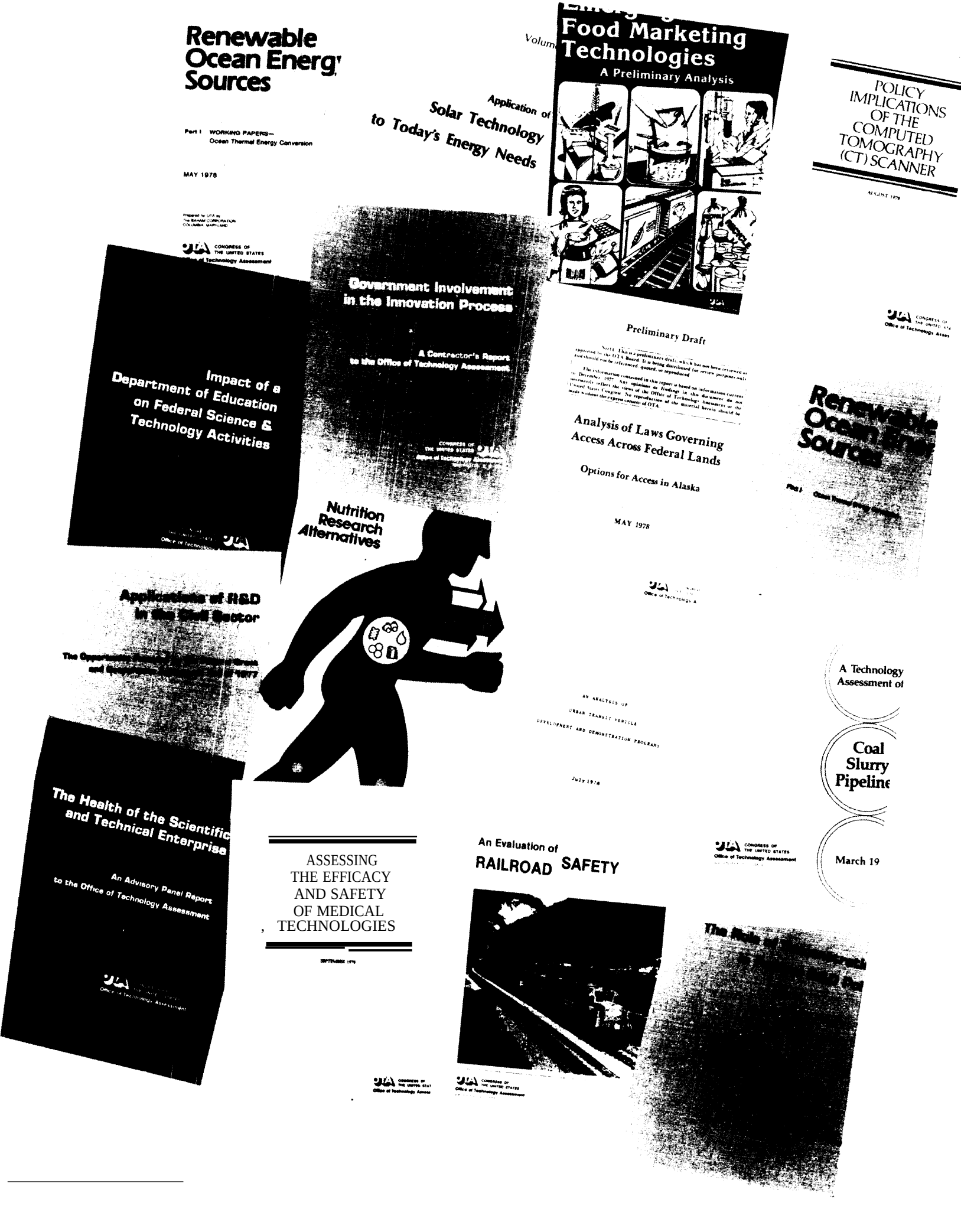
Section II

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
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Analysis of Laws Governing Access Across Federal Lands
Options for Access in Alaska
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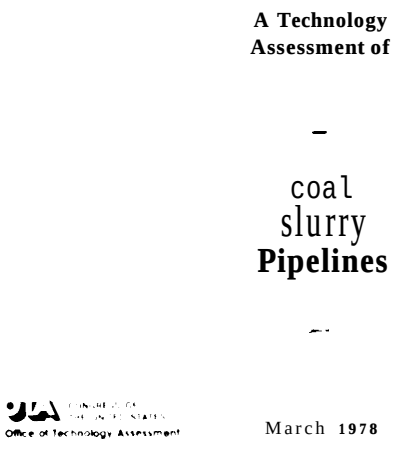
Renewable Ocean Energy Sources
Nutrition Research Alternatives
Applications of R&D in the Steel Sector
AN ANALYSIS OF URBAN TRANSIT VEHICLE DEVELOPMENT AND DEMONSTRATION PROGRAMS
July 1978
A Technology Assessment of
Coal Slurry Pipeline
March 19
The Health of the Scientific and Technical Enterprise
An 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.

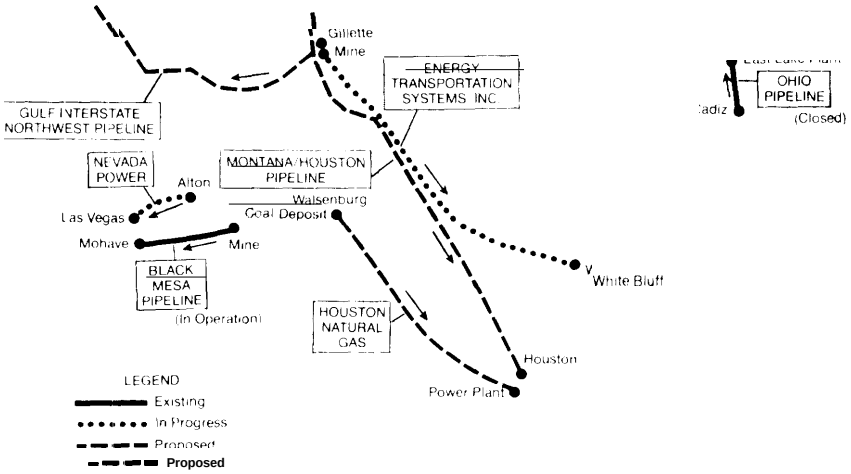
