Section III
PROGRAM DESCRIPTIONS

Congress enacts legislation authorizing and funding scientific and technological programs, and oversees them to ensure that they reflect congressional intent. Billions of dollars are also spent in the private sector on research and technological applications.

The role of OTA is to examine the probable effects—both beneficial and harmful—of the application of technologies. OTA assesses the social, economic, political, and environmental consequences for society of technological change. In addition, OTA evaluates the likely benefits and risks of various policy options available to the Congress for dealing with such impacts. OTA also provides early indications of the likely effects of future technological applications.

In carrying out its mission, OTA works primarily for the committees of Congress (see section V for a description of how assessments originate). The committees, usually working through their specialized subcommittees, draft legislation, evaluate administration proposals, determine funding levels, and oversee programs. OTA assessments provide technical and policy analysis, background information, and other data which assist the committees **in** fulfilling their responsibilities.

These assessments are organized and led by OTA program managers and staff (see section V for organization and operations). Each program area is staffed by a small core of professionals in various fields. The OTA staff is complemented by both full-time and temporary consultants who contribute specialized knowledge to particular projects. Contractors, such as universities and private research organizations, are employed for technical studies.

In addition, advisory panels, made up of recognized experts and representatives of groups most likely to be affected by a technology, are often formed to assist with projects. **By** reaching out into the scientific and

technical communities as well as the general public, OTA is thus able to bring a diversity of viewpoints and knowledge to bear on issues of national concern.

OTA's assessments help Congress in carrying out its legislative, authorization and appropriations, oversight, and policymaking responsibilities. OTA staff, consultants, and panel members brief committee members and their staffs and testify in committee hearings on the findings of assessments. Members of Congress use the OTA reports as background material for floor debate, in drafting legislation, and in conducting oversight hearings.

OTA assessments are programmatically structured in eight principal areas established by the OTA Board: energy, food, health, materials, national research and development policies and priorities, oceans, technology and world trade, and transportation.

During the year, reports on 14 major completed assessments were delivered to the requesting committees of Congress. More than 40 individual projects were in progress. In the remainder of this section, the broad concerns in each program area are sketched, along with a description of OTA activities to address these concerns.

Section III
PROGRAM DESCRIPTIONS

Energy Program

No issue has so preoccupied Congress in recent years as energy. The Nation relies on oil and natural gas for 75 percent of its energy needs. But while demand has been climbing, domestic oil and gas production has steadily declined. To close this growing gap between energy production and demand, oil imports have risen to a point where they now account for 47 percent of U.S. consumption.

This increase in imports has become a national issue of overriding concern. The combination of higher fuel prices, rising dollar outflows, and growing dependence on foreign suppliers has created serious economic and security problems.

To help Congress to deal with such complex problems, the Energy Program is broadly organized into energy supply and demand subprograms. Assessments which concern fossil, solar, and nuclear energy, and energy conservation have been or are being conducted.

During 1977, OTA completed three energy assessments and delivered two others in prepublication form to Congress. One report analyzed the facets of nuclear proliferation and safeguards. Another assessed the effectiveness of the President's proposed National Energy Plan and the broad range of its potential impacts on consumers, suppliers, and society as a whole. The third evaluated the potential for recovering natural gas from the extensive Devonian shale deposits found throughout the Appalachian region.

One of the prepublication drafts examined onsite solar energy systems' feasibility and potential for generating electricity, as well as heating and cooling. The other analyzed how using enhanced recovery methods in existing oil reservoirs might increase the Nation's petroleum supplies.

Three additional assessments are in various stages of completion. One, to be delivered to Congress in the spring, is evaluating methods and environmental effects of directly burning coal. Another, to be presented in January 1978, is analyzing the feasibility of using slurry pipelines to transport coal from where it is mined to where it will be used, and the impacts of pipelines on the environment and railroads. A third assessment is examining the technologies and potential for conserving energy in residential buildings.

Nuclear Proliferation and Safeguards

The concern for nuclear weapons proliferation has grown with the worldwide spread of nuclear energy plants and the rise in international terrorism. To help Congress determine how best to deal with this ominous problem, OTA analyzed proliferation risks which could arise during a transition from conventional nuclear power to plutonium reprocessing and breeder reactors. The study also evaluated the capabilities and motives of non-nuclear nations and terrorists for developing nuclear weapons, assessed international institutions and agreements, and examined various sets of policies which the United States could adopt to improve international safeguards. (Excerpts from this report may be found in section II.)

The report was requested by the Senate Committee on Government Operations. In April, during hearings held by the Committee's Subcommittee on Energy, Nuclear Proliferation and Federal Services on the Nuclear Non-Proliferation Act of 1977, OTA panel members testified on the report's findings. In the fall, Praeger Publishing Company reprinted the OTA report that was originally printed at the Government Printing Office, which now serves as a text for graduate courses in international relations at Johns Hopkins and Princeton universities' Schools of Foreign Affairs.

Analysis of the Proposed National Energy Plan

In April 1977, the Administration sent its proposed National Energy Plan (NEP) to the Congress. To help them analyze the complex package of proposals, the House Committees on Interior and Insular Affairs and on Science and Technology asked OTA to assess the effectiveness of the Plan and the broad impacts it would have on energy suppliers and users, the economy, environment, and State and local governments. At the same time, the General Accounting Office, Congressional Budget Office, and the Congressional Research Service also undertook analyses of the NEP at the request of congressional committees of jurisdiction.

To conduct the study, OTA established three task groups totalling more than 100 persons who represented a diversity of viewpoints, fields of expertise, and affected groups. A series of panel meetings identified and examined key issues of supply, demand, and societal impacts.

Within 8 weeks, these panelists and OTA staff completed their report on the strengths and weaknesses of the plan, its impact on energy supply and demand, and its effect on society. In addition, the report assessed alternative policies for achieving the plan's goals. (Excerpts from this report may be found in section II.) This rapid analysis was made possible by OTA's prior experience with evaluations of the ERDA budget and programs in 1975 and 1976 and of EPA's research plan in 1976.

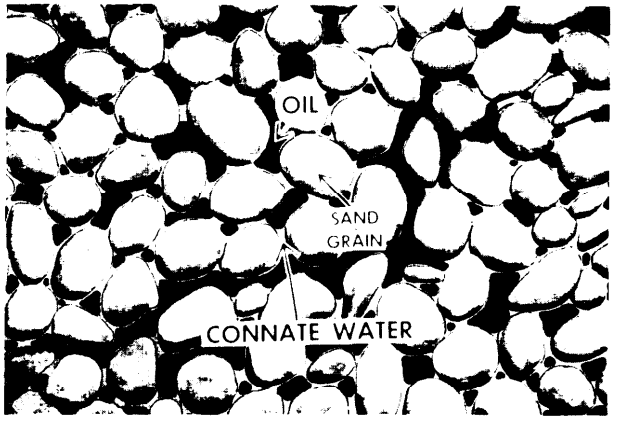
During the debates in both the House of Representatives and the Senate, Members of both political parties and on both sides of various issues frequently referred to or quoted from the OTA assessment. Reports of several committees also cited the study.

Enhanced Recovery of Oil

There has long been controversy over the potential recovery of oil from the Nation's known oil and gas reservoirs. To help resolve the question, OTA evaluated data from 50 percent of the operating oil fields in the United States to determine how much additional oil and gas could be recovered through so-called "tertiary" or enhanced recovery techniques. These include new and expensive technologies which involve injection of certain chemicals or carbon dioxide to free additional oil from reservoirs. OTA's survey took into account the most advanced recovery techniques now being tested.

