. foreign policy interests, examine those technologies and their implications, and measure the utility of policy responses to problems and opportunities which may be identified.

Studies in the Technology and World Trade Group will be carefully coordinated with other activities in OTA. For example, since many emerging technologies have their first international impacts through military uses, a close liaison is maintained with the National Security Group.

The Technology and World Trade Group is currently working on three major areas of study. A continuing study is analyzing the implications of world trade in technologies. It is assessing the significance of trade between the free world and Communist countries, between industrialized and less industrialized nations, and among members of the Organization for Economic Cooperation and Development (OECD). A second project is studying the impact of new technologies on the competitive position in world markets of four major U.S. industries: steel. electronics, aircraft. and chemicals. A new study begun in 1978 is examining the foreign policy implications of U.S. energy policy.

Technology Transfer

The volume and variety of international transactions involving the movement of technical know-how from one country to another has increased greatly in recent years. At the same time. so too has the recognition that this kind of technology transfer plays a significant role in determining relative national military and economic capabilities. Despite a large and varied literature, however. the complex process of technology transfer is not completely understood.

At the request of the House Committee on International Relations, OTA is attempting to disengage issues of technology transfer from the tangle of other forces influencing the country’s national security position and economic health. This project is identifying the opportunities and obstacles posed by technology transfer, and ana-

lyzing a range of appropriate policy responses and their likely consequences.

The project is divided into three distinct components. One is studying technology transfer between the United States and the Communist world. The second is assessing the impact of technology transfer in U.S. relations with the developing countries. And the third is evaluating the competitive position of U.S. industry relative to that in other OECD countries.

These studies will proceed largely on a case study approach. They are addressing such issues as the current state of U.S. technology, the U.S. role in international trade in technology, technology transfer and its relation to innovation and productivity, the role of technology transfer in the maintenance of national security, and the viabilit y of technology transfer as a political lever or tool of diplomacy.

Because of congressional interest, the study of East-West transfer is being undertaken first. The study is exploring the impact of Western technology on the economies of Communist countries. It is also reviewing methods for determining the economic and political costs and benefits—including the national security implications—for each party in the commercial transaction. Finally, the study is analyzing the efficacy of technology transfer as an instrument of foreign policy, and assessing the value of such transfers as a means of improving East-West trade.

This assessment is scheduled for completion in mid- 1979.

Competitiveness of U.S. Industries.

A growing number of people have become concerned recently that many U.S. industries are losing, or have already lost. their position of technical leadership in critical areas, relative to those in other countries. Further, there is fear that this change will adversely affect their ability to compete in world markets.

OTA is examining this problem by looking carefully at four important industries: steel, electronics, chemicals, and aircraft. These industries were chosen to illustrate a wide spectrum of issues and industry capabilities. They range from the steel industry, which is a mature, capital-intensive industry where technology changes slowly, to the electronics industry, which is very volatile and critically sensitive to a constantly changing technology.

The steel industry is being examined first because of congressional priorities. More than 500,000 persons are employed making steel, and many millions of other jobs are indirectly affected by the health of the industry. In recent years, however, the industry has faced serious challenges from Japanese and other foreign steel producers. The United States has lost critical export markets, and imports are increasing at a rate that is causing considerable concern. The steel industry has apparently been unable to generate sufficient capital to modernize and expand production, and there is concern that it is falling behind its foreign competition technologically.

OTA is analyzing the role technology plays in steelmaking in the United States and around the world. This assessment is examining the technologies now being used and attempting to anticipate those that may be available during the next few decades.

For the purposes of this study, the steel industry is not being treated as a single entity, Rather. three major elements of the industry are being treated separately: integrated carbon steelmaking, non-integrated carbon steelmaking (including “mini-mills”), and alloy/specialty companies. Each category presents unique opportunities and problems for study.

The study is examining ways in which research, development, and demonstrations of new steelmaking techniques are now conducted in the United States and by our major competitors. It is also exploring the incentives and barriers to the introduction of new technologies. The impact of a variety of Federal programs and regulations (including labor laws, environmental controls, and health and safety regulations) are also being explored. A broad range of possible legislative solutions to problems that are identified will be suggested and their impact assessed.

The study of industrial competitiveness was requested by the Senate Committee on Commerce, Science, and Transportation, the House Committee on Ways and Means, and the Joint Economic Committee. It is expected to be completed in mid-1979.

Foreign Policy Implications of Global Trends in Energy Supply and Demand

This assessment is examining the linkage between the global trends in energy supply and demand and the achievement of U.S. foreign policy objectives. It is identifying and analyzing areas in the world where energy shortages or high prices are likely to create political and economic difficulties during the next three decades. the impact of these actions on the economic and security interests of the United States, and the policy options available to mitigate negative impacts here and abroad. The assessment will be as specific about the time, location. and nature of energy-related problems as possible, given the uncertainties in existing information about world energy resources.

Requested by the Senate Committee on Foreign Relations. the assessment is proceeding in three basic stages. The first is reviewing existing information about energy resources, supply, and conservation programs now under way in key areas throughout the world. A major effort is being made to identify areas of disagreement and uncertainty and to explain the reasons for this disagreement.

The second stage will then prepare a series of credible scenarios for the price and availability of depletable energy resources during the next 30 years. These scenarios will illustrate. among other things, the impact of aggressive energy conservation policies, unexpected discoveries (or failures to discover) of new fossil fuel resources, and possible policy decisions by major petroleum-exporting nations.

The third stage will analyze the scenarios to illustrate their impact on the economic welfare of the United States and other nations. The assessment will highlight impacts that could weaken various national economies. seriously threaten the aspirations of developing nations, or jeopardize U, S. security. In addition, U.S. energy and foreign assistance programs, as well as other foreign policy initiatives, will be analyzed for estimates of their utility.

The project will be completed in mid- 1979.

HEALTH AND LIFE SCIENCES DIVISION

Food

As with energy and many other natural resources, Americans took for granted until recently a plentiful supply of relatively inexpensive food. Recent shifts in weather patterns, shortages of key resources such as fertilizer and water, and inflation, coupled with increased demand, led to rising prices and inconsistent availability of food in some countries.

At the same time, questions have been raised about the safety and nutritional value of our current food supply. Concern has been expressed over the potential consequences of chemicals used to repel pests. promote livestock growth, retard spoilage, or enhance the flavor, appearance, and shelf life of food.

To provide the Congress with information on these and other food-related problems, the OTA Food Group identifies current and emerging issues that affect the U.S. and world food situation. The food studies are organized around three functional areas: 1) production, including all resources required to produce agricultural

products and get them to the farm gate; 2) marketing, consisting of processing, wholesaling, and retailing; and 3) consumption and nutrition, both in and out of the home,

Two projects under way in 1978 examined issues concerning the production of food. One, begun in 1977, is studying the benefits and risks for humans of using drugs and chemical additives in livestock feeds. The second, begun in 1978, deals with pest management strategies.

In the food marketing area. one study was completed in 1978 and work continued on two others. The completed report distinguished for further study seven emerging technologies for marketing food products. The other evaluates techniques for labeling the shelf life of processed foods. A preliminary analysis of the impacts of surface transportation on food has been transferred to the Transportation Group in 1978 for consideration in the potential assessment of the movement of goods,

In 1978. the nutrition area completed a report on nutrition research alternatives conducted or sponsored by the Federal Government. Currently the nutrition area is carrying out an assessment of the impact of environmental contamination of food on health.

Finally, recognizing the need to better turn U.S. food policies into a global context, the OTA Food Group in 1978 began to plan for a new assessment to address alternative global food futures. This assessment will build on previous work on alternatives in the U.S. food policy and will use work developed from a number of other OTA food assessments.

Nutrition Research Alternatives

Requested by the late Senator Hubert H. Humphrey, this report provides guidance to Congress in oversight of executive branch agencies conducting or sponsoring research on human nutrition. The assessment found that Federal research programs have failed to keep up with the changing health needs of Americans. The report assesses alternatives for redefining and refocusing Government research programs on nutrition. (A summary of this report may be found in section 11.)

Background material provided from this OTA project was used in 1978 by the Senate Committee on Agriculture, Nutrition, and Forestry for hearings on cancer research. The Senate Committee on Appropriations employed OTA material to distinguish between clinical and basic research on nutrition.

Emerging Food Marketing Technologies

Many new and emerging technologies for marketing food will affect processors, transporters, wholesalers, retailers, and consumers alike. This report ranked various technologies by their likelihood of being adopted, their current state of development, and the major policy issues they raise. The study helped OTA define the need for a major assessment of alternative global food futures. (A summary of this report may be found in section 11.)

This report originated as a proposal from the OTA Director to the Board, which approved it for study in 1977.

Drugs and Chemicals in Livestock Feeding

Farmers and ranchers are widely using various drugs and chemicals as additives in livestock and poultry feed. Used to protect animal health and promote growth, this development is an integral part of the recent technological revolution in the production of meat, milk, and eggs. Other essential components of that revolution include sanitation, immunization, mechanization, and improved nutrition and breeding of livestock.

Because of suspected risks to human health from continued feeding of these drugs to livestock, the Food and Drug Administration (FDA) has announced plans to restrict the use of oxytetracycline, chlortetracyline, penicillin, nitrofuran, and diethylstilbesterol (DES).

There has been a growing concern about the contribution the use of antibiotics in feed has on the development of drug resistant bacteria as well

as recognition that some of these drugs cause cancer in laboratory animals.

OTA is assessing the risks, real or potential. to human health from continued use of these drugs, Also being addressed are the benefits. especially the economic contributions and impact on increased food supplies of these drugs, The effect on food prices of banning use of the drugs as feed additives is being considered, A number of options ranging from continued use to complete withdrawal of the drugs, along with the risks and benefits of each, are being developed.

The assessment was requested by the Senate Committee on Agriculture, Nutrition, and Forestry. OTA staff testified before the Subcommittee on Dairy and Poultry of the House Committee on Agriculture regarding the consequences of withdrawing these drugs, This project is scheduled for completion early in 1979.

Open Shelf-Life Dating of Food

The purpose of using an open date on packages is to inform consumers about the shelf life of the product. Federal regulations have been established for other areas of information disclosure, such as nutrition and ingredient labeling and food grades. However, open dating has remained a voluntary program at the Federal level. Thus. there is no uniform or universally accepted open-dating system for food in the United States. In parts of the country, some foods now have an open date in one form or another, whereas in other areas food lacks an open date altogether.

Requested by the Senate Committee on Commerce, Science, and Transportation, this project is assessing the present status of open dating and its projected benefits and costs. It also is analyzing alternative techniques, criteria, systems, and enforcement methods for open dating and their impact on the food industry, consumers, and the economy. Background reports prepared for this assessment were used in hearings by the House Committee on Interstate and Foreign Commerce on food labeling. which included open dating.

This study is expected to be completed in early 1979.

Pest **Management** Strategies

In the past three decades, U.S. agriculture has become increasingly dependent on chemical pesticides to control weeds. insects, and diseases that destroy crops. Continued reliance on these chemicals alone now appears impossible Heightened concern over their environmental effects, coupled with increased pest resistance and secondary pest outbreaks, severely limits the effective pesticides available to farmers. While these trends are found most fully in the United States, the problem is worldwide. If farmers are to meet the growing demand for food, new means for controlling pests are needed.

This assessment has three major objectives. The first is to assess the potential development and impact of pest management strategies in major regions of the United States over the next 10 to 15 years, The second is to evaluate Federal policies that constrain the development of technologies and strategies to manage pests, The third objective is to assess the potential and impact of adapting U.S. advances in pest management strategies on crop protection in developing countries,

Seven OTA regional studies, focused on the 12 chief agricultural crops, brought together a diverse group of scientific, consumer, and environmental interests. These interest groups also took part in a 2-day public meeting in Washington, D. C. in November along with more than 125 other persons to discuss crop protection problems and approaches to their solutions,

This assessment was requested by the Senate Committee on Agriculture, Nutrition, and Forestry, OTA staff testified in 1978 before the Subcommittee on Agriculture Research and briefed the staffs of the House and Senate Committees on Agriculture on the progress and potential use of assessment results. The study is expected to be completed by early 1979.

Environmental Contaminants in Food

In the past decade, various foods have become contaminated by substances in the environ-

ment that have been identified as toxic. Polybrominated biphenyl (PBB) in Michigan contaminated livestock feed and products, and kepone in the James River of Virginia contaminated fish and other seafoods. This type of food contamination has led to actual or potential risk to human health and has caused severe economic setbacks to the food producers whose products have been contaminated.

Requested by the House Committee on Interstate and Foreign Commerce. this assessment is addressing issues derived from the contamination of food by organic chemicals, metals and their complexes, and radioactive substances. The two major areas addressed by this assessment are tolerance and monitoring.

The section dealing with tolerance will analyze present and alternative methodologies for determining acceptable limits and estimating economic impact. The section dealing with monitoring will analyze existing and future means for detecting environmental contaminants in food products, predicting substances that could potentially contaminate food, identifying and analyzing the components of a monitoring system, and evaluating both Federal and State capabilities for monitoring food.

The expected completion date for this assessment is mid- 1979.

Genetics and Population

OTA created the Genetics and Population Group in response to the growing interest in these two areas. An assessment in the area of applied genetics was begun in late 1978. Planning for an assessment in population was also initiated in 1978 and a proposal for Board review was planned for early 1979.

Impacts of Applied Genetics

"Applied genetics" refers to those technologies that can influence the biological characteristics inherited by man, animals, and plants. Recent advances in knowledge may greatly expand our capability to affect genetic characteristics to improve the quality of life. However, there are also risks of inadvertent harm associated with these advances, many of which have not been fully examined.

To date, the Federal Government has focused on only one technology, recombinant DNA, and one issue, containment of new and possibly harmful organisms. Little attention has been given to other technologies, such as cell fusion, or to other issues, such as costs and benefits, and the social and ethical questions raised by these new technologies.

Thus, issues requiring attention include:

- What are some key opportunities for society through applied genetics?
- What are some of the potential problems?
- Is Government regulation of research on genetics desirable considering the dichotomy between freedom of scientific inquiry versus social values and public risks?
- If regulation is desirable, who should exercise it and how extensive should it be?
- Who should own new life forms that have commercial value and could benefit mankind? (This involves issues of public rights versus property rights and incentives to innotation s.)

This assessment will focus on the use of applied genetics technologies in agriculture, commercial/industrial processes, and prevention and treatment of inherited human defects. The project was identified in OTA's initial priority-setting process and was approved as an active project by the OTA Board on October 3, 1978. The genet-

ics assessment has been discussed with Senate and House committees with responsibility for agriculture, commerce, health, science and technology, and judicial issues (such as patents). Expressions of support for the study were received from the House Committee on Interstate and Foreign Commerce and the Senate Committee on Human Resources. Earlier, in September 1976, 30 House Members requested an OTA assessment of recombinant DNA technologies.