One environmental area of uncertainty involves the substances that will be present in the slurry water after it has been separated from the coal at the end of the pipeline. The Department of Energy is now sponsoring experiments to clarify this problem.

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:

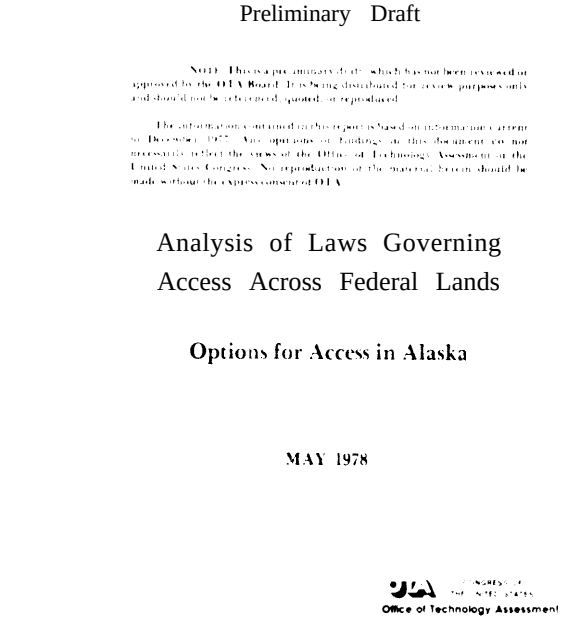
- Accident data have not been adequately used to analyze the nature. extent. and causes of specific safety problems, or in setting priorities for addressing these problems.
- Measures of effectiveness have not been designed into current regulatory, inspection, and R&D programs.
- Alternative approaches 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

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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.