The report concluded that significant amounts of oil can be recovered by such advanced technologies, but is cautioned that the OTA estimates were lower than those of earlier studies. According to the assessment, enhanced recovery techniques could yield from 11 to 29 billion barrels of oil, at current world oil prices, over the next 20 years. The report noted, however, that is doubtful that more than 51 billion barrels—about 20 percent of the known U.S. reserves–could be recovered under any economic conditions using current and foreseeable technology. (Excerpts from this report may be found in section II.)

Given current congressional concern about energy, a prepublication draft of the study was released in June. The final report, requested by Sen. Ted Stevens (R-Alaska) of the Technology Assessment Board, and the House Committee on Science and Technology, will be published in January 1978.



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Close-up of oil between grains of rock. A thin film of water called connate water clings to the surface of the rock grains. This water occupies part of the space in the rock along with the oil.

Gas Potential of Devonian Shales of the Appalachian Basin

This report assesses the potential for recovering natural gas from the vast shale deposits that accumulated during the Devonian geological age (310 million-350 million years ago) and that lie under the Appalachian regions of Pennsylvania, New York, West Virginia, and Kentucky. OTA based the study on data from 490 wells already operating in the area. Congress received a report on the current state of knowledge regarding the Devonian natural gas and its recovery. (Excerpts from this report may be found in section II.)

The OTA assessment was proposed by Senator Ted Stevens of the Technology Assessment Board and the Senate Committee on Commerce as part of a larger analysis of enhanced techniques for recovering oil and gas, The report has been used by the Joint Committee on Taxation to determine how various possible tax incentives would affect natural gas supply. The House-Senate conference committee used the report in its efforts to reconcile the House and Senate versions of the National Energy Plan regarding natural gas pricing policies.

Applications of Solar Technology to Today's Energy Needs

If the prices of fossil fuels and of electricity generated from conventional energy sources continue to rise, small, onsite solar energy equipment could supply increasingly significant amounts of energy. Such equipment, on location near homes or commercial buildings. could provide electricity as well as space cooling and heating. This was the principal finding of OTA's comprehensive assessment of solar technology. The preliminary results of the 3-year study were published in a two-volume, 1,400-page draft report for use by Congress in its deliberations on the National Energy Plan,

The OTA study evaluated the state of onsite solar technology and examined its effect on existing electric utility systems. A specially designed computer program also compared the economic viability of various types of solar equipment, under different ownership assumptions, with conventional energy sources at different future price ranges in four cities studied meticulously: Albuquerque. Boston, Fort Worth, and Omaha. The study also analyzed existing institutional constraints to solar energy: environmental. social. and economic implications; and the policies of the Federal Government regarding solar energy. (Excerpts from this report may be found in section 11.)

In support of the congressional debate on energy, and because of increasing interest in solar energy in particular, a prepublication draft of the report was issued in July. The final report, requested by the Senate Committee on Aeronautical and Space Sciences, will be published in 1978. Members of both the House and Senate quoted the study widely in debates on energy legislation in 1977.

Residential Energy Conservation

About one-fifth of all energy consumed in the United States heats and cools residential and commercial buildings. A significant amount of this energy could be saved by using both existing and newly developing technologies and better building design. The National Energy Plan, recognizing this fact, emphasized various proposed voluntary, incentive-based conservation measures for residential and commercial buildings.

At the request of the Senate Committee on Commerce, OTA is evaluating the opportunities for and the constraints on conserving energy in residential buildings over the next 15 years. The evaluation particularly stresses conservation through existing technologies, as well as the roles of consumers, builders, utilities, and Government in the decision making process as it affects the potential for saving energy.

The Senate Committee on Energy and Natural Resources used preliminary findings from this assessment in 1977 to evaluate the conservation provisions of the National Energy Plan.

Coal Utilization

To meet the demand for energy and to reduce dependence on dwindling supplies of oil and natural gas, the Administration has proposed shifting the U.S. fuel consumption in the coming years from oil and gas to coal. This shift could, however, create conflicts with environmental priorities. The question is how to burn increasing amounts of coal while maintaining clear air standards.

At the request of the Senate Committee on Public Works, OTA is assessing the social and environmental impacts and the economic and technical potential of existing and new methods of burning coal directly (i.e., in contrast to converting it to gas or liquids). In 1978, a survey of consumers, producers, and government officials will determine how the production and use of coal affect people and institutions. A second part of this assessment will evaluate methods and impacts of converting coal to gas or a liquid "synthetic" fuel.

Coal Slurry Pipeline

In recent years Congress has been compelled to sort out the conflicting claims of pipeline and railroad proponents over how coal from the Western States can best be transported from where it is mined to where it will be used. Slurry pipelines pump finely ground coal suspended in water or another liquid (a "slurry") over substantial distances. Proponents argue that pipelines will cut the costs of moving coal over long distances. Others, however, maintain that such pipelines will damage the environment and seriously hurt the railroads.

To address these and other issues for Congress, OTA is assessing the environmental and economic impacts of proposed coal slurry pipelines. The assessment involves four interrelated parts. The first forecasts to the year 2000 the amounts of coal to be transported. The second develops cost estimates and market scenarios to predict the impact of slurry pipelines on energy costs, the cost and quality of railroad service, employment, and other economic measures. The third assesses the environmental and social impacts of transporting coal by pipelines as opposed to railroads. The availability of water for use in slurry pipelines, particularly in the arid and semiarid West, commands particular attention. Finally, OTA is examining the legal and regulatory factors relating to rail and pipeline competition, water rights, environmental protection, and eminent domain.

The Senate Committees on Commerce and on Interior and Insular Affairs and the House Committee on Interstate and Foreign Commerce requested this OTA project. The House Committee on Interior and Insular Affairs has scheduled hearings for early 1978 on the question of eminent domain rights for the slurry pipelines. The assessment was virtually complete at year-end and will be delivered to the requesting committee in January 1978.

Food Program

Food production, processing and retailing account for one-third of the U.S. gross national product—about $600 billion per year. Approximately one in four persons employed by the private sector work in some area of the food industry. Eight million to ten million people produce, store, transport, process, merchandise, and serve the Nation's food. Although there are now fewer than 3 million farms in the United States, agriculture's assets equal about three-fifths of the capital assets of all manufacturing corporations in the Nation.

In 1972-73, shortages of foods, fuels, and fertilizers disrupted U.S. and world markets and shook the public. Since then, world food produc-

tion has greatly improved, although the overall situation remains fragile. Congress has had to contend with, on the one hand, issues of domestic surpluses and falling prices, and on the other, the realization that hunger and malnutrition persist in widespread areas of the world.

Likewise, major long- and short-term domestic problems confront the United States. Increased agricultural productivity has ensued from the use of new technology, which in turn requires heavy capitalization. The rising cost of farm labor is also forcing increased reliance on technology and capital.

Recent droughts in the American West and elsewhere in the world have vividly demonstrated the dependence of sufficient food supplies on the availability of water. Climatologists warn that if weather patterns become more varied, as many predict, greater year-to-year fluctuations in food supply can be expected.

The health and nutritional consequences of substituting processed for natural foods distress a number of people. Many have also expressed concern regarding the use of drugs in livestock feeds; the addition of chemicals to food products to retard spoilage, enhance flavor or appearance; and the hazards of chemical and microbiological contamination of foods.