Technology and World Population

Modern medicine has contributed to the increase in the length and quality of human life, as well as to the growth in human numbers. A world population that took 16 centuries to double has now reached 4 billion —with the prospect of doubling again in only 40 years. A growth rate of this magnitude has major implications for the world environment and for international economic and political stability. At year's end, OTA was considering a number of priority issues for possible study. They deal with the origins and impacts of population growth, contraceptive technology, and the effectiveness of programs to encourage contraception.

Among the major issues that are presently the subject of debate among population specialists, environmentalists, and planners are the following:

- Origins and impacts of population growth. Is high fertility more a function of socioeconomic factors (e. g., the status of women) or of ignorance concerning, and lack of access to, contraceptive technologies? What is the relationship between population growth and health care, economic development. and environmental quality in less developed countries? Can rapid population growth interact with technological innovation under some circumstances to produce international aggression and conflict?
- Contraceptive technology. From a biomedical standpoint, what are the comparative advantages and drawbacks of various contraceptive technologies in terms of safety and effectiveness? What are the prospects for a significant improvement in contraceptive technologies'?
- Program effectiveness. What factors under what conditions determine the effectiveness of family planning and related programs'? Can Government policy most effectively influence fertility through socioeconomic development or through provision of contraceptive services? Is there an optimal combination of those two approaches? What is the best institutional arrangement within the U.S. Government for formulating and administering an overseas program'?

Population growth is of special interest to the House Select Committee on Population. the Senate Committee on Foreign Relations, and the House Committee on International Relations. Drawing upon the needs of congressional staffs and with suggestions from CRS and a panel of outsiders, OTA staff began developing a proposal for a technology assessment in population in late 1978. The proposal will be taken to the Board in early 1979.

Health

Science and its applications have had profound impacts on every aspect of health care in the United States and the World. These impacts are likely to increase as the influence of technology on health care grows.

Until the mid-to-late 1960's many people assumed that nearly all technologies employed in the medical care sector were beneficial. Furthermore, many believed that the increased uses of additional technologies could only enhance the

quality of health care and improve overall health status. However, these assumptions have been challenged recently in both the public and private sectors because of the diminishing improvements in health status, the appearance of serious side effects associated with the use of some medical technologies, the inequitable distribution and availability of technological benefits, and the rapidly rising costs of health care.

The OTA Health Group addresses congressional concerns about medical care technologies. The Group assists the Congress by: 1) examining the Federal role in anticipating and managing domestic and international impacts of health technology; 2) highlighting the social, political, economic, and ethical implications of medical technologies: and 3) assessing the consequences of Federal policies involving the provision of and payment for particular medical technologies.

In 1978. the Health Group explored how medical technologies are evaluated before being widely adopted. The two long-term studies completed and the one initiated last year all concentrate on this major issue. One of the completed studies examined the use of computed tomography scanners, relatively new but widely used medical devices. The other analyzed assessments of the efficacy and safety of medical technologies. It also evaluated Federal policies and activities that purportedly ensure efficacy and safety. The newly initiated study is focusing on various questions that arise when determining the cost-effectiveness of medical technologies.

The Health Group also worked on four background reports during 1978. Two centered on Federal health data systems, building on the 1977 OTA report on the policy implications of medical information systems. One is reviewing legislatively mandated health data systems, and the other is examining current policy mechanisms for coordinating Federal statistical activities.

A third background paper identified issues and questions involved in the development, production, and use of vaccines. It was based on a case study of pneumococcal vaccine. The fourth analyzed the relationship between computer technology and the assessment, as well as enhancement, of physician services during the progression from undergraduate medical education to clinical practice.

Policy Implications of Computed Tomography (CT) Scanners

OTA used the CT scanner as a case study to highlight several important health policy problems and issues involved in the development and diffusion of new medical technologies. The CT scanner is a relatively new diagnostic device that combines X-ray equipment with a computer and television-like display tube to produce a cross-sectional image of the body. It is an extremely expensive medical device whose efficacy and safety have not been fully evaluated. Yet the scanners have been widely bought and used. (A summary of this report may be found in section II.)

Requested by the Senate Committees on Finance and Human Resources, the report helped stimulate legislation that created new programs for the evaluation of medical technologies. Information contained in the report also has been of particular assistance to the planning agencies across the country that have been confronted with the rapid spread of CT scanners.

Assessing the Efficacy and Safety of Medical Technologies

Requested by the Senate Committee on Human Resources, this study further developed issues raised by OTA's report on CT scanners. The study investigated the need for assessing the efficacy and safety of current and future medical technologies. It also discussed the methods and procedures used in evaluating medical technologies. Finally, it described the types of assessment programs currently supported by the Federal Government, and suggested alternatives for improving existing assessment programs and and policies. (A summary of this report may be found in section II.)

This study assisted congressional consideration of the legislation (passed in the 95th Congress) that created a National Center for Health Care Technology. In addition, the Department of Health, Education, and Welfare relied heavily on

earlier drafts of the report when forming its Office of Health Technology.

Cost-Effectiveness of Medical Technologies

Health technologies have contributed substantially to rapidly rising health care costs. The prevention and treatment of disease are consuming an increasinglv greater share of the country's resources, Given the finite nature of these resources, a number of questions need to be addressed. What is the return from this growing financial and human investment'? What is the relative contribution or benefit of various physiological, pharmacological, procedural, and health systems technologies? The most critical question: Are the resources spent on health care being allocated in the most rational manner?

Cost-effectiveness analysis is seen as a way to help allocate health resources more rationally, Such analysis compares the costs of alternate ways of attaining specified goals or effects. There is growing pressure to make cost-effectiveness a prime consideration **in** deciding whether to adopt particular medical technologies.

This assessment, requested by the Senate Committees on Finance and on Human Resources, is examining the potential effects of using cost-effectiveness techniques, The study is evaluating: (1) the feasibility of employing cost-effectiveness analyses of several specific medical technologies as case studies. (2) the need for using cost-effectiveness techniques. (3) the social costs and benefits, as well as the potential ethical, economic. political. and legal implications of using cost-effective techniques: and (4) the feasibility of expanded use.

The study, initiated in October 1978, is expected to be completed in early 1980.

Pneurnococcal Vaccine

During the past 15 years, the number of pharmaceutical companies developing and producing vaccines in the United States has dropped significantly. During this same period, the Federal Government has increased its financial commitment to vaccine research and development. Some authorities maintain that the Federal Government should further increase vaccine R&D (and possibly even go into production) because of the private sector's growing disinterest.

Using the development of pneumococcal vaccine as a case study, this background report identifies selected issues in three general areas: vaccine research and development in both the public and private sectors: the cost-effectiveness of preventing diseases through the use of vaccines, and factors that affect the use of preventive health technologies in genera] and vaccines in particular.

This report also analyzes the cost-effectiveness of using pneumococcal vaccine as a preventive health measure in selected segments of the population. This vaccine is intended mainly for people who have a high risk of contracting pneumococcal pneumonia. Theoretically, it is more desirable to prevent this form of pneumonia through vaccination than to treat it. Prevention could not only reduce hospital and other treatment costs, but it also could lower the number of deaths caused by pneumonia, the leading killer among infectious diseases in the United States. OTA is examining the validity and social implications of this idea.

Finally, this report identifies various factors that affect the use of vaccines, such as consumer awareness of benefits and risks, availability and cost, incentives to administer vaccines, liability for harm resulting from vaccination, and Government efforts to promote vaccine use. All of these factors need to be considered by public health planners when designing programs, either to help prevent or to help treat disease.

This study is expected to be completed early in 1979.

Computer Technology and the Quality *of Physician Services*

Physician training in~'elves the accumulation and application of knowledge in the care of patients. OTA is examining how various computer technologies might be used to assess and or im-

prove this process, which includes medical school selection. undergraduate and graduate medical education, and clinical practice.

Computers can assist in and manage instructional programs, aid in testing, perform diagnostic, prognostic. and therapeutic functions, and manage large amounts of data. Computers will soon provide large data banks on student characteristics and performance, on physician and institutional performance in patient care, on the status of individual patients, and on the health status of various population groups.

Such computer capabilities will change not only how and what physicians learn but also how they practice. Moreover, the growth of large health and medical-related computer banks will raise complex technical, political, and social questions involving the control, access, security, and privacy of such data.

This study was initiated by OTA to provide a background against which future assessments of more specific areas of the quality of medical care can be conducted. It will be completed in 1979.

Health Data Systems

The Federal Government lacks a coherent policy on the collection, analysis, and use of statistical information regarding people's health and their use of medical care resources. There is currently no national health information system. Instead, there is a patchwork of numerous data collection projects, each of which addresses a different need or purpose. Moreover, there is no systematic appraisal of the adequacy. need for, or use of health data that is currently collected.

Because of the lack of attention given to the numerous statistical activities of various Federal health programs. OTA was requested by the Senate Committee on Human Resources t. determine both the extent to which Congress requires the collection of health statistics and the degree to which such activities are coordinated. This assessment has been divided into two parts. One study is examining all statutory authorities that require agencies within the Department of Health, Education, and Welfare to collect health data. The other is focusing on the lack of coordination among various Federal agencies that collect health data and outlines alternatives for integrating health data collection and use.

SCIENCE, INFORMATION, AND TRANSPORTATION DIVISION

National R&D Policies and Priorities

The OTA R&D Policies and Priorities Group addresses broad issues that cut across scientific and technical fields. Often, more than one technology base (such as national laboratories or reorganization of the Federal structure for science and technology), or issues relating to technology that define an appropriate role for the Federal Government (such as industrial innovation or regulatory policy), is involved.

During the calendar year, the R&D Group was restructured and redefined to better address the needs of Congress in this complex policy arena. Previously, three standing advisory panels provided substantial assistance to OTA in defining issues, goals, and initial projects. The three panels dealt with the health of the scientific and technical enterprise, applications of science and technology, and decisionmaking on R&D policies and priorities. In 1978, these panels concluded their work. Additionally, the OTA Advisory Council, which had served as the steering committee for this Group, decided that its special guidance was no longer required.

During the calendar year, the R&D Group

completed the first series of projects begun in 1976 and issued five reports. Two were issued as OTA staff reports. One examined the management policies of the Federal Government for research and development aimed at the civil sector. Another analyzed the role of demonstrations in Federal R&D policy.

Two other reports written by OTA contractors under the guidance of the R&D Group were published during 1978. One examined the role of the Federal Government in influencing the innovation process. A second suggested criteria for Congress to use in evaluating administration proposals to reorganize Federal education programs for science and technology. The fifth report published in 1978 came from the panel on the health of the scientific and technical enterprise. It defined the enterprise and suggested criteria for judging its health.

Work continued in 1978 on the role of national laboratories and their potential for helping to solve national problems. Finally. two new assessments were initiated during 1978. one on technology for local development and the other on technological innovation and health, environmental, and safety regulations.

Demonstrations in Federal R&D Policy

Federal expenditures for demonstration projects have grown to more than $1 billion annually. However, several studies have indicated that the effectiveness of demonstrations as a tool for formulating policy has been limited OTA reviewed the experience with Federal demonstrations and provided Congress with a detailed set of guidelines for the effective evaluation of individual demonstration proposals. (A summary of this report may be found in section Il.)

Cooperative Agreements: Applications of Federal R&D in the Civil Sector

This report analyzes the recently enacted Federal Grant and Cooperative Agreement Act and points out the opportunities the Act provides for more effective financing of R&D intended to produce innovations in the civil sector. As required by the Act, Federal agencies must now distinguish between "procurement''—buying something for the direct use of the Government—and "assistance''--supporting or stimulating a non-Federal activity in the public interest. Thus, transactions in the future to support non-Federal R&D would come under the assistance category, rather than being considered as a procurement. (A summary of this report may be found in section II.)

Government Actions Affecting **Innovation**

Governments in most industrial countries seek to promote and shape technological development, particularly where market forces are clearly incapable of achieving defined national objectives. This report compiles the vast array of Government actions and policies that influence the innovation process in the private sector. Additionally, the report discusses a variety of actions and experiments in several foreign countries that are designed to enhance the innovative process in industry.

This report is intended to assist Congress in its response to the recommendations of the President based on "The Domestic Policy Review of industrial Innovation," which are expected early in the 96th Congress. (A summary of this report may be found in section II.)

Definition of the Scientific **and Technical** *Enterprise*

The product of three standing advisory panels, this report defines the scientific and technical enterprise and gives criteria for assessing its health. It also discusses the linkages between society and the major elements of the enterprise. and illustrates the role of technological innovation in a growth oriented economy. (A summary of this report may be found in section 11.)

Science and Technology Education

Issued as an interim report from the study of the reorganization of Federal science and technology activities, this report analyzed the potential impact of transferring education programs for science and engineering from the National Science Foundation to the proposed Department of

Education. (A summary of this report may be found in section II.)

National Laboratories

Of the more than $30 billion spent per year on R&D activities and facilities by the Federal Government, approximately 25 percent is invested in national research laboratories. An additional 5 percent goes 1:0 privately managed, federally funded R&D centers. The effective management of laboratories and use of their research efforts is of major concern when assessing the overall health of the Nation's scientific and technical enterprise.

To provide Congress with criteria for judging the effectiveness of the national laboratories, OTA is assessing their vitality and present institutional structure, The project is examining the role laboratories play in the overall scientific endeavor of the country, as well as considering how these national facilities can be directed toward solving national problems.

Case studies are being used to acquire practical experience from indepth examination of issues such as diversification, mission clarity, conversion, and interagency access to labs, as well as internal management issues such as long-range planning, relation with sponsoring agencies, mission orientation, and autonomy.

Reorganization of Federal Science and Technology Activities

Consideration of organizational structure and issues is essential to any review of Federal R&D activity. The existence of an agency with an assigned jurisdiction creates the essential base for actions that Government is asked to undertake.

In science and technology, Congress has usually created a new agency for each new area of Government activity undertaken. Examples of this include the National Aeronautics and Space Administration (NASA), the Energy Research and Development Administration (ERDA), and the National Science Foundation (NSF), among others. Organizational arrangements can affect an agency's ability to carry out its assignments and to gain Presidential, congressional, and public support for its activities.

This OTA assessment is designed to assist Congress in evaluating proposed reorganizations in the executive branch involving science and technology activities. Past proposals were reviewed by the Congressional Research Service at the request of OTA, and four central types of commonly suggested organizational structures were selected for assessment in this study. From an in -depth evaluation of these four structures, OTA derived principles common to each. The assessment will provide information congressional committees can use in assessing individual reorganization proposals.

Carcinogens in the Workplace

This preliminary analysis is examining how science and technology can be mobilized to-address important national problems. Its results will be used by OTA to determine whether a full assessment on this or a related topic is warranted. It was undertaken because of concern for occupational health, and as a case example of how to effectively mobilize technology to address specific problems.