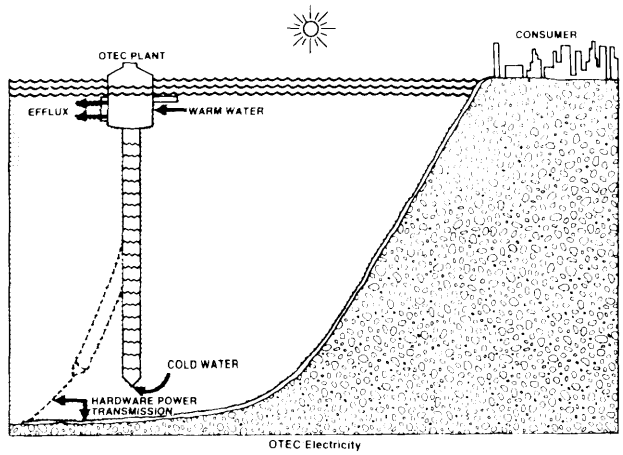
The number of sites where a sufficient temperature difference exists between the surface and a reasonable ocean depth is limited -–there are few off the continental United States—but at these sites the solar energy stored in the ocean is an abundant. renewable source of power. However, harnessing this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

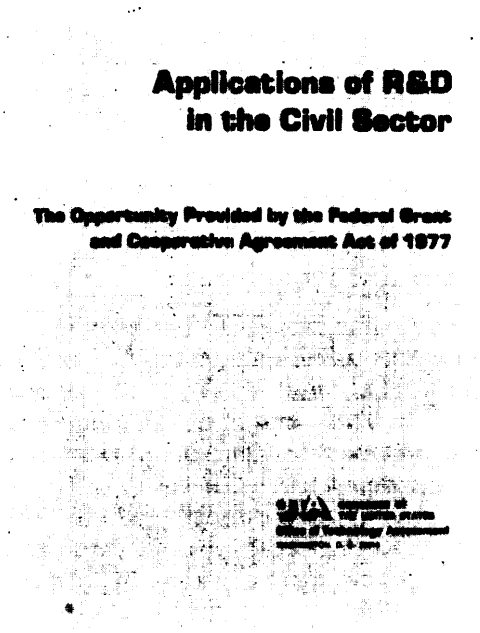
OTEC technology is not yet proven and probably could not become a viable part of the U.S. energy supply system in this century. Although the concept was demonstrated on a small scale in 1926. the technology is not developed to the point where acceptably precise estimates can be made about the technical 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.

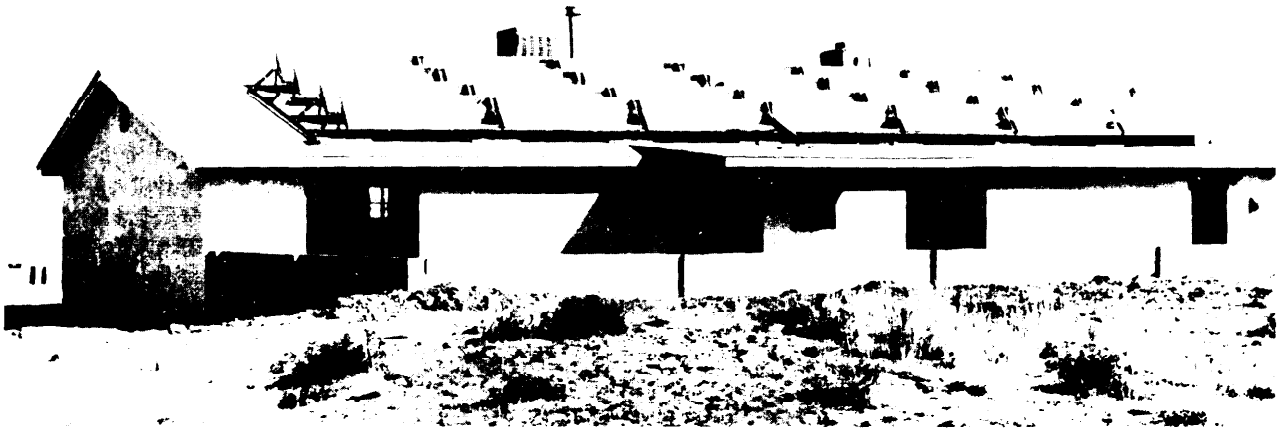
Onsite solar systems which rely on storage for backup can be designed to provide all of a building's energy needs, but generally are more expensive than systems relying on electric or gas backup. Systems relying on electric backup can be designed which would not adversely affect utility rates. Systems 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.