To provide Congress with information on these and other food-related problems, the OTA Food Program embraces a wide range of issues relating to agriculture, food, and nutrition. Projects encompass three areas: 1) production, from input to the farm gate; 2) marketing, including processing, wholesaling, and retailing; and 3) consumption and nutrition. Assessments in these areas center on two primary elements of congressional attention: better use and management of technologies and resources, and the impact of U.S. food policies on producers and on the nutrition and health of consumers at home and abroad.

In 1977, OTA examined opportunities and institutional means for expanding basic research to increase food production in the United States. The report was the first of a two-part assessment of agricultural research and development. The second part analyzes the implications of increasing U.S. support for agricultural research in developing countries.

A report completed in 1977 evaluated the Nation's retail food grading system and assessed options that Congress might consider for improving that system's information to consumers. A second project, begun in 1976, analyzes the transfer of food processing technology to developing countries.

Two other assessments concerning marketing issues were approved by the Board and initiated in 1977. One in examining open-dating techniques for labeling processed foods. The other is evaluating new technologies that will affect future food marketing practices.

Two assessments relating to food safety and health were also begun in 1977. One studies the benefits and risks for humans of using drugs and chemical additives in livestock feed. The second examines alternative strategies for nutrition research conducted or sponsored by the Federal Government.

Another ongoing project, initiated by OTA in **1976,** deals with overall food and nutrition policies. This project assesses alternative food policies in order to provide Congress with information and policy options to consider as it legislates a national food policy.

Perspectives on Federal Retail Food Grading

Commodities and food products are graded on the basis of sensory characteristics such as flavor, color, texture, or appearance. In a report published in June, OTA examined the Federal system of food grading to determine how it might respond more effectively to the needs of consumers as well as producers. The assessment analyzed the grading of fresh fruits and vegetables, fresh meat, and processed foods. (Excerpts from this report may be found in section II.)

This report, requested by the Senate Committee on Agriculture and Forestry and the Senate Select Committee on Nutrition and Human Needs, is assisting the Subcommittee on Domestic Marketing, Consumer Relations, and Nutrition of the House Committee on Agriculture as it prepares for hearings on fresh meat, fruits, and vegetables. The U.S. Department of Agriculture is also studying the report to determine what changes that do not require legislation can be made in the food grading system.

Organizing and Financing Basic Research to Increase Food Production

This assessment examined alternatives for organizing and financing basic biological research aimed at increasing food production. The assessment focused on three areas of high-priority research that offer the greatest potential: photosynthesis, nitrogen fixation, and cell culture studies. (Excerpts from this report may be found in section 11.)

The report was requested by the House Committee on Science and Technology and the Joint Economic Committee. Its findings were reflected in the USDA appropriations in which Congress, for the first time, specifically funded $15 million for fiscal year 1978 in competitive grants for basic research on food production.

Increased Support of Agricultural Research and *Development in Developing Countries*

In the second part of the study of agricultural research and development, OTA is assessing the implications of increased U.S. funding for agricultural research in developing countries.

Many experts feel that the best long-range solution to the world food problem is to help developing countries become self-sufficient in food production. Thus, OTA is assessing the willingness and ability of developing countries to benefit from increased U.S. support for agricultural research. The project also examines the legislative and institutional means for providing such support and alternatives for bolstering research in developing countries.

The study was requested by the House Committee on Science and Technology and the Joint Economic Committee. During 1977, the Subcommittee on Foreign Assistance of the Senate Committee on Foreign Relations used OTA preliminary findings to question the Agency for International Development about the ability of its technical staff to carry out food and agriculture programs in developing countries.

Transfer of Food Processing Technology to Developing Countries

In a related assessment, OTA is evaluating alternatives for and consequences of exporting U.S. food-processing technology to developing countries. The project identifies the quality and range of foods available to such nations, as well as those technologies that might improve the nutritive value and/or lower the cost of high-quality food.

In addition, OTA is analyzing the methods, constraints and effectiveness of institutional channels for making such technology transfers, the options available to the Congress for stimulating the technology exports, and the international channels for accomplishing the transfers.

The project was requested by the Joint Economic Committee, the Senate Select Committee on Nutrition and Human Needs, and the House Committee on Agriculture.

Alternatives in U.S. Food Policy

This project draws on the resources and experience gained from other Food Program assessments. It is evaluating technological issues and problems in production, marketing, consumption and nutrition, and developing information to help Congress legislate a national food policy.

The OTA Food Program and its Food Advisory Committee have set three objectives for this assessment. First, it will spell out elements needed to formulate a national food policy. Second, it will identify and analyze public policy and technological issues for Congress. And third, it

will identify and assess emerging issues in the food area.

OTA has examined the policies and programs affecting each part of the food system, how they relate to one another, and the tradeoffs which result from conflicting goals (such as lower food prices for consumers and higher incomes for farmers).

The assessment was requested by Senator Hubert Humphrey of the OTA Board, the Senate Committee on Agriculture and Forestry, the Senate Select Committee on Nutrition and Human Needs, and the House Committee on Agriculture.

Drug and Chemical Additives in Livestock Feeds

In 1977, the Food and Drug Administration (FDA) proposed banning penicillin, tetracycline, and nitrofurans as livestock feed additives used to stimulate growth or improve the health of animals. The FDA is concerned that these drugs may cause cancer in the animals or lead to the growth of resistant strains of bacteria that can be transferred to humans.

At the request of the Senate Committee on Agriculture, Nutrition, and Forestry and the House Committee on Agriculture, OTA is assessing the benefits and risks of using drugs and chemicals as additives in livestock feeds. The project identifies acceptable risk and available native feed additives and will evaluate the options available to Congress for improved regulation of drug additives.

As part of the project, OTA workshops in late 1977 brought representatives of the food and drug industries, Government regulatory agencies, and farm and consumer groups together to discuss the issues and consider background papers prepared by OTA staff and consultants. This public participation effort will continue in 1978.

Nutrition Research Strategies

The public has become increasingly conscious in recent years of the role of nutrition in maintaining health. Both Congress and the executive branch have responded to the increased public interest in nutrition. The Senate Select Committee on Nutrition and Human Needs held hearings in 1976 and 1977 on the relationship of diet to desease. With the Food and Agriculture Act of 1977, Congress made nutrition research a separate and distinct mission of the U.S. Department of Agriculture.

To assist Congress in considering policies affecting research in human nutrition, the Board approved a project to evaluate the implications of alternative strategies for conducting such research. The assessment focuses on two principal areas: the priorities for nutrition research and the administration and coordination of Federal domestic and international nutrition research activities. In 1977, a planning session and two workshops identified and discussed the issues. The first workshop considered priorities and alternative mechanisms for coordinating and administering research on nutrition. The second workshop discussed the role of the private sector in nutrition research and related issues.

New Marketing Technologies

In this planning project, OTA is surveying new food marketing technologies and issues that may arise from their adoption, and identifying technologies that may come into use in the near- and long-term futures. These technologies include texturing, blending, and flavoring methods that produce new foods, the electronic checkout at grocery stores, and the reportable pouch for packaging precooked foods prior to sale.

At OTA's request, more than 200 specialists in various aspects of food marketing offered their views on how such possible new technologies might affect the overall food system. A citizens' advisory panel integrated the information in an October planning effort directed towards identifying priority areas that Congress might consider in need of assessment by OTA. The study was requested by the OTA Board.