The project is examining the interactions between technical resources and social forces in the solution of national problems. It is evaluating the need to develop substitutes for hazardous substances, as well as the hazards stemming from factory operations. OTA is analyzing the benefits and economic consequences of regulation, including the costs of not regulating. Also being examined are preventive strategies to anticipate and deal with an oncoming era of chemicals.

The project will analyze major issues concerning occupational cancers and clarify the direction R&D efforts should take to solve this problem. Some three to five subjects for future OTA study are being identified.

Technology for Local Development

Innovative technology can be applied to help local communities throughout the United States solve their problems. A number of commu-

nities—urban, suburban, farming, and small town—are currently demonstrating how technology can be used. For example, Pocatello, Idaho, is using treated waste water to irrigate farmland. This system may help solve pollution problems and, at the same time, provide enough water for irrigation and supplemental nutrients.

In a related area, farmers near Hartington, Nebr., have developed cost-cutting ways to tap renewable resources for farm operations. Solar heating, insulation. biomass conversion, methane production, and wind energy are some of the innovations being developed.

Requested by the Board, the Senate Committee on Governmental Affairs, and the House Select Committee on Population, OTA is assessing technologies that could provide energy, waste treatment, fresh food, and other services at a much lower cost and, at the same time, give local communities more self reliance. Additionally, such technologies can protect the environment and conserve natural resources.

The assessment is proceeding in three basic steps. First, OTA is surveying local activities that use technologies appropriate to meeting community goals. Second, prototype projects are being selected to assess indepth the key impacts and feasibility questions of the technologies as well as governmental and private arrangements that aid or hinder their development. And third. a series of options are being developed by OTA that deal with proposals for coordinating Federal research and development programs, financing, and other relevant impacts of the technologies for local development

Because of the nature of the technologies being assessed, the project is reaching out to communities across the country to identify the relevant issues to be considered by the assessment and to seek methods for encouraging innovative technology.

Technological Innovation and Health, Safety, and Environmental Regulation

Regulatory policies seeking to minimize the risks posed by technology to the health and safety of individuals. as well as to the environment, have been criticized as being too strict or not strict enough. Some critics argue that the current regulatory laws and policies inadequately protect against the risks posed by modern technology. Others contend that regulation generates costs in excess of benefits, and has inhibited the innovations in technology that have in the past been a major source of economic growth.

As part of its major review of Federal policies affecting industrial innovation, the Senate Committee on Commerce, Science, and Transportation asked OTA to assess alternative regulatory policies. The Committee seeks a better understanding of how Federal policies might more effectively stimulate the development of technologies to meet regulatory goals without unnecessarily impeding innovations that may be responsive to changing market demands.

To understand the linkage between regulatory law and technological innovation, the assessment is examining how those laws and other key factors influence the actions of regulatory agencies, and their effect, in turn, on investment by private industry. The effects of current regulatory policies are also being examined in selected industries, and their effects compared with those of alternative policies.

Oceans

The Oceans Group focuses on a broad range of issues encompassing the uses and quality of the oceans and the systems deployed on or in the oceans or along their shores. The impacts of energy development on the people and environment of the coastal areas and the possibilities of

harnessing the oceans to meet future U.S. energy needs, in particular, have been subjects of study .

Toward that end, the Oceans Group completed one study, continued work on two others, and initiated two additional assessments in 1978. OTA reported on the prospects of obtaining energy from the temperature differences between waters at the ocean surface and those at its depths. A following part of that study is examining other technologies for exploiting the oceans as a source of renewable energy. A second continuing study is assessing the social and economic impacts of locating energy facilities in coastal areas.

OTA launched a new study in 1978 of radioactive nuclear waste disposal. Another new study is identifying environmental issues affecting the Panama Canal Zone. Finally, the Oceans Group is assisting on a study of bioenergy conversion, focusing on the possibility of using seaweed (or kelp) for energy.

Ocean Thermal Energy Conversion

The search for new sources of energy to replace dwindling supplies of oil and gas from easily accessible reservoirs has naturally led to the oceans. Oil and gas are now being produced from offshore wells, and the oceans are serving as avenues of transportation for increasing imports of liquefied natural gas. In addition, scientists and engineers are exploring the possibility of tapping the oceans themselves as a source of energy.

As part of a broader study of renewable energy sources from the oceans, OTA examined the potential for and technical problems facing ocean thermal energy conversion (OTEC)—the concept for obtaining energy from the temperature differences between warm waters at the ocean's surface and the cold waters at its depths. Some estimates place the potential for OTEC in U.S. waters at 15,000 megawatts--the equivalent of 15 large generating plants. (A summary of this report may be found in section II.)

This project was undertaken at the request of the Senate National Ocean Policy Study. OTA staff testified before the Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries in oversight hearings of OTEC programs run by the Department of Energy. OTA staff also briefed members and staff of the Senate Committee on Appropriations on the report's findings.

Renewable Energy From the Ocean

In the second part of the study of renewable energy sources from the oceans, OTA is evaluating the potential for technologies to harness the energy in ocean winds, waves, tides, currents, and salinity gradients. This project is examining the state-of-the-art of these emerging technologies, pinpointing the status of research efforts, and identifying the major problems that must be resolved before these concepts will be technically and economically feasible.

Also requested by the Senate National Ocean Policy Study, this study is expected to be completed early in 1979.

Siting of Coastal Energy Facilities

Meeting the demand for energy requires new facilities, and this, in turn, raises questions and possible conflicts about where these facilities are located. This is particularly the case in coastal areas where dense population finds industrial, residential, transportation, and recreational users competing for land. Furthermore, many view energy facilities as threats to the natural environment of the coastal areas.

These and other issues are the subjects of an OTA project assessing the implications of placing energy-producing facilities in coastal areas. The study requires an analysis of the public decision-making process and the extent to which Federal laws and policies, such as those regulating air and water quality, influence the siting process.

This study originated with a request from OTA's Board. It was supported by the House Committee on Interior and Insular Affairs and the Senate Committee on Commerce, Science, and

Transportation. It is scheduled for completion in early 1979.

Disposal of Nuclear Waste

There is perhaps no more vexing energy problem than how to effectively and safely dispose of radioactive wastes from nuclear powerplants. More than 30 years into the nuclear age, the United States still has no program for the long-term disposal of these wastes. Nearly all of the waste material from nuclear powerplants and the manufacture of atomic weapons is in "temporary" storage.

In this study, OTA is evaluating what is currently known about the disposal of nuclear wastes, both on land and under the sea. The project is also assessing the environmental and health implications of various means of nuclear waste disposal. OTA is also examining the process by which storage sites are selected and managed, including the role of State and local governments. Finally the project is identifying what research is still needed to demonstrate the ability to safely dispose of nuclear waste.

This study was requested by the House Committees on International Relations and on Science and Technology, and the Senate Committees on Energy and Natural Resources and on Commerce, Science, and Transportation. The project is expected to be completed in late 1979.

Panama Canal Zone

The Oceans Group was also asked in 1978 to analyze environmental issues related to the Panama Canal. The treaty granting sovereignty over the canal to Panama calls for a joint U. S.-Panamanian commission to ensure the environmental integrity of the Canal Zone. OTA interviewed government and private sector officials in the United States and Panama, and held a 2-day seminar in August to highlight those problems the joint commission needs to address.

This OTA background study was requested by the House Committee on Merchant Marine and Fisheries. A staff paper was completed in late 1978.

Telecommunications and Information Systems

Technologies for telecommunications and information systems are advancing rapidly. New facilities are being established, new services planned and offered. new enterprises emerging. In addition, governments are taking an increased interest in the implications of these new technologies and their applications. Governmental and industrial reorganizations are occurring, new legislation is being proposed and adopted, and relevant international norms are being formulated.

Because of these developments, several committees of the Congress consider it essential to assess the broad societal impacts of these technologies.

To provide this information, OTA established the Telecommunications and Information Systems Group in 1978. In addition to conducting specific assessments, OTA seeks to develop an analytical data base with service and system projections for the next 5. 10, and 20 years, and to assess a broad range of both known and, as yet, unforeseen impacts and implications of the emerging technologies.

OTA's initial work on telecommunications and information systems consisted of three exploratory projects. In 1976, the Office published a preliminary evaluation of the use of broadband communications in rural areas, after a study undertaken at the request of the Senate Committee on Agriculture and Forestry. In 1977, OTA completed, at the request of the House Committee on Ways and Means, an exploratory analysis of the proposal by the internal Revenue Service to expand and revise its Tax Administration System

(TAS) with a billion dollars worth of new computer capability. The third exploratory effort was a preliminary analysis of the National Crime Information Center (NCIC), which was begun in 1977. (A summary of this report may be found in section II.)

Building on this experience, OTA initiated two new assessments in 1978 that pertain to telecommunications and information systems. One of these projects assesses the societal impacts of national information systems. The second addresses the impacts of telecommunications in the light of changes that have occurred in recent decades.

National Information Systems

Obtainable until recently only at relatively high costs, computers are now available in drastically reduced sizes and prices, and with greatly enhanced speed and capability. These advances have led to a rapid increase in the number of U.S. and worldwide computer-based systems used to collect, store, retrieve, process, and disseminate proprietary, personal, financial, and governmental information. Combined with telecommunication technologies, computers can transmit data instantaneously almost anywhere in the world.

Further, the commingling of computer and telecommunication technologies has accelerated the use of information systems.

Such systems could enhance Government services such as mail delivery, criminal justice, research, and education, as well as private sector services such as banking, marketing, and shopping.

Without proper planning and safeguards, however, their use could also result in infringement of individual rights and civil liberties, cause unanticipated changes in employment, restrict services and choices in the free market, and raise concerns about data security and freedom of international data flow. The importance of addressing these issues now is emphasized by the millions of dollars being spent on information systems and by the complex infrastructure of providers, users, and regulators that has evolved.

As indicated above, an assessment of the societal impacts of national information systems was begun in 1978. Three major systems will be examined in this assessment: the Computerized Criminal History (CCH) system of the FBI's National Crime Information Center (NCIC), electronic message systems, and electronic funds transfers. Issues of constitutional rights, privacy, security, and access, and Federal-State relationships are raised by these systems. OTA will study their impacts, as well as alternative ways of dealing with them and the implications of each.

Requests for these studies came from the House and Senate Committees on the Judiciary and the House Committee on the Post Office and Civil Service.

Telecommunication Systems

For at least the past two decades, telecommunications technology has been in a period of revolutionary change. Satellites, optical fibers, and many other innovations have been added to the repertoire of available electrical and radio technologies. As new systems and services achieve economic feasibility. it becomes both timely and necessary to assess their impacts, as well as the national policies pertaining to them.

OTA is analyzing new technologies and services, as well as likely future changes, in light of the Communications Act of 1934, the basic Federal law governing telecommunications. Begun in late 1978, this study is exploring alternative policies and their affect on the structure of industry and Government relationships, and their affect in turn on telecommunications. It is also assessing the economic and social relationships underlying that structure.

In addition to identifying and analyzing new technologies, service, and policies, OTA is examining both current and proposed institutions to assess their effects on competition in the industry, allocation of scarce spectrum resources, availability of the technologies, international data flow, industry employment patterns, and innovations. In identifying policy alternatives, the assessment seeks to point out the potential beneficial and adverse impacts of each possible choice. The

focus is on the technologies and the effect of industrial institutions and Government regulation and policy on their development, introduction, manufacture, availability, cost, and use.

The assessment was requested by the Senate Committee on Commerce, Science, and Transportation. It is anticipated to be completed by late 1979.

Transportation

Transportation industries in the United States have had to contend with increasing economic, operational, environmental. and safety problems in recent decades. To assist these industries and to ensure that the Nation has an adequate transportation capability compatible with other national goals, Congress in recent years has reorganized and refinanced the railroads, expanded and encouraged mass transit, sponsored research on new transportation systems, and required manufacturers to produce safer, more fuel-efficient. and environmentally acceptable cars.

Specifically, the 95th Congress passed legislation deregulating the Nation's airlines. placing mass transit on a par with highway construction, and improving Federal programs and strengthening mandates regarding the safety and energy efficiency of all forms of transportation.

To assist Congress in addressing such issues. the OTA Transportation Group conducts assessments on all key transportation modes: the railroads, urban mass transit, auto and truck, and aircraft, In 1978, the Transportation Group completed two studies, brought two to near completion. and initiated work on two others.

OTA completed a study evaluating the effectiveness of various laws in promoting the safety of U.S. railroads. A background study of research and development programs for new urban transit vehicles was also completed and transmitted to Congress.

An assessment of the future role and characteristics of the automobile transportation system was nearing completion at year's end, In addition, a follow-on to the previously completed railroad safety study. comparing railroad operations and practices in the United States and Canada, was also nearing completion at year's end. Two new studies were begun in 1978—an evaluation of a demonstration program for advanced rapid transit systems, and an assessment of the impacts of advanced airplanes.

Railroad Safety

In recent years, the Federal Government has attempted to solve the compelling financial, institutional, and operational problems of the U.S. railroad industry in order to maintain acceptable levels of service. Toward that end and in compliance with the Railroad Safety Authorization Act of 1976 (Public Law 94-348), OTA evaluated the effectiveness of the Railroad Safety Act of 1970 and other Federal laws aimed at improving the safety of the Nation's railroads. OTA also examined Federal programs, as well as railroad industry and labor union practices designed to improve railroad safety. (A summary of this report may be found in section 11.)

After a rash of accidents involving dangerous cargoes in the winter and spring of 1978, Congress and the American public have become increasingly aware of the problems regarding railroad safety. Consequently, OTA staff testified on the findings of the study before two congressional committees—the Subcommittee on Transportation and Commerce of the House Committee on Interstate and Foreign Commerce, and the Subcommittee on Surface Transportation of the Senate Committee on Commerce, Science. and Transportation.

Railroad Safety: A U.S.-Canadian Comparison

Following completion of the railroad safety report, the House Committee on Interstate and Foreign Commerce asked OTA to compare the safety records and operational practices of the United States and Canada. Using data generated by the original railroad safety study as well as that supplied by the Canadian Government, railroads, and labor unions, OTA examined safety practices and programs in Canada that could improve U.S. railroad operations.

Specifically, the study examined the economic, demographic, organizational, and operational factors in Canada bearing on the continuing problems of railroads in the United States. The regulatory laws and policies of each country were also being compared for their effect on railroad operations. The study was scheduled to be completed early in 1979.

The Automobile Transportation System

The automobile provides a degree of personal mobility that is unparalleled in history. Almost every aspect of modern society has been influenced in some way by the automobile and road system that has grown up in this country. Cities have been transformed, opportunities for work, residence, and recreation have been widened, travel has become a common, if not indispensable, feature of American life—so much so that almost 85 percent of U.S. households now own at least one automobile and more than 90 percent of the passenger miles traveled each year are by private automobile.