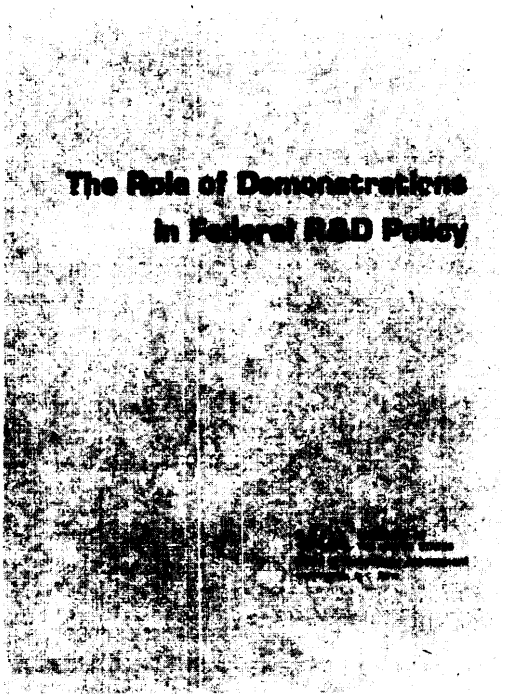
Initiated in 1971, the TRANSBUS project resulted in the fabrication and testing of three prototype buses featuring new components. improved access, and a low floor. However, insufficient emphasis was placed on development of key components, resulting in several unresolved technological and operating 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.

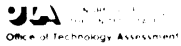
For Congress to effectively evaluate demonstrations, a set of realistic expectations for a demonstration's outcome would be useful. Toward this end, OTA reviewed the extensive experience with demonstrations, including both social and hardware demonstrations, and developed both a conceptual framework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

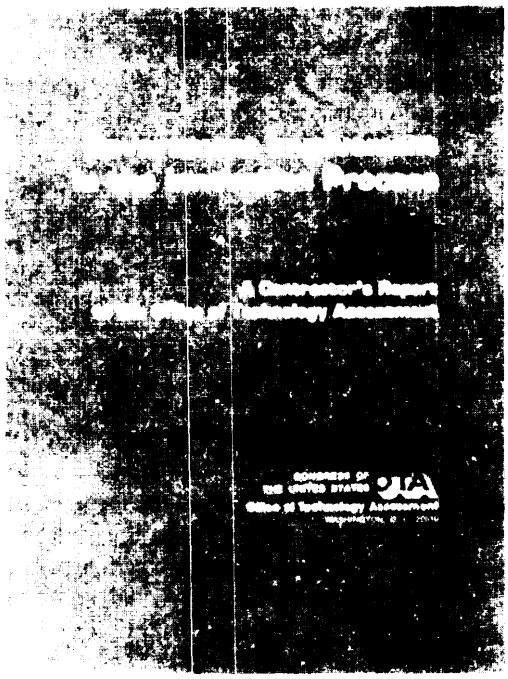
However, CT scanning represents one element in the great increase that has occurred in recent years in technological capability, diagnostic testing, and rising medical costs. Because of their rapid adoption and high purchase price (averaging a half million dollars each), CT scanners raise important policy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