Open-Dating Techniques for Processed Foods

Many food processors now print "sell by" or "use by" dates on their packages to indicate the last date on which the product will be fresh or offer maximum nutrition. However, there are no standards for such so-called "open-dating" techniques. Dates differ from product to product and from manufacturer to manufacturer. Indeed, there are no laws or regulations set by the Federal Government which require processors to list sale or use dates.

At the request of the Senate Committee on Commerce, Science, and Transportation, OTA is evaluating proposed legislation that would require comprehensive and informative food labeling, designed to prevent deception and to assure consumers that the food is safe. The project is analyzing various open-dating techniques which would require processors to label each food product with either an open sale or use date, or both. Other techniques are also being studied.

Specifically, OTA is evaluating what information product labels should convey to consumers, how information can be conveyed, the characteristics of different processing technologies that would influence what open-dating techniques could be used for different products, and the consequences for producers as well as consumers of the various open-dating techniques.

Health Program

From 1950 to 1976, total expenditures for medical care in the United States rose from $12 billion to almost $140 billion. During this period, the percentage of the gross national product spent on health increased from 4.5 to 8.6 percent, and that portion of personal income devoted to medical care went from 5.8 to nearly 10 percent. In more recent years, the share of medical costs paid by the Federal Government more than doubled, climbing from 12 percent in 1965 to 28 percent in 1975; Federal spending for medical care increased from $20.2 billion in 1971 to $45.9 billion in 1977.

A substantial portion of the increase in health expenditures resulted from expanded use of medical technologies. In the past 20 years, medical technologies have led to improvements in the prevention, diagnosis, and treatment of disease. Other types of medical technologies have the potential to improve the efficiency with which medical care is delivered.

Members of Congress have expressed apprehension about rapid increases in medical expenditures. In recent years, these concerns have elicited the enactment of Federal legislation, restricting the development and use of medical technologies. Other congressional actions have been taken to minimize health hazards from technological applications related to the workplace, home, food supply, and the environment.

To assist Congress in evaluating these issues, the OTA Health Program is examining the implications of medical technologies on society. Medical technologies— including both hardware (devices and facilities) and software (methods and skills) —are defined as the set of drugs, devices, and procedures used to deliver medical care to individuals, and the organizational systems within which such care is delivered.

The health system can be viewed as a set of inputs, outputs, and processes. Inputs include devices and professionals, the demand of individuals for care, and the expenditures for health care. Outputs are the effects of care on the health of individuals. Processes include the use of technology, medical procedures, and financing and administrative mechanisms. A comprehensive view permits the Health Program to identify questions and select assessment topics which help the Congress resolve issues involving the delivery of medical care.

During 1977, the Health Program completed two studies. One evaluated methods of discern-

ing chemicals which cause cancer and reviewed evidence on whether saccharin causes cancer in humans. The second report assessed the policy implications of medical information systems. In addition, a background study on the therapeutic uses of drugs was completed.

Work also progressed on three additional assessments. One examines the policy implications of computed tomography scanners. A second study analyzes the safety and efficacy of medical technologies. The third assessment reviews congressional-mandated requirements for health data systems and the implementation of those requirements.

Cancer Testing Technology and Saccharin

In the wake of the decision by the Food and Drug Administration (FDA) to ban the use of saccharin as an artificial sweetener because of laboratory evidence indicating that it caused cancer in animals, OTA was asked by the Subcommittee on Health and Scientific Research of the Senate Committee on Human Resources to: 1) assess the capacity of current testing methodology to predict the carcinogenic potential of chemicals consumed by humans; 2) evaluate the potential risk of cancer from saccharin for humans; 3) evaluate the benefits of saccharin use, particularly for diabetics and those with special medical problems; and 4) assess the potential availability of alternate artificial sweeteners.

The study, conducted by the OTA staff with technical assistance from an 1 l-member panel of scientists and medical specialists, commissioned 12 short-term tests of mutagenicity to be conducted on saccharin. It marked the first time that scientific experiments were carried out as part of an OTA assessment. (Excerpts from this report may be found in section II.)

After completing the study, OTA panel members testified before the subcommittee on the preliminary findings and offered their personal observations on the safety and use of saccharin. In the debate on a bill to delay FDA's ban, seven different senators cited the OTA report in support of provisions requiring warning labels on products containing saccharin. The report was published in October 1977.

Policy Implications of Medical Information Systems

Published in November 1977, this report examines the policy implications of using computer-based information systems for clinical care as well as for business or administrative functions. In addition, the report presents analyses of the benefits and limitations of medical information systems, the factors influencing their adoption, and alternative Federal policies regarding their use. The study was requested by the Senate Committee on Human Resources. (Excerpts of this report may be found in section II.)

Policy Implications of Computed Tomography (CT) Scanners

The computed tomography (CT) scanner is a new radiological device that combines an on-line computer with sophisticated X-ray equipment to produce a cross-sectional image. CT scanners have been rapidly and enthusiastically accepted by the medical community and are used to diagnose a wide variety of diseases. Net expenditures on CT scanning in the United States have reached nearly $400 million per year and continue to grow rapidly. Medicare, Medicaid, private insurance companies, and individual patients must confront the problem of paying these bills.

The revolutionary nature of CT scanner technology, the speed of its acceptance, and its expense have produced many problems for the medical system. Because many of these problems are common to other new medical technologies, the case study of the CT scanner will highlight several important issues for health policy.

Requested by the Senate Committee on Finance, this OTA study is examining Federal policy regarding safety and efficacy; the effect of health planning and regulatory policies on diffusion; the relationship between efficacy and patterns of use; and the impact of reimbursement policies on expenditures.

Efficacy and Safety of Medical Technologies

Issues of efficacy arise when a new technology is introduced, when use of an existing technology is expanded or questioned, or when alternative medical technologies are compared. Although various Federal laws regulate drugs and medical devices, the basic responsibility for determining the safety and efficacy of medical technologies has traditionally rested with the medical profession.

Federal agencies and private groups recently have increased their activities related to efficacy and safety. For example, the number of tests conducted has increased, and dissemination of their results has attracted greater attention. However, such common procedures as tonsillectomy, appendectomy, and fetal monitoring have not been adequately assessed for efficacy or safety. Re-examination of other, widely used procedures, such as mammography, are underway.

Requested by the Senate Committee on Labor and Public Welfare, the study investigates the need for assessing efficacy and safety, the methods and procedures for making such evaluations, the types of assessment currently being supported by the Federal Government, and ways to improve existing policies.

Health Data Systems

The Federal Government engages in medical research, education, planning, regulation, delivery of services, and payment programs. Most of these programs collect data to aid in management and evaluation. The National Center for Health Statistics of the Department of Health, Education, and Welfare also provides general health data on the Nation's population. The total costs for some 282 separate data collection activities by the Federal Government amounted to more than $62 million in 1976.

This program-by-program approach to collecting health data results in a number of problems, such as duplication of efforts and data; lack of coordination, timeliness and relevance; uneven quality; and incompleteness. Moreover, some data that may prove important for policymaking in the future are presently not pursued.

Thus, OTA is reviewing congressional requirements for health data and how well those requirements are being satisfied. Requested by the House Committee on Interstate and Foreign Commerce, the study investigates Federal policies and their impact on data collection. It also evaluates alternative policies to coordinate the collection of data that would assist Congress in preparing for future needs.