Along with the manifold social and economic benefits of the automobile, certain problems have emerged. The future supply of petroleum is uncertain. Air pollution is a major urban problem. Death and injury on streets and highways continue to mount. Traffic congestion strangles movement in cities. Roadways, parking lots, and auto-related facilities take up land and contribute to urban sprawl. Policies and programs to deal with these problems and to meet the future personal transportation needs of the country may require major social and economic changes in the coming years.

In response to these concerns, the Senate Committee on Commerce, Science, and Transportation asked OTA to assess the impact of changes in the future use and characteristics of the automobile. OTA examined potential changes and their anticipated impacts both for the short term (the next decade) and the long term (to the year 2000 and beyond). The assessment identified factors that are expected to influence the evolution of the automobile transportation system, and evaluated policy options that could promote technological change in the directions indicated by present problems and future needs.

Among policies OTA considered are those that would conserve petroleum or promote a transition to alternative energy sources, to reduce harmful pollutants, and improve the safety of automobiles and highways. Attention was also given to questions of consumer cost, financing of highway building and maintenance, capital requirements for new technology, and support of alternative modes of personal transportation. Of special interest was the prospective role for the Federal Government in fostering technological change and avoiding adverse social and economical impacts.

By the end of 1978, this project was nearing completion. The final report will be published early in 1979.

Impact of Advanced Air Transport Technology

For the past 40 years, the United States has dominated the free world market for airplanes. That supremacy is now being challenged by consortiums in Western Europe, backed by their respective governments, with products such as the A-300 Airbus. Development of new high-speed planes may permit continued U.S. dominance, thereby contributing to the Nation's economy and balance of trade. However, the aviation industry may need continuing support from the

Federal Government. particularly where long-term and high-risk R&D projects are concerned.

To determine an appropriate role for the Federal Government in support of the aviation industry, OTA is assessing the economic, energy, environmental, safety, and societal impacts of advances in air transport technology. Both passenger and cargo planes are being examined, as well as the potential impacts of the expected growth in air traffic over the next several decades. The project is looking at advanced supersonic transports; commuter, cargo, and hypersonic aircraft; vertical and short takeoff and landing aircraft; energy efficient subsonic aircraft, lighter-than-air vehicles: and general aviation. The assessment is also evaluating alternatives for Federal support for research and development in aeronautics and related technologies.

Requested by the House Committee on Science and Technology and the Senate Committee on Commerce, Science, and Transportation, the study is expected to be completed early in 1980.

Impact of Advanced Group Rapid Transit Technology

One goal of the Urban Mass Transportation Administration (UMTA) is to develop long-range solutions to urban transportation problems. The Advanced Group Rapid Transit (AGRT) technology. being developed under UMTA sponsorship, could be available in the next 5 to 10 years. The AGRT systems consist of small, fully automated vehicles operating on exclusive guideways, free of surface congestion. AGRT vehicles will carry up to **12** passengers, all seated in many instances, and transport them to their destination without the need to transfer.

In 1978. an UMTA request to expand the AGRT program led the House Committee on Appropriations to request an independent assessment by OTA. Specifically, OTA was asked to determine if the need for AGRT had been adequately demonstrated. The committee also asked OTA to consider how many prototype systems might be developed and to compare U.S. research support for transit with that of other countries.

In addition to examining AGRT's potential to improve passenger service, the assessment will look at costs. environmental and safety considerations, energy impacts, and urban development opportunities. The study is scheduled to be completed by mid- 1979.

Exploratory and Planning

OTA's Exploratory and Planning Group evaluates assessment requests and proposals 'that do not fall into other program areas, analyzing such aspects as technological, social, economic, and legal ramifications, scope, parties at interest, and policy issues. These analyses help the OTA Board in deciding whether major assessments are warranted.

Further, a vital part of OTA's statutory mission is anticipating and alerting the Congress to potential impacts (both positive and negative) of currently evolving or future technology-related national issues. Thus, long-range planning and analysis play a significant role in setting OTA's agenda of future activities.

The Exploratory and Planning Group participates in this process. While it often leads to full-scale assessments, some OTA exploratory efforts result in reports which serve immediate congressional needs. In 1978, such projects included: OTA priorities, approaches to risk assessment, natural hazards, technology and centralization, measurement of quality of life as a basis for technological choices, and non-ionizing radiation.

OTA Priorities Project

The legislation that created OTA empowers the Director to initiate requests to the Board for their approval of assessment projects. To facilitate the selection of such candidate projects, the Director, early in 1978, assigned the Exploratory and Planning Group to establish a process for setting priorities among potential projects. From the start. the effort was to be clear, credible, and open to public participation. It involved the development of criteria for evaluating projects, the collection of possible topics, and, finally, the careful evaluation of these "candidates. " The goal was a short list of projects that could be completed within 9 to 24 months on budgets of $300,000 to **$600,000** per year. Each should make a basic contribution to congressional deliberations on major public issues.

A list of more than 4,000 topics was systematically culled down to a working list of 30 priority projects for further consideration by the Board. During this process, seven of the highest priority projects were selected for activation in 1978 and approved by the Board for OTA assessment. The Exploratory and Planning Group is continually seeking out and evaluating new potential projects for this OTA working list. The final report on OTA priority-setting activities in 1978 was presented to Congress in January 1979. (A more detailed description of these activities appears in section IV of this report)

Natural Hazards

Each year natural disasters cause billions of dollars of property damage, kill and injure hundreds of people, leave thousands homeless, and create a multitude of social, economic, and financial problems. The Federal Government has responded with such programs as flood insurance, low cost disaster loans, and improved early storm warnings.

Some Federal programs, however, may inadvertently increase the risks from natural disasters. For example, Federal mortgage and insurance programs may encourage housing and other construction on flood plains or earthquake faults. Indeed, no Federal program has taken a holistic approach to studying and planning ways to mitigate, prevent, or control natural hazards.

At the request of the House Committee on Banking, Finance, and Urban Affairs, the Senate Committee on Banking, Housing, and Urban Affairs, and the Senate Committee on Appropriations, OTA initiated a planning study of natural hazards, and their social, economic, environmental, and political consequences. Staff studies and workshops identified and clarified issues and trends, and offered policy options. An operational and policy framework, based on the lifecycle of a natural disaster, has been developed.

By year's end, reports were being prepared on five separate aspects of natural hazards. These include:

- Issues and options in managing flood hazards.
- A preliminary analysis of U.S. policy needs related to natural hazards,
- Criteria for evaluating the President's reorganization plan for emergency preparedness and response.
- Criteria for evaluating the implementation plan required by the Earthquake Hazards Reduction Act of 1977.
- Disasters in the developing countries–lessons applicable to U.S. domestic preparedness.

Approaches to Risk Assessment

There is growing concern over the increasing scope and number of risks, many stemming from technological complexity, in our society. It is generally the Government's responsibility to forecast, control, and mitigate risks. However, the parameters of risks are presently not well understood. Consequently, Government is unable to deal adequately with the wide range of risks from both manmade and natural hazards.

The Exploratory and Planning Group is undertaking a project to comprehensively review and analyze such risks, ranging from individual to global risks. The result will be a systematic inventory of technological risks. A comparative analysis for each risk will be developed, including a

"time history" that will delineate rates of change in various risks. Fourteen elements will be included in each comparative analysis. among them the number of people affected. severity and duration. exposure, known or suspected factors that could convert a risk into a disaster. psychic factors, and costs involved.

This inventory will provide a basis for improving public policy in dealing with risks. It will also directly serve OTA's internal need for a more systematic approach to assessing risks. Finally, the project will give Congress a framework for better interpreting and deliberating on risks and hazards.

Technology and Centralization

Two key features mark our modern technological society--the ever-increasing scale of activities, and the centralization of many functions such as energy production, information storage, and food production and distribution. These features evolved as advancing technology improved our capacity to predict and control the workings of complex institutions and machines. Large, centralized systemsare often able to deliver goods more cheaply, reliably, and with better labor productivity than small, less centralized systems.

An Exploratory and Planning project will probe several issues related to the social choices involved in technologies of different scales and complexity. These issues include:

- The advantages and disadvantages, costs, and benefits of technologies as a function of scale or size of the enterprise and degree of centralization or decentralization.
- The degree to which Federal policies influence the choices of large, centralized systems and small decentralized activities,
- General principles which apply to congressional debates on the impacts of scale and centralization on energy supply, communications, information systems, national security, employment, national growth, and environmental quality.

Measures of Quality of Life as a Basis *for Assessing Technological Choices*

Potential or actual returns from technological innovation are usually measured in economic terms. Growing dissatisfaction with these measures, such as gross national product (GNP), stems from the fact that they do not and cannot fully reflect prevailing social conditions and values. It is clear that new measures are needed to deal with issues involving quality of life, attitudes, aspirations. goals. and satisfactions. Congress and the Nation also need to develop new ways of thinking about new problems.

For example, new energy measurements might deal with caloric balances. Life quality might be better thought of in terms of one's total lifecycle, or the tradeoffs between time and money. Various agencies of the Federal Government (as well as some international bodies) have recognized the need for better ways of expressing human impacts, attitudes. and so on. They have begun to study approaches such as social accounting and social indicators. Thus far, however, there is no consensus on what should be measured (or how), and on what framework can be used to present indicators meaningfully and usefully.

The overall goal of this project is to explore the application of the quality of life concept to technology policymaking by concentrating on the following tasks:

- Analysis of current efforts of Government agencies, academia. and the private sector to develop various social indicators.
- Evaluation of strengths and weaknesses in current indices and development of a new index for quality of life. This new index would reflect the interconnection of various human activities and new concepts of value— time vs. money, pain vs. death, the work/play balance, etc.
- Evaluation of various methods of displaying quality of life indexing data to ensure use by those who need the information.

- Estimation of what impact the existence of quality of life data would have on technologically-related decisionmaking, including ways in which the Congress can both foster this development and use it in preparing legislation,

Methodology and Orientation

Within OTA there is a continuous need to systematize methods and study strategies. internally disseminate advice on methods and techniques, and orient activities to other organizations in and out of Government. Accordingly, the Exploratory and Planning Group has produced a series of methodological notes for OTA internal use, The Group also provides briefings on technology assessment, technology, and the systematic study of the future to Federal agencies. foreign governments, international organizations, and State and local government officials.

IVon-ionizing Radiation Hazards

In early 1978, OTA initiated a preliminary analysis of the issues associated with potential microwave and other non-ionizing radiation hazards. The need to consider the hazards as well as the benefits associated with present and potential uses of the whole range of non-ionizing radiation. including those parts associated with high-tension powerlines, laser beams, and all radiofrequency radiation. became evident as technological considerations and public concerns were taken into account.

The preliminary analysis will present a set of principal public policy issues confronting Congress in this area as well as identify the technological factors that give rise to them. The analysis considers the kinds of technical and nontechnical information most likely to be needed in order to identify policy options and the consequences of pursuing one or another. Based on both recent reports and interviews, this project also identifies relevant statutes. responsible authorities, existing standards, and centers of governmental and nongovernmental activity and analysis, It also indicates some of their limitations.

Undertaken at the request of the House Committee on Interstate and Foreign Commerce, the analysis is expected to be completed early in 1979.

Section IV

THE PRIORITIES PROCESS

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The Technology Assessment Act (Public Law 92-484) requires the Office to provide Congress with "early indications of the probable beneficial and adverse impacts of applications of technology." The Act notes that "it is essential that, to the fullest extent possible, the consequences of technological applications be anticipated, understood, and considered in determination of public policy on existing and emerging national problems."

The Act established three mechanisms by which OTA assessments may be initiated: by the chairman or ranking minority member of congressional committees, by the OTA Congressional Board, or by the Director in consultation with the Board. In its first 5 years of operation, the major proportion of OTA's work has originated through committee initiatives, the remainder developing from requests from its Board. During this period, requests for OTA work exceeded its resources and often were for examination of short-term, but urgent, issues.

Early in 1978, OTA initiated a process through which a more appropriate portion of the Office's effort could be directed toward longer range and more global and comprehensive assessments of the impacts of technological applications. The goal of this activity was to establish a priority list of major national and global, scientific and technological issues of long-term importance to the Nation and Congress on which the Office might perform analyses.

This list of 30 or so projects, to be revised at least annually, is to be used by the Director in selecting projects for submittal to the Board for their consideration for approval. The Board can then weigh these requests along with those coming from chairmen and ranking minority members of congressional committees and Members of the Board in deciding how to allocate OTA's resources. The Office anticipates that 10 to 15 priority projects might be initiated in 1979.

The Outreach

From the outset, the OTA priorities process was open and broadly participatory. Between February and May, more than 5,000 persons were asked to consider the critical technological issues that they thought were of especial importance to the United States and the world. and to submit their top three candidate items to OTA. Letters inviting suggestions were sent to public institutions and such private organizations as the National Academies of Sciences and Engineering, the Stanford Research Institute, RAND Corporation, the World Future Society. and the American Council of Learned Societies. Solicitations were also sought in a workshop held at the annual meeting at the American Association for the Advancement of Science (AAAS).

At the same time, the Congressional Research Service (CRS) and the General Accounting Office (GAO) were asked for their suggestions. Within OTA, a series of internal meetings were held to elicit ideas of its staff. In addition, OTA sent letters to its consultants, contractors, panel members, and other advisors, past and present—some 1,000 persons in all—requesting their input. In March, the Advisory Council received a 2-hour briefing on the design of the priorities process to date and for the remainder of the year allocated nearly all its time toward the development of the priority list.

The Ranking Criteria

These efforts to solicit priority issues from as broad and informed a set of contributors as possible resulted in 1,418 suggested topics for study. OTA extracted another 2,293 items from the published literature. To sort out these 4,293 total items and to give them a rank order, OTA mobilized its staff to organize, combine, winnow, and eventually reduce the list to a more manageable size.

To accomplish this sorting and ranking process, OTA senior staff developed a set of 25 criteria by which to judge and rank the suggested topics. The criteria comprised characteristics that fell into topical, organizational, and client-related categories.

The five most important are:

- Does the assessment involve the impact of technology?
- Is there congressional interest?
- Does the technology impact significantly on human needs and quality of life?
- Would the assessment provide foresight?
- Can OTA do the assessment?

(The complete list of 25 criteria is presented in table 1.)

In June, the staff representatives of OTA Board members were briefed and solicited for their own ideas as well as for advice on how to improve the process.

Processing the Candidate Items

Having refined the criteria and the process for applying them to the evaluation of specific candidate items, groups of OTA staff met to rank the 4,293 items that had come in both in response to the outreach and from published sources. They grouped the items into general categories, clustered them around specific subtopics, and eliminated some of them.

At this stage, OTA program groups were asked to evaluate these clusters, regroup them where necessary, and generally deal with all items falling under their sphere of interest and capability. For example, in the area of telecommunications, a group of people, including OTA staff and several individuals from outside the organization, helped to evaluate and weigh 238 topical items.