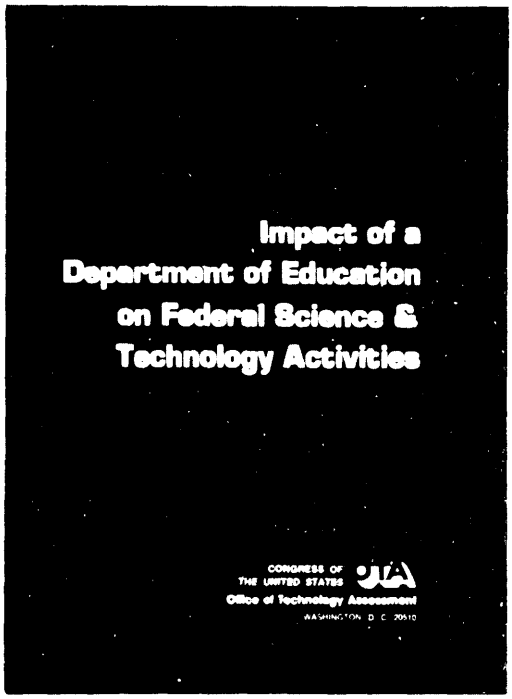
Governments in all modern industrial countries seek to promote and shape technological development, particularly where market forces are clearly incapable of achieving defined national objectives. Private companies tend to support those research projects whose results they can control. But, only the 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.

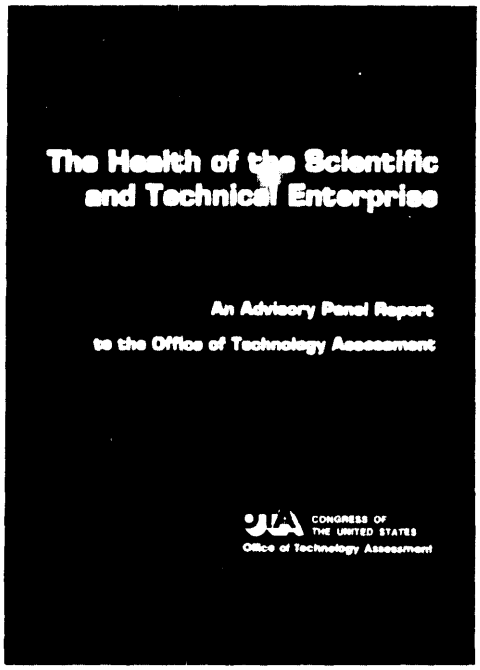
Yet, the Federal Government has failed to shift its research priorities from traditional concerns with deficient diets and the biochemical functions of nutrients to the relationship between nutrition and health. Greater emphasis is needed on research on how diet contributes to the development of chronic 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.

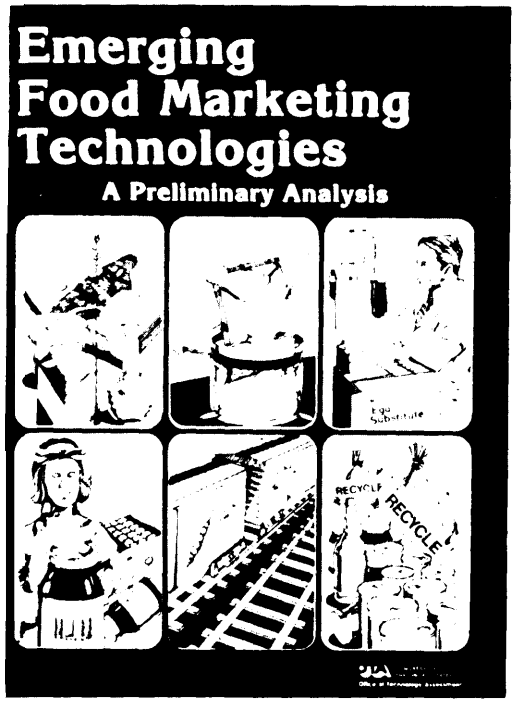
As part of a broad study of national research and development policies and priorities in the United States, OTA established an advisory panel of experts to examine the scientific and technical enterprise. Because of the ambiguity and oftentimes deceptiveness of the indicators commonly used, this report 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.