Materials Program

The era of plentiful, cheap, and inexhaustible materials is ending. The supply, use, and eventual disposal of materials must be reconciled with environmental values. The environmental abuse caused by materials extraction and processing in past decades, for instance, is no longer tolerable. Efforts continue to restrict mineral and energy development on public lands.

Until recent years, waste disposal has been regarded as a distasteful burden. Conducted in the cheapest and most convenient manner, waste disposal gave little regard to the environment, esthetics, health, and the value of reuse. Responding to changing attitudes and the public demand for environmentally acceptable disposal of municipal wastes, Congress passed the Resource Conservation and Recovery Act in 1976.

Congress is also concerned about the use of materials, such as the desirability of standards or incentives to achieve more durable products. More durable products would reduce the demand for materials and deter waste.

In response to such congressional concerns, the Materials Program addresses issues spanning the entire materials cycle, from exploration and

extraction through production to use, reuse, and eventual disposal. This approach emphasizes the links between issues and problems at one phase of the cycle with those at another. Individual subprograms address issues relating to a national materials policy, supply and resource development, the use of materials, resource management, and health, safety, and environmental issues of the materials system.

During 1977, several projects neared completion. Two of the projects address the need to conserve materials by using them more efficiently. One examines the prospects for increased use of materials through recovery and recycling. The other evaluates methods of conserving materials in manufacturing and use by reducing waste.

Three additional projects are assessing issues and problems stemming from minerals exploration and exploitation. The first examines laws, policies, and practices that affect access to minerals on Federal lands. The second analyzes the effects of Federal land management and ownership on exploration and production of minerals on non-Federal lands. And the third assesses the value of past and future mining activity on existing Federal coal leases.

Two new projects begun during 1977 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. The Energy and Oceans Programs are working with the Materials Program on this second project.

Engineering Implications of Chronic Materials Scarcity

This report, completed during 1977, covers the proceedings of the fourth biennial conference on national materials policy at Henniker, N. H., held August 8-13, 1976. The conference, sponsored by the Federation of Materials Societies and OTA, focused on the relationship between engineering and the scarcity of materials, and the implications for national policies (particularly involving the work of the OTA Materials Program and the National Commission on Supplies and Shortages).

Resource Recovery, Recycling, and Reuse

Millions of tons of usable materials are squandered each year. Solid wastes from municipal sources alone totalled 135 million tons in 1975. That figure could burgeon to 225 million tons by 1990, according to the U.S. Environmental Protection Agency. Wastes, costly to collect and dispose of, are a major potential source of reusable materials.

At the request of the House Committee on Science and Technology and the Senate Committee on Commerce, OTA is examining this potential for and barriers to recovering and recycling resources from municipal solid waste. This project aims to identify and analyze both the policy options for realizing the potential and the likely impacts of implementing those options.

The project has several parts: 1) an evaluation of markets for such recovered goods as paper, aluminum, ferrous metals, glass, and energy: 2) an analysis of the effects of freight rates on the movement and sale of recovered goods; 3) a study of the economic and technical feasibility of using centralized facilities for recovering resources; and 4) an analysis of the implications of mandatory deposits on beverage containers.

In 1977, the Members and staffs of the congressional committees responsible for overseeing the Resource Conservation and Recovery Act of 1976 received preliminary results of the assessment, OTA staff members testified on the findings before the Subcommittee on Transportation and Commerce of the House Committee on Interstate and Foreign Commerce at hearings on implementation of the Act held May 28, 1977.

Conservation through Reduced Wastage

Resource recovery involves the recycling of used materials, thereby conserving them. Elsewhere in the materials cycle, considerable savings can ensue from reducing the amount of materials lost in their manufacture and use. Such reduced

wastage would conserve resources, lower manufacturing costs, and help control wastes.

At the request of the Senate Committee on Commerce, OTA is examining the materials cycle to determine reasons for wastage, and to identify and evaluate alternative approaches to the design, manufacture, and conservation of materials. To provide focus, the scope of the assessment is limited to primary metals (chromium, nickel, copper, aluminum, and iron) and certain key products, such as autos and railroad rolling stock, appliances, and military and construction equipment.

Three congressional committees used preliminary findings from the assessment in 1977. Data developed by OTA on the flow and uses of materials were provided to the Senate Committee on Commerce, Science, and Transportation in developing legislation on product regulation. The findings were also made available to the Subcommittee on Consumer Protection and Finance of the House Committee on Interstate and Foreign Commerce and the House Committee on Science and Technology.

Management of Fuel and Nonfuel Minerals on Federal Lands

Government actions are key to the exploration for and recovery of minerals and other resources on publicly owned lands. OTA is assessing the effects of modifying or restructuring State and Federal laws, policies, and practices that significantly affect access to minerals on Federal lands.

The assessment seeks to provide alternative approaches to facilitate mineral development in ways that are environmentally acceptable and take other public land uses into account. The assessment has two parts. The first involves a compilation and analysis of information about the effects of current State and Federal laws, policies, and practices concerning mineral development on Federal lands. The second analyzes possible changes in the existing system and the impacts of such changes.

An interim report prepared in 1976 has been distributed to) various congressional committees and executive branch and State agencies. The 1977 annual report of the Department of the Interior cited data from the interim report on the availability of minerals on Federal lands. The joint Federal-State Land Use Planning Commission for Alaska named the interim report as the basis for the Commission's study of metalliferous and non-fuel minerals. The State of Wyoming has used the findings in its suit against the Department of the Interior's strip mining regulations.

In 1977, as part of the assessment, OTA also 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 mineral 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.

Access **to** *Minerals on Non-Federal Lands*

In a related project, OTA is assessing various aspects of Federal land management and ownership that influence the exploration for and development of minerals on non-Federal lands. Particular attention focuses on public lands governed by the Alaska Native Claims Settlement Act of 1971. Under that Act, Congress must decide, by the end of 1978, how much of the 375 million acres in Alaska to preserve as wilderness and how much to open up for commercial development. Widely divergent bills in Congress would set aside from 25 million to 140 million acres as parks, wildlife refuges, national forests, or wild and scenic rivers, with only minimal development permitted.

Faced with a lack of published data, OTA, with assistance from the Congressional Research Service, undertook a search for information dealing with the amount of minerals and other natural resources and transportation needs and availability in five selected areas in Alaska. Representatives of citizen groups, mining companies, land owners, and State and Federal officials were interviewed to help OTA staff and consultants build a data base for the assessment.

The report also focuses on the influence of Federal land management and ownership on the exploration for and development of minerals on Federal lands where the surface and subsurface property rights are severed. OTA interviewed more than 500 knowledgeable persons in Alaska, Arizona, Nevada, Colorado, Wyoming, and North Carolina to learn how Federal authority for land management, as reflected by laws, policies, and practices, affects access across Federal lands to minerals located on non-Federal lands.

Preliminary findings of the assessment, which was requested by Senator Ted Stevens of the OTA Board, were presented to the House Committee on Interior and Insular Affairs and the Senate Committee on Energy and Natural Resources for use during hearings on the Alaskan lands issue. The Federal-State Land Use Planning Commission for Alaska has employed the OTA data in its resource planning. The findings have also been utilized in the study of energy facilities siting in coastal areas being conducted by the OTA Oceans Program.