The OTA Group Managers' Candidates

During the period of criteria refinement and candidate evaluation, OTA group managers, working with his or her staff, forwarded a half dozen or so candidate items for the final list. These inputs were collected into a list of 66 items, which were scrambled before sending them back to each group manager for his or her vote on the top 15 items. From this exercise, five items clearly emerged showing a high level of interest:

Table 1 .—Criteria for Judging Suggested Priority Items

Organizational:

1. Can OTA make a unique contribution?
2. Does the project have an early warning or impacts analysis component?
3. Is it doable?
4. How much time will it take to do?
5. Is the project manageable and capable of being bounded?
6. Will an analysis or knowledge on the subject make a difference?
7. Is OTA qualified to address this issue?

Client-Related:

8. What is the likelihood of congressional use?
9. Is it policy relevant?
10. How important is the item to national priorities and needs?
11. Can this topic or a series of studies on it yield information for Congress?
12. Can a study be completed in time to influence key decisions?
13. Is the item focused on development of policy rather than program evaluation or implementation?
14. Is the subject an appropriate one for Government considerate ion?
15. Is this now or likely to become a major national issue?

Topical:

16. Is this a systems problem with links to other systems?
17. Will this be a significant issue or opportunity in the future (10 to 30 years)?
18. Does this item represent a major new national opportunity?
19. Will it affect the societal infrastructure to a great extent?
20. Will a study help structure national debate?
21. What will be the impacts on human needs?
22. What will be the effect on the quality of life?
23. What is the national importance of this item?
24. How many people are likely to be affected?
25. What is the intensity, dimension, and duration of the potential impacts?

- Alternative Energy Futures.
- Global Food System Goals and the Implications for the Application of United States Science and Technology.
- Genetic Engineering.
- Effects on Climate of Coal Burning and Biomass Energy Production.
- Water Policy.

While OTA was considering and developing the lists of issues from published sources and suggested by various outside individuals and OTA staff, GAO and CRS were developing their own lists for submission to OTA. The inputs from both of these congressional research agencies strongly reinforced OTA's ranking process. Indeed, several of their suggested items wound up at or near the top of OTA's final priorities list.

On the basis of these numerous inputs to the priority-setting process, a list of 286 candidates for consideration was assembled. The list included the 66 items suggested by OTA group managers plus 220 synthesized from all other sources. A description of each was prepared, and the entire package was given to the OTA Director in July for consideration.

The Director's Initial Review

During the last 2 weeks of July, the Director, in consultation with senior staff, carefully reviewed the 286 candidate items. At this time, they screened the items through the "importance" and "convergence" criteria relating to the Office as an organization, and through those relating to Congress.

At the end of this period, 50 items considered to be of top priority were selected for further scrutiny and development. (See table 2.) Through individual consultation and group meetings of OTA senior staff, the list was further modified to yield a new list of 37 useful prospects for study by OTA. Each of these items was then assigned to a senior staff person for more detailed analysis. For each topic, a 10-page background paper and a l-page summary sheet were prepared. These "problem descriptions" were prepared in a variety of ways. Where strong staff expertise in the given area existed, the paper was written in-house. In some cases, a consultant expert prepared the document. In others, a workshop was held and the paper was based on its outcome.

Following this exercise and further consideration of prospective priorities, the list was reduced to 32 items. Although many other important projects were on the larger list, the 32 items were felt to approach a more manageable number within OTA's resources. The potential priority items on risk assessment, technology and centralization/decentralization, and considerations of quality of life relevant to technology assessment were initiated as exploratory projects to meet the methodological needs of the Office.

During this process, the Director consulted widely with others. He held face-to-face personal interviews with each member of OTA's Congressional Board. He elicited their personal sense of priorities and at the same time asked their evaluations of OTA's working list of priorities. He sent copies of the developing priorities list to each member of the Advisory Council and asked for their comments and advice. He also met with the staff of several congressional committees, as well as with OTA Board staff.

The First Board Action

Having received and weighed the various opinions of all of these advisors, the topic order of the priority items was rearranged for presentation to a joint OTA Board-Advisory Council meeting on September 18, 1978. At this joint meeting, unanimous support was expressed for the process. The September 18 list was further revised as a result of continuing review by the Advisory Council and consultation with committee staffs.

Even in this preliminary phase, the priority setting process helped define choices for OTA's immediate program. At its October 3 meeting, the Board approved six items from the priorities list for OTA study. A seventh item on the prelimi-

Table 2.—Preliminary Working List, August 1978

1. Alternative National Energy Futures
2. Alternative Global Food Futures
3. Alternative National Water Futures
4. Impacts of Genetic Engineering
5. Impacts of Food on Health
6. The Potential of Preventive Medicine
7. Technological Innovation (The Federal Role: Regulations, Patents, and Basic Research)
8 Impact of New Telecommunications Technology (Microprocessing, The Information Society)
9 Impact of Technology on World Population
10 Deterioration of Life-Support Systems (The Carrying Capacity)
11 Peace Technology (Satellite Surveillance, Economic Conversion)
12 Impact of Technology on Weather and Climate
13. U.S. Vulnerability to-l-reports of Materials
14. Impact of Wastes on Marine Resources
15. R&D Priorities for U.S. Food Production (Nitrogen Fixation, Photosynthetic Efficiency, Genetics)
16. Potential for Food from the Ocean
17. Impact of Technology on Employment (Automation, New Businesses, Job Satisfaction)
18. Technology and Inflation
19. Technology and Education (Telecommunications, Scientific Illiteracy)
20. Application of Information Technology to Health Care
21. Allocating the Electromagnetic Spectrum Globally
22. Potential for Advanced Air Transport
23. Implications of High-Speed Ground Transport Technologies
24. Telecommunications and the Automobile
25. Energy Technology and the Environment
26. Designing for Conservation of Materials
27. Furthering the Efficacy/Cost Ratio in Health Care
28. Impact of Technology on National Defense (Risk of Nuclear Warfare and Terrorism, U.S. vs. U.S.S.R. Capabilities, Command and Control, Utility of Surface Naval Vessels)
29. Potential for a Totally Replenishable Energy System
30 Technology and the Developing World (Meeting Basic Human Needs—Food, Health, Water, Education)
31 Effect of Technology on Small Business
32 Technology and Mental Health
33 The Future of Wood
34 Ratio of Civilian to Military Technology vs. Economic Prosperity (West Germany, Japan, U. S. S. R.)
35. Technology and Decentralization (Risks of Centralization)
36. Impact of Technology on Risks to Humankind
37. Impact of Technology on Gross National Product and on the Quality of Life (Social Indicators)
38. Role of Technology in Meeting Housing Needs
39 Potential of Ocean Minerals
40, Impact of the Breeder Reactor
41, Space Utilization
42, Potential for Controlled Nuclear Fusion
43, Impact of Non-ionizing Radiation
44. Chemotherapy and Vaccines for Infectious Diseases
45. Prospects for Increased Longevity
46. Technology of Prophylactic Dentistry
47. Prescription Drug Use
48. More Efficient Energy Utilization
49. Electric Utilities and Solar Energy
50. Technology and Antarctica

nary list had been approved earlier by the Board. These seven are:

- Alternative National Energy Futures.
- Regulations and Technological Innovation.
- Effects of Nuclear War.
- Impacts of Telecommunications Technology.
- Impacts of Applied Genetics.
- Cost Effectiveness of Medical Technologies.
- Potential for Advanced AirTransport.

From October through December a special effort was made to complete the process of soliciting the views of staffs of all of the committees of Congress. This effort plus continuing work with OTA staff members and the Advisory Council helped to establish the final 1979 priorities list.

The priority-setting activity combined broad public outreach, the systematic application of criteria for judging suggestions, and the selection of specific projects to meet congressional needs. The success of this effort is reflected in the support given it by the Board, Advisory Council, and OTA personnel and congressional committee staffs. In separate statements, the chairman and vice-chairman of the Board and the chairman of the Advisory Council all testified to the impor-

tance of the priorities list for Congress. OTA, and the American public.

The Final 1979 Priorities List

The OTA priority list for 1979 is as follows:

1. Impact of Technology on National Water Supply and Demand.
2. Alternative Global Food Futures.
3. Health Promotion and Disease Prevention Technologies.
4. Technology and World Population.
5. Impact of Technology on Productivity of the Land.
6. Impact of Technology on Productivity, Inflation, and Employment.
7. Technology and the Developing World–Meeting Basic Human Needs.
8. Peace Technology.
9. Impact of Microprocessing on Society.
10. Applications of Technology in Space.
11. Designing for Conservation of Materials.
12. Future of Military Equipment.
13. Impact of Technology on the Movement of Goods.
14. Weather and Climate Technology.
15. Allocating the Electromagnetic Spectrum Globally.
16. Implications of Increased Longevity.
17. Controlled Thermonuclear Fusion.
18. Technology and Mental Health.
19. Technology and Education.
20. Prescription Drug Use.
21. Forest Resource Technologies.
22. Health Technologies and Third-World Diseases.
23. Electric Vehicles: Applications and Impacts.
24. R&D Priorities for U.S. Food Production.
25. Alternative Materials Technologies.
26. Deep Ocean Minerals Development.
27. Energy Efficiency in Industry.
28. Role of Technology in Meeting Housing Needs.
29. Ocean Waste Disposal.
30. Technology and the Handicapped.

Section V

ORGANIZATION AND OPERATIONS

Section V
ORGANIZATION AND OPERATIONS

Created by the Technology Assessment Act of 1972 (86 Stat, 797), OTA is a part of and is responsible to the legislative branch of the Federal Government. OTA received funding in November 1973 and commenced operations as the second session of the 93d Congress convened in January 1974.

The Act provides for a bipartisan Congressional Board, a Director, Deputy Director, and such other employees and consultants as may be necessary to conduct the Office's work.

The Congressional Board is made up of six Senators. appointed by the President pro tempore of the Senate, and six Representatives, appointed by the Speaker of the House, evenly divided by party. In 1978, Senator Edward Kennedy, D-Mass. , and Congressman Larry Winn, Jr,. R-Kansas, served as the Chairman and Vice Chairman, respectively, of the Board. The two posts alternate between the Senate and House with each Congress. The Board members from each House select their respective officer.

The Congressional Board sets the policies of the Office and is the sole and exclusive body governing OTA. The Board appoints the Director, who is OTA's chief executive officer and is responsible solely to the Board, on which he serves as a nonvoting member.

The Act also calls for a Technology Assessment Advisory Council comprising 10 public members eminent in scientific, technological, and educational fields, the Comptroller General of the United States, and the Director of the Congressional Research Service of the Library of Congress. When requested by the Board, the Council may offer advice on technology assessment matters.

In providing assistance to 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; estimate and compare 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

OTA's primary function is to provide congressional committees with assessments or studies that 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:

- the Chairman of any standing, special, select, or joint committee of Congress, acting for himself, at the request of the ranking minority member, or a majority of the committee members;
- the OTA Board; or
- the OTA Director, in consultation with the Board.

In 1978, a priority-setting process was initiated to identify major national and global issues for OTA study. (See section IV for a description of this process.)

The authorization of specific assessment projects and the allocation of funds for their performance is the responsibility of the OTA Board. The Board early established priority areas of study, and approves individual assessment projects within those areas. To facilitate 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 activity be done effectively by the requesting committee or another agency of Congress?
- 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 this assessment?
- Would this assessment compliment or detract from other OTA projects?

Assessments emerge from the combined effort of a staff with appropriate expertise, citizen advisory panels of experts, consultants, contractors, and other congressional information agencies. A particular assessment project may involve exploratory meetings, workshops of advisory panels, staff analyses, and consultant studies.

Different approaches are used. The method employed. personnel involved, and the skills tapped depend on the technology under study, the requesting client, the nature of the issues at stake, and the time available for and the setting of the project. Required to consider the needs of Congress, the vast range of technological issues, and the resources available for a study, OTA remains flexible in its assessment methods.

All OTA assessments strive to be objective, nonpartisan, holistic, and authoritative. They must also be timely so as to meet congressional schedules.

Organizational Structure

The Office is organized into three operating divisions, each headed by an assistant director. The three divisions are Energy, Materials, and Global Security; Health and Life Sciences; and Science, Information, and Transportation. They encompass assessments grouped in the areas of energy, food, genetics and population, health, materials, national security, oceans, R&D priorities and policies, technology and world trade, telecommunications and information systems, and transportation. An exploratory group evaluates assessment requests that do not fall into these group areas, and assists long-range planning. A chart detailing OTA's organizational structure accompanies this section.

Staff professionals represent a wide range of disciplines and backgrounds, including the physical, biological, and environmental sciences, engineering, social sciences, law, and public administration. Professionals from executive branch agencies, detailed to OTA on a temporary basis, and participants in several congressional fellowship programs also contribute to the work of the Office.

Support Services

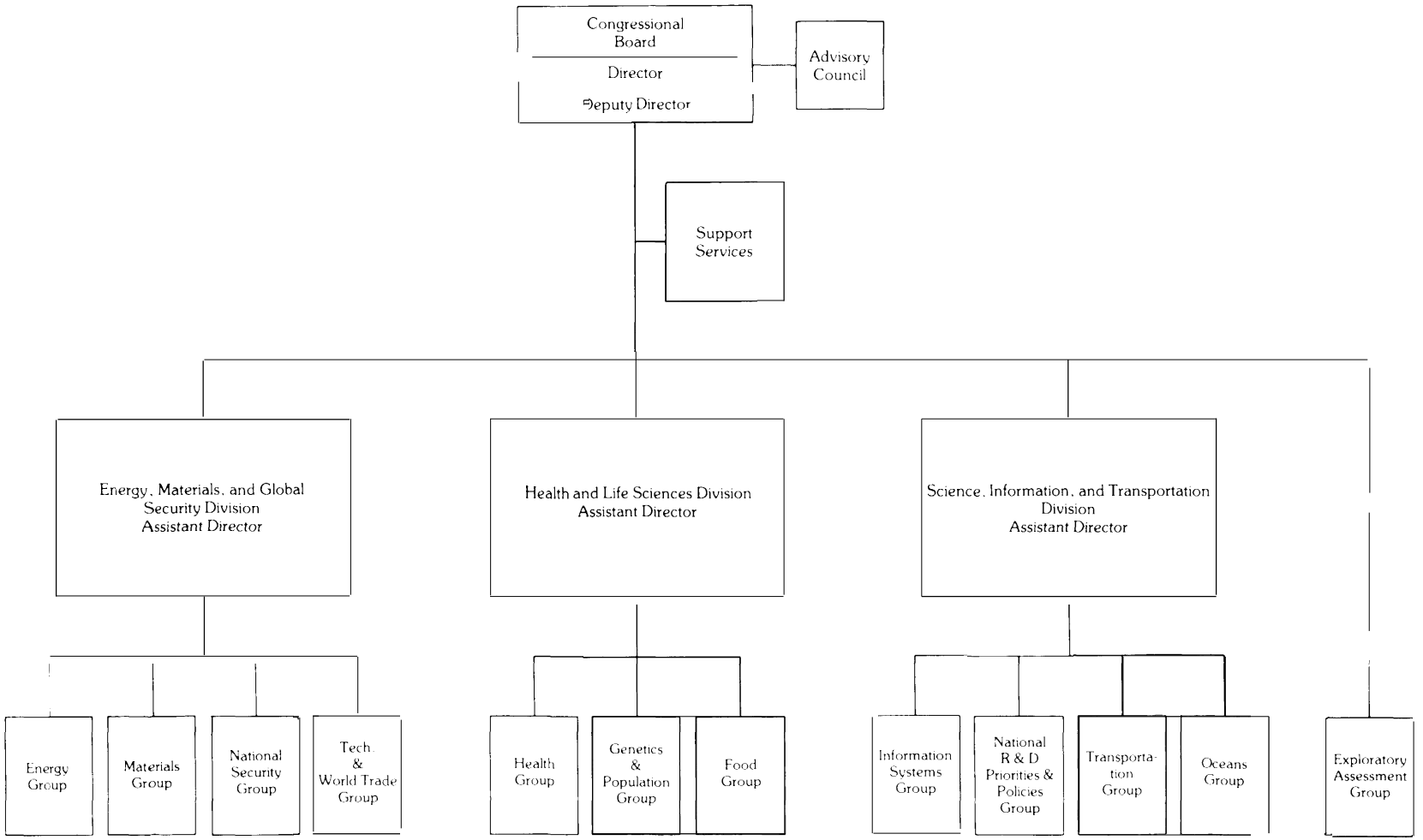
Financial and Administrative

An administrative officer oversees administrative and financial aspects of OTA operations, including procurement and contracting, budget and financial accounting and control, payroll, travel, office space, security, accounts payable and receivable, and other miscellaneous support services.

In response to the growth in demand for OTA assessments and increased costs, the OTA Board in 1978 approved budget requests totaling $10.0 million for fiscal year 1979 for submission to Congress. Congress appropriated $9.2 million. In addition OTA carried over $758,000 from fiscal year 1978, and received supplemental appropriations of $1 million for the assessment of alternative energy futures and $196,000 for the Government-wide pay raise, for a total fiscal year 1979 authorization of $11.2 million.

Office of Technology Assessment

Organizational Structure



Personnel

A personnel officer is responsible for the development of personnel policies and procedures and their implementation. These include recruitment, selection, orientation and processing, classification, salary structuring, and performance evaluation.

Publishing

A publishing officer is responsible for the production, editing, layout and design, graphics, printing. and sale of OTA publications and other printed material.

Information Services

An information services staff, which maintains an in-house library of books, reports, journals, and other materials on science, technology, and related areas, supports OTA activities. The library serves as a liaison to the Library of Congress as well as to other libraries and organizations throughout the Nation in order to meet the information needs of the OTA staff.

Current awareness tools and a computerized literature search service, the latter providing access to more than 115 computerized data bases, provide staff members with an extensive array of information services. In 1978, the library set up a data base on technology assessment. It includes the OTA history and legislative background. speeches and testimony given by OTA staff, news and journal articles on technology assessment, and other information pertinent to the work of the Office.

The library is available to members of the general public who have a specific interest in technology assessment or in the work of the Office.

Public Participation and Public Affairs

Public involvement constitutes an important part of OTA's technology assessment process. In addition to the wide use of citizen advisory groups and consultants, the Office disseminates information to the various parties-at-interest so that they may become more effectively involved in OTA assessments. In keeping with the objective of an open operation and the widest feasible involvement of public views, meetings of OTA's Congressional Board and Advisory Council are open to the public. Staff members who specialize in public participation and a public affairs officer advise the OTA Director.

To support public involvement, the public affairs office through its mail list and the news media continually informs the general public, Congress, and affected or interested parties of the initiation, status, and completion of assessments. The office responds to requests from both Congress and the general public for information about its activities. To further inform Congress and the public, the public affairs office prepares and distributes the annual report and one-page summaries of OTA reports.

APPENDIXES

Appendix A— Report of the Outgoing Chairman of the Board

B— Report of the Outgoing Vice-Chairman of the Board

C—Summary Report of Advisory Council Activities

D—Assessments in Progress

E—Reports Completed and Published in 1978

F—List of Published OTA Reports

G—Roster of OTA Personnel as of December 1978

H—List of Advisors, Consultants, and Panel Members

I–Technology Assessment Act of 1972

Report of the Outgoing Chairman of the Board

Senator Edward M. Kennedy

1978 was a productive year at OTA. In this, the sixth year of OTA's young life, impressive and exciting progress has been made in its mission to assist Congress evaluate the problems and opportunities facing our Nation as a result of rapid technological change. Strong leadership and new initiatives have expanded the scope and perfected the quality of OTA studies, and the process by which this quality is achieved. Throughout this past year, I believe OTA has made great strides in our unique and urgent role to provide Congress with an objective and informed view of the impact of technology on our society.

Leadership

As Chairman of the Technology Assessment Board in 1978, I had the chance to work closely with Congressman Larry Winn, Jr. , of Kansas as the Vice-Chairman of the Board. Larry brought to the Board the kind of nonpartisan common sense and absolute commitment to the realization of OTA's goals that made our joint leadership of the Board a special opportunity for me. We on the Board owe Larry our appreciation for his time and his wisdom.

Dr. Jerome Wiesner continued as Chairman of the Technology Assessment Advisory Council during 1978. Jerry has tirelessly supported and directed efforts to reshape and refine the role of the Council. He has fused the Council into a uniquely effective advisory group, bringing it together into a vigorous, action-oriented group of experts from every field of science and technology. Jerry has been an extraordinary link between the Council, the Board, and the Office with his good will, his fine sense of humor, and his vision and judgment. To him and to the other members of the Council, there is no way to express our gratitude adequately. All of the members are extremely busy members of their own communities. and each has taken the time to give OTA the benefit of their shared experience and expertise.

Dr. Russell W. Peterson became Director of OTA in January 1978, and; by the close of the year, the Office's resources had been redirected, its staff reorganized, and its goals more clearly defined, as a result of his dedicated leadership and hard work.

Director Peterson asked for and received from the Board authority to administer the Office and its staff in a more efficient and effective way. He conceived and directed a priority-setting process for OTA. He brought OTA through a difficult transition from an infant agency to a highly respected support agency of Congress.

Mr. Daniel De Simone, the Deputy Director, continued in 1978 the same high quality and respected service to OTA he has given since its establishment. Dan has assisted Board members, the Council, staff members, and two Directors with enthusiasm and vigor, and the Board deeply appreciates his continued commitment.

During 1978, there were several changes in the membership of the Technology Assessment Board. The Board lost one of its beloved spokesmen, Senator Hubert Humphrey, who had served on the Board from its beginning.

Hubert's concern was global yet sensitive—a perspective that he applied to so many of our national issues. With this personal perspective, Hubert's guiding hand and influence contributed to the building of OTA.

In the food area, Hubert worked closely with the OTA staff to develop our Food program. He was concerned that our Nation's food policy was fragmented, and he was quick to note that this

was also the case in other areas—for example, in energy and health care areas. He did not impose his personal philosophy or policies upon OTA, but urged us to consider alternative solutions, make the commitment, and put the resources behind it. Hubert's philosophy and his influence and inspiration remain with us.

Clifford Case, who had served both as a member and Vice-Chairman of the Board during his tenure, left the Board at the end of his term in 1978. Cliff brought to the Board a sense of bi-partisanship that was and is crucial to OTA's effectiveness and growth. He gave an enormous amount of his time to our nationwide search for a new Director. Cliff's participation on the Technology Assessment Board was appreciated and will be missed.

The Board also lost the services of Congressman Olin Teague, who retired in 1978 at the end of his term. "Tiger" Teague, perhaps more than any other individual, is responsible for the new direction at OTA. He worked hard to establish OTA; he served as chairman of the Board during a difficult growth period for the Office. As Chairman of the House Committee on Science and Technology, he conducted hearings on OTA during 1978 that highlighted the fine tuning the Office needed, suggested realistic solutions to its problems, and articulated the potential impact of this support agency. He is a good friend to all of us, and I am hopeful we will be able to continue to call on him for his valued advice and support.

The Technology Assessment Board welcomed Senator Adlai Stevenson to the Board in 1978. In his short period of Board membership, Adlai has already had a very positive impact on OTA policy. He brings to the Board a long-standing interest and expertise in science and technology issues.

New Directions

Board/Council Joint Meeting. On September 18, 1978, for the first time in 4 years, the Technology Assessment Board and the Technology Assessment Advisory Council participated in a joint session to discuss OTA's mandate and how best to meet the goals set for the Office by Congress. This meeting was much more than the symbolic coming together of the Board and Council members. All the participants had the opportunity to hear and respond to the recommendations by leaders in the private sector and Members of Congress on a range of projects that would be helpful to Congress. Members of the Board and Advisory Council discussed, as well, the role of the Council and the issue of allocating resources between long- and short-range projects. I am hopeful that in the future joint working sessions will continue to mold a close working relationship between the Board and the Council.

House Hearings. Congressman Olin Teague, Chairman of the House Committee on Science and Technology, initiated a series of hearings in 1978 in the Subcommittee on Science, Research, and Technology into the purposes of the Technology Assessment Act of 1972, possible problems in fulfilling those intentions, and potential improvements to enhance OTA's effectiveness. No one is better qualified to define these issues than Congressman Teague and his able staff assistants, John Holmfeld and Phil Yeager. Mr. Yeager, who drafted much of the Organic Act and contributed greatly to the legislative history, assisted members of the subcommittee in their development of recommendations for improving OTA's effectiveness.

As Chairman of the Board, I made several recommendations during testimony before the Subcommittee on October 4, 1977, and March 22, 1978, including:

1) the Technology Assessment Board, the policymaking body of OTA, should turn its attention and energy to directing an examination of long-range issues, including the secondary impacts of emerging technologies;
2) the Board should adopt a new policy regarding staff hiring, promotion policies, and other administrative matters in order to free Board time for policy issues; and
3) the Council should exercise a quality control function by continuing to develop cri-

teria and methodology to better design our assessments and evaluate the results.

These recommendations, endorsed by others on the Board and the Council, were supported by the Committee, and have been undertaken at OTA.

The Committee report concluded:

> OTA has been set up to do a job for the Congress which is (a) essential: (b) not capable of being duplicated by other legislative entities: and (c) proving useful and is already relied upon
>
> OTA should retain its basic operating method of depending to a large extent on out-of-house professional assistance in performing its assessments.
>
> Continued Congressional support for OTA is warranted,

The study by the House Science Subcommittee on Science, Research, and Technology, together with its recommendations, is the beacon and the guidebook for the definition of OTA's mission and the refining of its procedures.

Outreach to Congress

Under Director Peterson's leadership, a new program to reach out to Congress was developed in 1978. Quicker. more efficient methods of communicating with Members of Congress were developed; new one-page information sheets are now delivered to every Member on each OTA study. All of the committees of Congress that have made requests for OTA assistance (or which may in the future) were asked to meet with the Director and his staff to discuss how OTA might assist these committees in the new Congress. The results of these efforts have been a new awareness of OTA's work among the Members of Congress, and new respect for the Office, which is providing timely, useful information for congressional debate. As Chairman of the Board during 1978, I had the chance to speak with many of my congressional colleagues about OTA and I am pleased to observe the new enthusiasm generated by Director Peterson's outreach program.

Conclusion

Our Nation has learned in the last decade that technology development tends to be more rapid than public comprehension and congressional action; that the only developments that seem to move faster than technology are the latest crises resulting from the depletion of our resources; and that emerging and controversial technologies are reported on the front pages of our morning papers before any decision by elected representatives is made on the purpose, the direction, or the meaning of the new technologies for the next generation of Americans.

OTA is firmly on the road to becoming a unique, effective, respected, and critical support agency of Congress. While our feet are solidly on the ground, our direction is ever-forward—looking ahead so we may assure our children that the miraculous advances of technology will serve mankind well and wisely: and that future generations will not be the servants of an undisciplined and insensitive technology, It was my privilege to serve as Chairman of the Technology Assessment board in 1978, and I look forward to continuing my services as an OTA Board Member in 1979 because I firmly believe OTA's mission is essential, unique. and useful.

Edward M. Kennedy
Chairman
Technology Assessment Board

Report of the Outgoing Vice-Chairman of the Board

Congressman Larry Winn, Jr.

To the Congress:

During the majority of the 95th Congress, I have had the pleasure of serving as the Vice Chairman of the Technology Assessment Board. This has personally been a very worthwhile and fulfilling opportunity. I feel, though, that it is quite important that I express my views regarding the development and operation of the Office of Technology Assessment throughout the last Congress.

This has truly been an active 2 years—2 years that will undoubtedly hold some of the most significant milestones in the history of OTA. It has been a period that has offered both the bitter and the sweet. We have suffered through the perils of the resignation of two Board members and the first Director, Emilio Daddario. We also witnessed a new breath of freshness with the appointment of our new Director, Russell Peterson. We have participated in an extensive evaluation of OTA and its organic act conducted by the House Committee on Science and Technology.

Despite the periods of turmoil and change, though, I believe the overall effect has been one of strengthening and maturing within the organization. I don't feel that OTA's effectiveness has been deteriorated as an independent arm of Congress. On the contrary, OTA should be stronger because of this period.

In these times of economic austerity it is obvious to wonder what the future will hold for OTA. Will OTA suffer due to the more conservative fiscal trends? I believe the future for OTA is bright. I do not feel the economic constraints will seriously hamper the efforts of OTA. However, there are many barriers and stumbling blocks that must be confronted. In the following sections, I would like to mention some areas which are of particular significance to me and in my opinion represent the most likely areas for future problems.

The Role of the Technology Assessment Board

The role of the Board as quoted from the organic act is to ". . . formulate and promulgate the policies of the office. " This role should be critically analyzed relative to the past actions of the Board. There have been times that the Board has become embroiled in details and matters that appear to be far removed from promulgating policy. In fact, many of the actions border on being management. The Board is not the place to manage the Office. The task of formulating a program policy that meets the needs of Congress is a formidable challenge requiring the total attention of the Board. In addition, it is of paramount importance, when formulating this policy, for the Board members to avoid the natural tendency of promulgating policies that satisfy individual needs as opposed to the needs of Congress as a whole.

Because of the size of the task of establishing policy, it is also imperative that the Members participate actively in the process. The Board members are undoubtedly the most qualified group available to define the short- and long-term needs of Congress. However, those needs cannot be satisfied in an equitable sense if there is not full participation by the Board members. As a consequence, every effort should be made to schedule meetings to maximize the opportunity for full participation by the Board members. As a consequence, every effort should be made to schedule meetings to maximize the opportunity for full participation by the Board members. Along with the expert advice of the Technology Assessment Advisory Council, I am confident

that a policy can be formulated that will do justice to the needs of Congress as a whole.