Existing Federal Coal Developrnenf

In 1977, the Administration called for increased U.S. reliance on coal as a basic energy source. To help Congress determine if and how coal production can be increased, OTA is analyzing Federal coal leases, permits, and preference-right lease applications and how they relate to current and future plans for the development of coal reserves.

Mandated by Congress in section 10 of the Federal Coal Leasing Amendments Act of 1975, the study evaluates mining activities, the revenues from leases, and the feasibility of using deep mining technology in the leased areas.

Future A vailability of Materials Imported by the United States

Materials imports comprise vital elements for continued economic growth in the United States. OTA is assessing selected policy alternatives to deal with issues and problems which might affect future U.S. access to foreign resources, focusing on the impact of events or situations that could influence such future access. The study was requested by the House Committee on Science and Technology.

Recovering Commodities from Subeconomic Resources—Case Study of Shale Oil

As supplies of many natural resources from easily accessible deposits decline, potentially rewarding but costly development of untapped reserves could significantly increase domestic supplies. OTA is assessing the adequacy of current technology for recovering low-grade natural resources. Oil shale is the first such resource being assessed.

Oil shale, a porous sedimentary rock common across large areas of the Western United States, contains vast amounts of oil. The U.S. Bureau of Mines estimates that the total oil contained in the Green River Formation in Colorado, Utah, and Wyoming alone could be as much as 2 trillion barrels–almost the equivalent of the crude oil potentially recoverable throughout the world by conventional means.

However, most of that shale oil may remain out of reach because of technological, environmental, and economic constraints. For instance, no technology has yet emerged that can produce shale oil at competitive prices.

Accordingly, OTA is evaluating the current technology and Government policies for recovering shale oil. The conditions or requirements for producing shale oil in sufficient quantities and at competitive prices are under study. The project is also assessing the environmental effects, transportation requirements, water availability, and social and economic impacts of developing shale oil.

The Senate Committee on Energy and Natural Resources, which requested the assessment, utilized preliminary findings on the status of shale oil technology in its consideration of a Federal Oil Shale Commercialization Test Bill.

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National R&D Policies and Priorities Program

The Federal Government now spends about $28 billion per year on research and development activities and facilities in the United States. With another $20 billion per year from the private sector, the total national investment in R&D in the United States approaches $50 billion annually.

Recognizing the importance of this national investment, the OTA Board authorized a Program of R&D Policies and Priorities in October 1975. The Program was established by the Board according to a plan proposed by OTA's Advisory Council.

To implement the program, OTA has assembled a staff of seven professionals supplemented by consultants and contractors. The principal resource consists of the members of the three advisory panels plus a separate task force on appropriate technology created in 1977. The members constitute an outstanding group of leaders from science, engineering, and other professions drawn from academia, industry, labor, and environmental and public interest groups.

Program Structure and Issues

The program became operational with the establishment of interrelated advisory panels, the first meeting of which occurred in May 1976.

The first of these, the Panel on the Health of the Scientific and Technical Enterprise is chaired by Dr. Harvey Brooks, the Benjamin Peirce Professor of Technology and Public Policy of Harvard University. The second, the Panel on the Applications of Science and Technology, is chaired by Dr. Lewis Branscomb, Vice President and Chief Scientist of IBM. The third, the Panel on Decision Making on R&D Policies and Priorities is chaired by Dr. Gilbert White, Director of the Institute of Behavioral Science of the University of Colorado. •

•During most of 1977, this Panel was co-chaired by Professor Adam Yarmolinsky of the University of Massachusetts who late in the year resigned to become Counsel of the Arms Control and Disarmament Agency.

To supplement the work of these three panels, the R&D Program (in June 1977) established a Task Force on Appropriate Technology chaired by Lola Redford, a leader in solar energy and other environmental and consumer issues. This task force is examining "appropriate, " alternative, or intermediate technologies which might not receive adequate attention within the existing scientific and technical enterprise.

More specifically, the range of panel activities is as follows:

Health Panel. This panel has addressed the following questions: (1) What are the elements of the scientific and technical enterprise (e.g. universities, national laboratories, industrial laboratories, human resources, etc.); (2) How are they interrelated; (3) What do we mean by the health of the enterprise; (4) What criteria can we use for assessing its health; (5) How can we better shape science indicators to provide the basis for continuing assessment of the enterprise; (6) How can we set priorities among fields of science; (7) How can we enhance the institutional resources in the science and technical enterprise; (8) How can we better plan, develop, and utilize the human resources in the enterprise; and (9) How can we improve the quality control mechanisms which function in the enterprise?

The specific projects undertaken with the guidance of the Health Panel are: (1) Preparation of a paper defining the Health of the Scientific and Technical Enterprise, showing its implications for the development of improved science indicators. (2) Preparation of a paper on establishing priorities among fields of science. (3) Preparation of a paper on quality control mechanisms in the scientific and technical enterprise. (4) Research project on the extent to which Federal R&D funding may displace private funding of R&D. (5) Task Force study on Women and Minorities in Science. (6) Task Force study on National Laboratories as an institutional resource. (Although listed under the Health Panel, this task force is drawn from members of

all three panels and receives guidance from all three panels).

Applications Panel. This panel has examined the relative status of U.S. technology in the world economy and is considering the following questions: (1) What can the Federal Government do directly (e.g. through R&D contracts) to influence innovation in our society; (2) What can the Federal Government do indirectly (e.g. through regulation, tax policy, patent policy, etc.) to shape the environment within which innovation occurs in our society; (3) How can we influence the process of technology transfer between the United States and other nations; and (4) How can we better mobilize our scientific and technical resources to tackle specific national problems in areas such as health, energy, etc?

The specific projects undertaken with the guidance of the Applications Panel are: (1) Research Project on the Federal Role in influencing the innovation process; (2) Research Project on Role of Demonstrations; (3) Research project on implications of the Federal Grant and Cooperative Agreement Act of 1977; (4) Task Force study of Carcinogens in the Workplace; and (5) Analysis of technology transfer issues and planning for the forthcoming U. N. conference on Science and Technology for Development.

Decision-Making Panel. This Panel has been concerned with the decision processes whereby R&D policies and priorities are shaped within the Congress, the executive branch, the Judiciary, the regulatory agencies, State and local government, and the public. This panel has been particularly concerned with the integration of R&D policy within a broader framework of economic, social and regulatory policy.

The specific projects undertaken with the guidance of the Decision-Making Panel are: (1) Preparation of paper on integration of R&D policy with economics, social and regulatory policy; (2) Study of executive branch reorganization options regarding science and technology activities; (3) Preparation of a paper on expected impact of zero based budgeting on R&D Programs: **(4)** Development of congressional guidelines for evaluation of R&D budgets.

Appropriate Technology Task Force. The purpose of this task force is to define appropriate technology, survey ongoing work in the field, identify problems, potentials, opportunities, and obstacles which have been encountered. and finally to indicate what legislative options there may be for Congress to consider in dealing with appropriate technology. (Appropriate technology may be defined as technology which is decentralized or diversified, amenable to management by its users, and in harmony with the environment and our use of natural resources.) The task force, which met twice in **1977,** organized itself into several working groups to: (1) define the field; (2) survey relevant executive branch programs; (3) survey congressional plans and programs; and (4) undertake case studies of appropriate technology activities in fields such as urban community housing, agriculture, or energy.