The Role of the Advisory Council

In past years, the Advisory Council has not been utilized to its fullest extent. However, two very positive changes occurred during the 95th Congress which will hopefully alleviate this problem. First of all, the Board officially stated that the Council's primary role would be to advise the Board on what technology assessment projects will most adequately satisfy the Board policy.

Secondly, the Office has established a project priority list. This list will provide an excellent opportunity for the Office and the Council to reflect the technology assessment needs. This list will undoubtedly act as a very valuable input into the Board's decision process for establishing the OTA policy.

I cannot overemphasize the significance of the Council's input in this process. The Board does not represent a good ear for the new and expanding technologies and their impact on society. The Council is the Board's most valuable line of communication for that type of information. It is also important to recognize the importance of maintaining a fresh perspective on the Council. As the needs and problems of society change we must have a Council that is abreast of those changing needs.

The Role of the Director

While carrying out the policy, the Director should have the latitude to bring to bear his own perspective on the OTA staff without the outside influence of the Board and Council. However, continuous consultation and communication with the Board members is imperative. The Director's position is rather unique because he is a member of the Board. In this position, he has a great opportunity to directly bring the technical aspects to the predominately non-technical Board. However, he does have a rather tenuous balancing job when he attempts to not only satisfy the short term, brush fire needs of the Congress but also maintain a far-reaching crystal ball outlook.

Growth of OTA

OTA has a very valuable role to play for Congress. In these times of rapidly advancing technology, its role is even more critical. However, if the breadth of OTA jurisdiction is extended too far, its usefulness will be challenged. It is imperative that this focused direction on technology assessment be maintained. In conjunction with this, the manpower and budget would not maintain any sustained real growth.

The future holds a multitude of challenges that must be met forthrightly. I look forward to working with my colleagues in meeting these challenges and encourage their enthusiastic support.

Larry Winn, Jr.
Vice Chairman
Technology Assessment Board

Summary Report of Advisory Council Activities

Jerome B. Wiesner, Chairman

The Technology Assessment Advisory Council spent much of its time this past year attempting to further clarify and establish its role as an integral part of OTA. With the arrival of a new Director, Dr. Russell Peterson, there was opportunity to explore the relationship among the several components of OTA; in particular, the Council saw an opportunity to resolve the many ambiguities in its role.

At its first meeting of the year, held in February with Dr. Peterson, the 'Council voted unanimously in support of Dr. Peterson's proposal to shift oversight responsibility of the R&D panels and of the program in the New and Emerging Technologies from the Council to the Director's Office. It was agreed that the three existing panels would finish their reports at the earliest possible date, and would then be dissolved. A new and single R&D panel would be established later.

There were two main objectives in this shift of responsibility: 1) to improve the Council's oversight effectiveness; and 2) to create a new role for the Council, at the request of the Board, as an active participant in the priority-setting process of OTA. While a start has been made, this new role has not yet been adequately developed. There were some substantial time constraints for many Council members that prevented sufficient Council interaction with the Director, with the Board, or with the OTA staff. It is hoped that the Council's impact on OTA priority setting will be strengthened in the future.

Originally, considerable enthusiasm was generated among Council members for this priority-setting responsibility. Members devoted considerable time and energy to preparation of individual presentations made to the Council and Director on priorities that they felt were pertinent to the unique mandate of OTA. Much of the Council's time was devoted to these presentations and to serious discussion of topics covered. These topics included: Life Support Systems; Decisionmaking in Technology Assessment; Productivity, Innovation, R&D—Their Potential Impact on Inflation; and the Status of Military Technology Assessment and Funding. Much of the discussion sessions focused on the appropriate role of OTA in its science advisory capacity to Congress. Council members hope to have an even greater impact on the priority-setting process in the coming year.

The Council has continued to strive for improved communications with both the Director and the Technology Assessment Board. An event of enormous significance in improved relations was the first-ever joint meeting in September of the Board, the Advisory Council, and the Director. Council members were encouraged by this meeting as they had an opportunity to air their opinions and concerns on such matters as Council participation in the priority-setting process, the appropriateness of such various proposals as the Nuclear Effects Study, and ramification of OTA involvement in military technology assessment.

In other Council business, Dr. Jerome Wiesner and Dr. Fred Robbins were reappointed to the Council for 6 months, at the end of their respective terms. This Board action was taken to allow the new Director and OTA time to consolidate activities before major changeovers took place. Dr. Wiesner was reelected Chairman of the Council, a position he has held since 1976. Dr. Edward Wenk declined renomination as Vice-Chairman; Dr. Robbins was then elected to the position.

In July, Drs. Wiesner and Robbins were reappointed by the Board. At that time, the Board also appointed Dr. James Fletcher to fill the position left vacant with the expiration of Dr. Eugene Odum's term. Dr. Odum had declined renomina-

tion for reappointment. Though the Council regrets the loss of Dr. Odum, it warmly welcomes Dr. Fletcher, Professor of Technology and Energy Resources at the University of Pittsburgh.

The development of the congressional technological assessment activity has been marked by a series of difficult administrative and human relations problems, including those discussed in this report. The search for a new Director was long and complicated. These difficulties have been highly visible and tend to mask the fact that OTA has done many studies of major value; studies not only of great benefit to Congress but to the Nation at large. A number of OTA documents have become basic source materials in their fields and some members of the OTA staff and panels are regarded as leaders in their respective fields.

Furthermore, as our society becomes increasingly complex and increasingly risk conscious, good technological assessments will be an essential ingredient of technological and social progress. Clearly much is left to be done in the development of assessment methodology. Essential information on which to base assessments is often lacking, especially information needed to establish the magnitudes of risks posed by technology. Also, a totally satisfactory mode of interaction with the many elements of Congress remains to be developed.

We should keep in mind the fact that OTA is a wholly new undertaking, a social experiment attempting to integrate the many aspects and impacts of technology in a modern society. It is in this spirit that the Council will continue its support of the congressional effort to create a strong OTA and sound assessment processes.

Assessments in Progress

1. Automobile Assessment
2. Railroad Safety: U.S.-Canadian Comparison
3. Use of Drugs and Chemicals as Feed Additives
4. Residential/Commercial Energy Conservation
5. Direct Coal Utilization
6. Renewable Energy From Oceans, Part II
7. Open-Dating Techniques for Processed Foods
8. Effects of Nuclear War
9. Siting of Coastal Energy Facilities
10. Alternative Pest Management Strategies
11. Conservation Through Reduced Wastage
12. Environmental Contaminants in Food
13. Implications of International Technology Transfer, East/West
14. Energy From Biological Processes
15. Impacts of Global Trends in Energy Supply, Demand, and Technology
16. Impact of Technology on U.S. Industrial Competitiveness, Part I
17. Recovery of Mineral Commodities From Subeconomic Resources
18. Disposal of Nuclear Waste
19. Technology for Local Development
20. Societal Impacts of National Information Systems
21. Impacts of Telecommunications Technology
22. Existing Federal Coal Development Rights
23. Cost-Effectiveness of Medical Technologies
24. Regulations and Technological Innovation
25. Impacts of Advanced Air Transport Technology
26. Impacts of Applied Genetics
27. Future Availability of Materials Imported by the United States
28. Solar Power Satellite Systems
29. Alternative Energy Futures

Reports Completed and Published in 1978

Energy Group

Enhanced Oil Recovery	January 1978
Coal Slurry Pipelines	March 1978
Task Reports, Volume II, Part I	March 1978
Task Reports, Volume II, Part II	March 1978
Application of Solar Energy, Volume I	June 1978
Application of Solar Energy, Volume II	October 1978

Food Group

Nutrition Research Alternatives	September 1978
Food Marketing Technologies	October 1978

Health Group

Policy Implications of CT Scanners	August 1978
Efficacy and Safety of Medical Technologies	September 1978

Oceans Group

Renewable Energy from the Oceans: Ocean Thermal Energy Conversion	June 1978
Working Papers,	June 1978

R&D Priorities and Policies Group

R&D in the Civil Sector	June 1978
Role of Demonstrations in Federal R&D	July 1978
Reorganization of Federal Science Education	August 1978
Government Involvement in the Innovation Process	August 1978
Health of the Scientific and Technical Enterprise	October 1978

Telecommunications and Information Systems

NCIC's Computerized Criminal History System	December 1978

Transportation Group

Railroad Safety	May 1978
Working Papers	May 1978

Administrative Reports

1977 Annual Report	March 1978

Pamphlets and Brochures

Automobile Assessment	June 1978
List of Publications (Revised)	September 1978

List of Published OTA Reports

			Available through: U.S. Government Printing Office		National Technical Information Service	
			Stock Number	Price	Stock Number	Price
1.	OTA-A-1	Annual, Report, March 15, 1974			PB 246 191	$4.50
2.	OTA-A-2	Technology Assessment Activities of the National Science Foundation, June 12 and 13. 1974 (Hearings before the OTA Congressional Board)			PB 248 382	$3.00
3.	OTA-H-3	Drug Bioequivalence, July 1974	052-003-00037-7	$1.90	PB 244 862	$6.00
4.	OTA-M-4	Requirements for Fulfilling a National Materials Policy. August 1974			PB 250 631	$9.25
5.	OTA-T-5	Automobile Collision Data An Assessment of Needs and Methods of Acquisition			PB 244861	$1075
6.	(1)	An Analysis of the Department of the Interior's Proposed Acceleration of Development of 011 and Gas on the Outer Continental Shelf, March 1975 '			PB 252202	$450
7.	(2)	An Analysis identifying Issues in the Fiscal Year 1976 ERDA Budget. March 1975			PB 244863	$650
8.	OTA-A-6	Annual Report, March 15, 1975	052-070-03050-3	$1.15	PB 244 833	$5.25
9.	OTA-O-7	An Analysis of the Feasibility of Separating Exploration From Production of 011 and Gas on the Outer Continental Shelf, May 1975	052-003-00095-4	$2.80	PB 248 381	$3.00
10.	OTA-T-8	Automated Guideway Transit: An Assessment of PRT and Other New Systems. June 1975	052002 -00020-6	$365	PB 244854	$1300
11.	OTA-O-9	011 Transportation by Tankers An Analysis of Marine Pollution and Safety Measures, July 1975	052-07003091-7	$280	PB 244457	$1175
12.	(3)	Analyses of Effects of Limited Nuclear Warfare, September 1975 '				
13.	OTA-T-10	The Financial Viability of Conrail, September 1975			PB 250630	$600
14.	OTA-T-11	A Review of Alternative Approaches to Federal Funding of Rail Rehabilitation. September 1975			PB 250632	$600
15.	OTA-E-12	An Analysis of the ERDA Plan and Program, October 1975	052-010 -00457-3	$385	PB **250636**	**$1200**
16.	OTA-E-13	An Analysis of the Impacts of the Projected Natural Gas Curtailments for the Winter 197576, November 1975			PB 250623	$450
17.	OTA-T-14	A Review of National Railroad Issues, December 1975	052-003 -00124-1	$170	PB 250622	**$650**
18.	OTA-T-15	Energy, the Economy, and Mass Transit, December 1975	052-003-00" 132-2	$200	PB 250624	$800
19.	OTA-T-16	An Assessment of Community Planning for Mass Transit. February 1976 Volume 1 Summary	052003 -00133-1	$180	PB 253679	$600

			Available through: U.S. Government Printing Office		National Technical Information Service	
			Stock Number	Price	Stock Number	Price
20.	OTA-T-17	Volume 2: Atlanta Case Study.	052-003-00138-1	$1.15	PB 253 680	$4.50
21.	OTA-T-18	Volume 3: Boston Case Study.	052-003-00140-4	$1.15	PB 253 681	$4.50
22.	OTA-T-19	Volume 4: Chicago Case Study.	052-003-00141-1	$ .95	PB 253 682	$5.25
23.	OTA-T-20	Volume 5: Denver Case Study.	052-003-00143-8	$1.05	PB 253 683	$4.50
24.	OTA-T-21	Volume 6: Los Angeles Case Study.	052-003-00145-4	$1.45	PB 253 684	$5.25
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Vice President and Chief Scientist
IBM Corporation

Harvey Brooks
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Solomon Buchsbaum
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Robert Charpie
President
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Donald Collier
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Southwest Research Institute

Leo Goldberg
Distinguished Research Scholar
Kitt Peak National Observatory

Jerry Grey
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Resources for the Future, Incorporated

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Richard Krause
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Claire Nader
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OCEANS

Ocean Thermal Energy Conversion Review

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William Heronemus
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James L. Johnson
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David Jopling
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Richards T, Miller
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Danzil Pauli
National Academy of Engineering
Marine Board

Louis Roddis
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Oswald Reels
Director, Marine Science Institute
University of Texas

Herman Sheets
Ocean Engineering
University of Rhode Island

Robert Snyder
Oceanographer

Robert Taggart
Marine Research Consultant

Gary Thomas
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Environmental Impacts of Panama Canal Treaties Panel

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University of Texas at Austin

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International Engineering Co.

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Renewable Ocean Energy Sources Ad Hoc Advisory Group

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Disposal of Nuclear Wastes Panel

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Kenneth Boulding
Professor
American Association for the
Advancement of Science

Frank Collins
Oil. Chemical. and Atomic Workers

Floyd Culler
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Electric Power Research Institute

Hans Frauenfelder
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Hollis Hedberg
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Princeton University

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Harvard University

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John Taylor
Vice President
Westinghouse Electric Corporation

William A. Thomas
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Mason Willrich
Director, International Relations
Rockefeller Foundation

Donald Wodrich
Director, Rockwell International Waste Program
Richland National Laboratory

Advisory Panel on Nuclear Waste Management

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New York University

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James Crow
Professor of Genetics
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TELECOMMUNICATIONS AND INFORMATION SYSTEMS

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Donald Marchand
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Myron Uretsky
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Systems Planning Corp.

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Kent Joscelyn
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National Science Foundation

Wilfred Owen
The Brookings Institution

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Angela Rooney
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Upper Northeast Coordination Council

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New York University

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Special Consultant to the President
United Auto Workers

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Lay Public

Mia Choumenkovitch
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Del Dobbins
Lay Public

Alvin Frost
Lay Public

Mark Horowitz
Lay Public

William Lindsay
Lay Public

Lena Lupica
Lay Public

Larry Newlin
Lay Public

G. C. Sasser
Lay Public

Technology Assessment Act of 1972

Public Law 92-484
92nd Congress, H. R. 10243
October 13, 1972

An Act

86 STAT. 797

To establish an Office of Technology Assessment for the Congress as an aid in the identification and consideration of existing and probable impacts of technological application; to amend the National Science Foundation Act of 1950; and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Technology Assessment Act of 1972". Technology Assessment Act of 1972.

FINDINGS AND DECLARATION OF PURPOSE

SEC. 2. The Congress hereby finds and declares that:

(a) As technology continues to change and expand rapidly, its applications are—

(1) large and growing in scale; and

(2) increasingly extensive, pervasive, and critical in their impact, beneficial and adverse, on the natural and social environment.

(b) Therefore, it is essential that, to the fullest extent possible, the consequences of technological applications be anticipated, understood, and considered in determination of public policy on existing and emerging national problems.

(c) The Congress further finds that:

(1) the Federal agencies presently responsible directly to the Congress are not designed to provide the legislative branch with adequate and timely information, independently developed, relating to the potential impact of technological applications, and

(2) the present mechanisms of the Congress do not and are not designed to provide the legislative branch with such information.

(d) Accordingly, it is necessary for the Congress to—

(1) equip itself with new and effective means for securing competent, unbiased information concerning the physical, biological, economic, social, and political effects of such applications; and

(2) utilize this information, whenever appropriate, as one factor in the legislative assessment of matters pending before the Congress, particularly in those instances where the Federal Government may be called upon to consider support for, or management or regulation of, technological applications.

ESTABLISHMENT OF THE OFFICE OF TECHNOLOGY ASSESSMENT

SEC. 3. (a) In accordance with the findings and declaration of purpose in section 2, there is hereby created the Office of Technology Assessment (hereinafter referred to as the "Office") which shall be within and responsible to the legislative branch of the Government.

(b) The Office shall consist of a Technology Assessment Board (hereinafter referred to as the "Board") which shall formulate and promulgate the policies of the Office, and a Director who shall carry out such policies and administer the operations of the Office. Technology Assessment Board.

(c) The basic function of the Office shall be to provide early indications of the probable beneficial and adverse impacts of the applications of technology and to develop other coordinate information which may assist the Congress. In carrying out such function, the Office shall: Duties.

(1) identify existing or probable impacts of technology or technological programs;

(2) where possible, ascertain cause-and-effect relationships;

(3) identify alternative technological methods of implementing specific programs;

(4) identify alternative programs for achieving requisite goals;

(5) make estimates and comparisons of the impacts of alternative methods and programs;

(6) present findings of completed analyses to the appropriate legislative authorities;

(7) identify areas where additional research or data collection is required to provide adequate support for the assessments and estimates described in paragraph (1) through (5) of this subsection; and

(8) undertake such additional associated activities as the appropriate authorities specified under subsection (d) may direct.

(d) Assessment activities undertaken by the Office may be initiated upon the request of:

(1) the chairman of any standing, special, or select committee of either House of the Congress, or of any 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 Board; or

(3) the Director, in consultation with the Board.

Information, availability.

(e) Assessments made by the Office, including information, surveys, studies, reports, and findings related thereto, shall be made available to the initiating committee or other appropriate committees of the Congress. In addition, any such information, surveys, studies, reports, and findings produced by the Office may be made available to the public except where—

(1) to do so would violate security statutes; or

(2) the Board considers it necessary or advisable to withhold such information in accordance with one or more of the numbered paragraphs in section 552(b) of title 5, United States Code.

81 Stat. 54.

TECHNOLOGY ASSESSMENT BOARD

Membership.

SEC. 4. (a) The Board shall consist of thirteen members as follows:

(1) six Members of the Senate, appointed by the President pro tempore of the Senate, three from the majority party and three from the minority party;

(2) six Members of the House of Representatives appointed by the Speaker of the House of Representatives, three from the majority party and three from the minority party; and

(3) the Director, who shall not be a voting member.

Vacancies.

(b) Vacancies in the membership of the Board shall not affect the power of the remaining members to execute the functions of the Board and shall be filled in the same manner as in the case of the original appointment.

Chairman and vice chaiman.

(c) The Board shall select a chairman and a vice chairman from among its members at the beginning of each Congress. The vice chairman shall act in the place and stead of the chairman in the absence of the chairman. The chairmanship and the vice chairmanship shall alternate between the Senate and the House of Representatives with each Congress. The chairman during each even-numbered Congress shall be selected by the Members of the House of Representatives on the Board from among their number. The vice chairman during each Congress shall be chosen in the same manner from that House of Congress other than the House of Congress of which the chairman is a Member.

Meetings.

Subpena.

(d) The Board is authorized to sit and act at such places and times during the sessions, recesses, and adjourned periods of Congress, and upon a vote of a majority of its members, to require by subpena or otherwise the attendance of such witnesses and the production of such books, papers, and documents, to administer such oaths and affirmations, to take such testimony, to procure such printing and binding, and to make such expenditures, as it deems advisable. The Board may make such rules respecting its organization and procedures as it deems necessary, except that no recommendation shall be reported from the Board unless a majority of the Board assent. Subpenas may be issued over the signature of the chairman of the Board or of any voting member designated by him or by the Board, and may be served by such person or persons as may be designated by such chairman or member. The chairman of the Board or any voting member thereof may administer oaths or affirmations to witnesses.

DIRECTOR AND DEPUTY DIRECTOR

Appointment.

Compensation.

83 Stat. 863.

SEC. 5. (a) The Director of the Office of Technology Assessment shall be appointed by the Board and shall serve for a term of six years unless sooner removed by the Board. He shall receive basic pay at the rate provided for level III of the Executive Schedule under section 5314 of title 5, United States Code.

(b) In addition to the powers and duties vested in him by this Act, the Director shall exercise such powers and duties as may be delegated to him by the Board.

(c) The Director may appoint with the approval of the Board, a Deputy Director who shall perform such functions as the Director may prescribe and who shall be Acting Director during the absence or incapacity of the Director or in the event of a vacancy in the office of Director. The Deputy Director shall receive basic pay at the rate provided for level IV of the Executive Schedule under section 5315 of title 5, United States Code.

Deployment restriction.

(d) Neither the Director nor the Deputy Director shall engage in any other business, vocation, or employment than that of serving as such Director or Deputy Director, as the case may be; nor shall the Director or Deputy Director, except with the approval of the Board, hold any office in, or act in any capacity for, any organization, agency, or institution with which the Office makes any contract or other arrangement under this Act.

AUTHORITY OF THE OFFICE

SEC. 6. (a) The Office shall have the authority, within the limits of available appropriations, to do all things necessary to carry out the provisions of this Act, including, but without being limited to, the authority to—

(1) make full use of competent personnel and organizations outside the Office, public or private, and form special ad hoc task forces or make other arrangements when appropriate;

Contracts.

(2) enter into contracts or other arrangements as may be necessary for the conduct of the work of the Office with any agency or instrumentality of the United States, with any State, territory,

86 STAT. 800

or possession or any political subdivision thereof, or with any person, firm, association, corporation, or educational institution, with or without reimbursement, without performance or other bonds, and without regard to section 3709 of the Revised Statutes (41 U.S.C. 5);

(3) make advance, progress, and other payments which relate to technology assessment without regard to the provisions of section 3648 of the Revised Statutes (31 U.S.C. 529);

(4) accept and utilize the services of voluntary and uncompensated personnel necessary for the conduct of the work of the Office and provide transportation and subsistence as authorized by section 5703 of title 5, United States Code, for persons serving without compensation;

80 Stat. 499; 83 Stat. 190.

(5) acquire by purchase, lease, loan, or gift, and hold and dispose of by sale, lease, or loan, real and personal property of all kinds necessary for or resulting from the exercise of authority granted by this Act; and

(6) prescribe such rules and regulations as it deems necessary governing the operation and organization of the Office.

Records and accounts.

(b) Contractors and other parties entering into contracts and other arrangements under this section which involve costs to the Government shall maintain such books and related records as will facilitate an effective audit in such detail and in such manner as shall be prescribed by the Office, and such books and records (and related documents and papers) shall be available to the Office and the Comptroller General of the United States, or any of their duly authorized representatives, for the purpose of audit and examination.

(c) The Office, in carrying out the provisions of this Act, shall not, itself, operate any laboratories, pilot plants, or test facilities.

Agency cooperation.

(d) The Office is authorized to secure directly from any executive department or agency information, suggestions, estimates, statistics, and technical assistance for the purpose of carrying out its functions under this Act. Each such executive department or agency shall furnish the information, suggestions, estimates, statistics, and technical assistance directly to the Office upon its request.

Personnel detail.

(e) On request of the Office, the head of any executive department or agency may detail, with or without reimbursement, any of its personnel to assist the Office in carrying out its functions under this Act.

(f) The Director shall, in accordance with such policies as the Board shall prescribe, appoint and fix the compensation of such personnel as may be necessary to carry out the provisions of this Act.

ESTABLISHMENT OF THE TECHNOLOGY ASSESSMENT ADVISORY COUNCIL

Membership.

SEC. 7. (a) The Office shall establish a Technology Assessment Advisory Council (hereinafter referred to as the "Council"). The Council shall be composed of the following twelve members:

(1) ten members from the public, to be appointed by the Board, who shall be persons eminent in one or more fields of the physical, biological, or social sciences or engineering or experienced in the administration of technological activities, or who may be judged qualified on the basis of contributions made to educational or public activities;

(2) the Comptroller General; and

(3) the Director of the Congressional Research Service of the Library of Congress.

Duties.

(b) The Council, upon request by the Board, shall—

(1) review and make recommendations to the Board on activities undertaken by the Office or on the initiation thereof in accordance with section 3(d);

(2) review and make recommendations to the Board on the findings of any assessment made by or for the Office; and

(3) undertake such additional related tasks as the Board may direct.

Chairman and Vice Chairman.

(c) The Council, by majority vote, shall elect from its members appointed under subsection (a)(1) of this section a Chairman and a Vice Chairman, who shall serve for such time and under such conditions as the Council may prescribe. In the absence of the Chairman, or in the event of his incapacity, the Vice Chairman shall act as Chairman.

Term of office.

(d) The term of office of each member of the Council appointed under subsection (a)(1) shall be four years except that any such member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term. No person shall be appointed a member of the Council under subsection (a)(1) more than twice. Terms of the members appointed under subsection (a)(1) shall be staggered so as to establish a rotating membership according to such method as the Board may devise.

Travel expenses.

(e)(1) The members of the Council other than those appointed under subsection (a)(1) shall receive no pay for their services as members of the Council, but shall be allowed necessary travel expenses (or, in the alternative, mileage for use of privately owned vehicles and a per diem in lieu of subsistence at not to exceed the rate prescribed in sections 5702 and 5704 of title 5, United States Code), and other necessary expenses incurred by them in the performance of duties vested in the Council, without regard to the provisions of subchapter 1 of chapter 57 and section 5731 of title 5, United States Code, and regulations promulgated thereunder.

80 Stat. 499; 83 Stat. 190. 5 USC 5701.

Compensation.

(2) The members of the Council appointed under subsection (a)(1) shall receive compensation for each day engaged in the actual performance of duties vested in the Council at rates of pay not in excess of the daily equivalent of the highest rate of basic pay set forth in the General Schedule of section 5332(a) of title 5, United States Code, and in addition shall be reimbursed for travel, subsistence, and other necessary expenses in the manner provided for other members of the Council under paragraph (1) of this subsection.

UTILIZATION OF THE LIBRARY OF CONGRESS

SEC. 8. (a) To carry out the objectives of this Act, the Librarian of Congress is authorized to make available to the Office such services and assistance of the Congressional Research Service as may be appropriate and feasible.

(b) Such services and assistance made available to the Office shall include, but not be limited to, all of the services and assistance which the Congressional Research Service is otherwise authorized to provide to the Congress.

(c) Nothing in this section shall alter or modify any services or responsibilities, other than those performed for the Office, which the Congressional Research Service under law performs for or on behalf

of the Congress. The Librarian is, however, authorized to establish within the Congressional Research Service such additional divisions, groups, or other organizational entities as may be necessary to carry out the purpose of this Act.

(d) Services and assistance made available to the Office by the Congressional Research Service in accordance with this section may be provided with or without reimbursement from funds of the Office, as agreed upon by the Board and the Librarian of Congress.

UTILIZATION OF THE GENERAL ACCOUNTING OFFICE

SEC. 9. (a) Financial and administrative services (including those related to budgeting, accounting, financial reporting, personnel, and procurement) and such other services as may be appropriate shall be provided the Office by the General Accounting office.

(b) Such services and assistance to the Office shall include, but not be limited to, all of the services and assistance which the General Accounting Office is otherwise authorized to provide to the Congress.

(c) Nothing in this section shall alter or modify any services or responsibilities, other than those performed for the Office, which the General Accounting Office under law performs for or on behalf of the Congress.

(d) Services and assistance made available to the Office by the General Accounting Office in accordance with this section may be provided with or without reimbursement from funds of the Office, as agreed upon by the Board and the Comptroller General.

COORDINATION WITH THE NATIONAL SCIENCE FOUNDATION

SEC. 10. (a) The Office shall maintain a continuing liaison with the National Science Foundation with respect to—

(1) grants and contracts formulated or activated by the Foundation which are for purposes of technology assessment; and

(2) the promotion of coordination in areas of technology assessment, and the avoidance of unnecessary duplication or overlapping of research activities in the development of technology assessment techniques and programs.

Scientific programs, financing. 92 Stat. 360.

(b) Section 3(b) of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1862(b)), is amended to read as follows:

"(b) The Foundation is authorized to initiate and support specific scientific activities in connection with matters relating to international cooperation, national security, and the effects of scientific applications upon society by making contracts or other arrangements (including grants, loans, and other forms of assistance) for the conduct of such activities. When initiated or supported pursuant to requests made by any other Federal department or agency, including the Office of Technology Assessment, such activities shall be financed whenever feasible from funds transferred to the Foundation by the requesting official as provided in section 14(g), and any such activities shall be unclassified and shall be identified by the Foundation as being undertaken at the request of the appropriate official."

64 Stat. 156; 32 Stat. 365. 42 USC 1873.

ANNUAL REPORT

SEC. 11. The Office shall submit to the Congress an annual report which shall include, but not be limited to, an evaluation of technology assessment techniques and identification, insofar as may be feasible, of technological areas and programs requiring future analysis. Such report shall be submitted not later than March 15 of each year.

APPROPRIATIONS

SEC. 12. (a) To enable the Office to carry out its powers and duties, there is hereby authorized to be appropriated to the Office, out of any money in the Treasury not otherwise appropriated, not to exceed $5,000,000 in the aggregate for the two fiscal years ending June 30, 1973, and June 30.1974, and thereafter such sums as may be necessary.

(b) Appropriations made pursuant to the authority provided in subsection (a) shall remain available for obligation, for expenditure, or for obligation and expenditure for such period or periods as may be specified in the Act making such appropriations.

Approved October 13, 1972.

LEGISLATIVE HISTORY:

HOUSE REPORTS: No. 52-469 (Comm. on Science and Astronautics) and No. 92-1436 (Cam. of Conference).
SENATE REPORT No. 99-1123 (Comm. on Rules and Administration).
CONGRESSIONAL RECORD, Vol. 118 (1972):
Feb. 8, considered and passed House.
Sept. 14, considered and passed Senate, amended.
Sept. 22, Senate agreed to conference report.
Oct. 4, House agreed to conference report.

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