Oceans Program

Half of all Americans live or work within 50 miles of a coastline—along the Atlantic or Pacific Oceans, the Gulf of Mexico, or the Great Lakes. That figure may grow to 80 percent of the U.S. population by the year 2000, according to a recent study by the Senate Committee on Commerce. Such concentrations of people on what amounts to less than 10 percent of U.S. territory have brought intense development and competition for land for housing, industry, commerce, energy facilities, resort communities, and transportation networks.

The increasing pressures on the coastal areas and oceans have already heightened congressional interest in the impacts of such development. It is unclear how much or what kind of development coastal areas can sustain before the complex relationships between land and sea as well as between human and marine life become

irreversibly disrupted. In 1977, Congress encountered issues involving the preservation of marine and coastal environments, the development of energy and other natural resources, the use of the oceans to feed a burgeoning world population, and the organization of the executive branch to meet ocean-related problems.

To provide Congress with information on these and other areas of concern, the Oceans Program focuses on a broad range of issues encompassing the use 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 help meet future U.S. energy needs especially have evoked keen study.

In 1976, OTA completed a major study of the effects of three proposed offshore energy systems—oil and gas exploration and development, deepwater ports for large tankers, and floating nuclear powerplants—on the coastal areas of New Jersey and Delaware. The experience and the methods derived from that study have contributed directly to two 1977 Oceans Program projects as well as to projects in other OTA program areas.

In response to continuing congressional concern about activities on the Outer Continental Shelf, OTA followed up the coastal effects assessment with an agency-by-agency analysis of the Federal role in offshore oil and gas leasing. A short staff paper and graphs of the entire Federal leasing process went to the House Ad Hoc Committee on the Outer Continental Shelf, which published the OTA document in a report on offshore oil and gas development. Another assessment, of the social and economic effects of locating the sites of energy facilities in coastal areas, is **also)** relying on methods developed and information gained from the coastal effects study.

During 1977, the Oceans Program completed two additional assessments. One examined alternatives for enforcing and managing the new U.S. 200-mile offshore fisheries zone. The second report identified issues raised by the transportation system for liquefied natural gas.

Work continued in 1977 on two other projects begun in 1976. One investigates the technology for and systems to be used in developing the oceans as a source of energy. The second project evaluates the current status of marine science and technology in the United States and its development over the past 15 years.

Establishing a 200-Mile Fisheries Zone

Published in June, this report analyzed four major aspects of the 200-mile U.S. fisheries zone: enforcement of regulations envolving the zone, management of the zone, information needed to implement or revise the legislation, and opportunities for expanding and revitalizing the U.S. fishing industry.

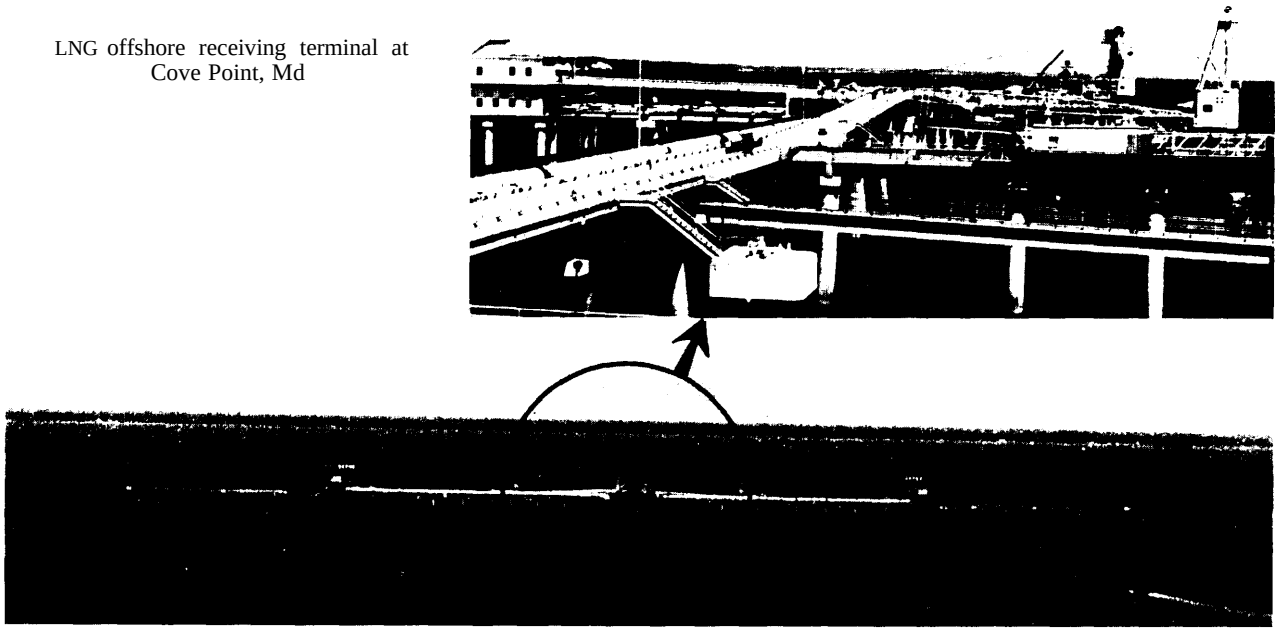
In the report, OTA indicated four pilot projects which might offer the Federal Government significant experience, enabling it to make decisions about appropriate methods and levels of enforcement. The pilot projects involve placing U.S. observers aboard foreign fishing vessels, joint research by various Federal agencies to adopt remote sensing technology for monitoring fishing grounds, development of a multipurpose ocean surveillance and information center, and the use of transponders with Loran-C for tracking and identifying fishing vessels. (Excerpts from this report may be found in section II.)

The study, requested by the House Committee on Merchant Marine and Fisheries and the Senate Committee on Commerce, has been used by several congressional committees that oversee establishment of the zone. The OTA staff testified before the Senate Committee on Commerce, Science, and Transportation on April 20, 1977, on enforcement of the zone. Information developed by OTA also served the Senate Committee on Appropriations, as it critiqued the Coast Guard's plans for acquiring new equipment for use in enforcing the zone.

Transportation of Liquefied Natural Gas

This report requested by the Senate National Ocean Policy Study, examined the current technology for transporting liquefied natural gas

LNG offshore receiving terminal at Cove Point, Md



Photos by OTA

(LNG) by tankers. The study described the Federal regulatory process governing the development and operation of LNG systems. It also identified several areas of note for congressional consideration concerning legislation regulating LNG-related activities. These include design, construction, regulation, and inspection of LNG tankers and terminal facilities; criteria for selecting sites for LNG facilities; the decisionmaking process for certifying LNG projects; liability for accidents; the reliability of foreign suppliers; the policies for pricing LNG; and the status of safety research on LNG. (Excerpts form this report may be found in section 11.)

Legislation introduced into both the House and Senate in 1977 to regulate the certification of LNG facilities in the United States reflects the findings of the report.

Renewable Energy from the Oceans

The search for nonpolluting, renewable energy sources free from foreign control has brought many people to perceive the potential of the world's oceans. A number of technologies have evolved to harness the energy in ocean wind, waves, tides, and temperature differentials.

OTA's analysis of the potential of such technologies and concepts will pinpoint the status of research efforts, and isolate the major outstanding problems that must be solved before the concepts will be technically and economically feasible. The project was requested by the Senate National Ocean Policy Study

Siting of Energy Facilities

Meeting the demand for energy requires new facilities, and this, in turn, raises questions and possible conflicts about these facilities' location. 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.

During 1977, OTA staff members interviewed more than 100 Federal, State, and local government officials, and representatives from the energy industry in California, Maryland, and Massachusetts, to learn how well the current system for siting energy facilities works, and what the issues and problems are. A request from the House Committee on Interior and Insular Affairs and the Senate Committee on Commerce inaugurated the project.

Marine Science and Technology

OTA is reviewing the status and history of marine science and technology in the United States of the past 15 years. OTA was asked by the Senate National Ocean Policy Study to find out what knowledge and capabilities have and have not been gained from the investment of large sums of Federal funds, and the reasons why .

In response to the request, OTA submitted an extensive set of questions to a wide range of marine specialists in fields such as transportation, fishing, energy, hard minerals, ocean research and engineering, and meteorology. The results of the planning study completed to date have helped the Oceans Program to plan for future projects, and have been provided to the Senate National Ocean Policy Study.

Technology and World Trade Program

The impact of technology on the Nation's international trade has increasingly claimed the attention of Congress in recent years. More and more Americans believe that the U.S. balance of trade has suffered from the export of technology, and from American investment in foreign industry. Others argue, however, that the United States can only maintain a healthy economy and remain competitive in world markets through an open trade policy that encourages innovation and the continous exchange of new technology.

To evaluate such issues and provide a factual base from which to make accurate assessments, OTA created the Technology and World Trade Program in 1976. In 1977, this program continued planning studies which focus on the relationship of technology to the competitive position of the United States in international markets, and the related effects on the U.S. economy. OTA is currently examining the U.S. trade position as reflected in analyses of trade, productivity, and other statistics. Factors under study include the control of technology exports, trade with the Soviet Union, and better means of transferring technology to developing nations.

The Technology and World Trade Program has organized its planning efforts into three complementary categories. The first examines representative industries which have similar technological and economic characteristics. The second assesses technology and world trade issues that affect more than one industry or groups of industries. The third evaluates the relationship of geographical factors to technology and world trade.

During 1977, the Technology and World Trade Program began planning for two assessments slated for 1978. One assessment will examine the technological state of the U.S. steel industry and its relationship to international trade. The steel industry typifies a mature industry which is experiencing both declining foreign sales and serious domestic competition from imports.

OTA convened a panel of experts on world trade and the steel industry in the spring of 1977 to formulate issues for the planned assessment. Responding to congressional concern (and the work of the panel), the House Committee on Ways and Means asked OTA to examine the trade position of the U.S. steel industry vis-a-vis

its foreign competitors, assess how technology might bolster the industry's trade position, and present alternative policies by which the Congress could encourage technological innovation.

While the first panel felt that economic factors and business strategies outweighed and perhaps dictated technology developments during the postwar period, a second panel, assembled in late 1977, suggested that new steel technologies might restore the industry's world leadership position in the future.

In addition to providing Congress with factual data upon which to base decisions, the assessment of the steel industry is designed to provide insights into similar problems facing other businesses, such as the petrochemical, textile, and electronic industries.

A second planning study begun in 1977 by the Technology and World Trade program concerns the transfer of technology from the United States to other countries. Reflecting the questions arising within Congress about the possible impacts of such transfers on the traditional U.S. position of technological dominance, the House Committee on International Relations asked OTA to examine the issues involved in technology transfer. the future ability of U.S. industries to compete in world markets, and the extent to which U.S. industry requires technology developed by other nations.

This planning study focuses on how technology transfer affects U.S. technological leadership. It also examines the technological competitiveness of selected U.S. industries relative to foreign industries. The selected industries—steel, electronics, petrochemicals, and aerospace—are those which have long held a dominant position in world technology. a position of considerable strategic and economic importance.

Questions for future OTA study include the access by U.S. industry to foreign technology, the role of multinational corporations in the transfer of technology. and the transfer of soft technologies such as entrepreneurial, managerial, and scientific skills.

In considering this possible assessment, OTA participated in a workshop covering technology and world trade sponsored by the Congressional Research Service. OTA will continue to maintain close liaison with CRS as well as with the General Accounting Office and the Congressional Budget Office. OTA utilizes the resources of other Federal agencies and private institutions interested and experienced in technology and world trade. These include the Departments of State and Commerce, the National Science Foundation, the Export-Import Bank, and the National Academies of Sciences and Engineering.

When planning concludes, approval for these two assessments will be sought from the OTA Board. During 1978, the Technology and World Trade Program also expects to start planning studies of the electronics and aerospace industries, East-West and North-South trade relations and the relationships of employment, technology and trade.

Transportation Program

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

To assist Congress in addressing such issues. the OTA Transportation Program to date has been structured around three key transportation

modes: the railroads, mass transit, and the automobile. Assessments undertaken in 1975 and 1976 resulted in a series of reports treating railroad reorganization and revitalization, the relationship of energy and the economy to mass transit, community planning for mass transit systems, and new means for automatic control of mass transit trains.

In 1977, work continued on three projects initiated in 1976. One assesses the future use and characteristics of the automobile. A second project evaluates the effectiveness of various laws in increasing the safety of railroads, and the third examines the research and demonstration methods for new urban transit vehicles. A fourth project begun in 1976, an examination of the possible uses and potential effects of coal slurry pipelines, was transferred in 1977 to the OTA Energy Program (q. v.).

Changes in Use and Characteristics of Automobiles

The private automobile has become the predominant form of personal transportation in the United States in the 20th century. By 1977, 83 percent of U.S. households owned at least one car, and more than 90 percent of the annual passenger miles travelled were by automobile. Available evidence further indicates that, despite recent increases in mass transit ridership, the automobile will continue to dominate the field of personal transportation for the foreseeable future.

At the same time, however, serious problems have emerged, clouding the future of the automobile. These include declining supplies of petroleum, increased costs for materials and labor, rising environmental and safety concerns, and widespread traffic congestion on the Nation's highways and urban streets. Consequently, at the request of the Senate Committee on Commerce, OTA undertook a major assessment of potential changes in the use and characteristics of automobiles over the short term (next decade) and the long term (to the year **2000).**

The assessment is probing the factors that influence the characteristics of automobiles, their use, and the services that support the automobile transportation system. It is identifying potential changes in the automobile and assessing the immediate and long range effects of alternative policies on automobile use and characteristics.

An examination of the future uses and characteristics of automobiles requires an assessment of the entire automobile system. This includes car owners, manufacturers, and parts suppliers; the maintenance and repair services; the highway, road, and street network; fuel producers and distributors; insurance and financing businesses; and Federal, State, and local laws and policies affecting the automobile system.

An analysis of factors such as the future availability of fuels and materials, the need to reduce harmful pollutants and to improve the safety of cars, and possible shifts in public attitudes, aims toward the development of public policy alternatives. By exploring several foreign countries' experiences with the automobile and other forms of personal transportation, OTA hopes to unearth solutions that might prove applicable in the United States.

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. To assist Congress as it examines issues and problems relating to the railroads, OTA conducted studies assessing the financial aspects of the reorganization of rail transportation, and published them in a series of reports in 1975.

The Railroad Safety Authorization Act of 1976, P.L. 94-348, required OTA to evaluate the effectiveness of the Railroad Safety Act of 1970 and other Federal laws aimed at improving the safety of our Nation's railroads. It further requested an examination of those programs, activities, and expenditures of the Government, railroad industry, and railroad unions designed to improve the railroad safety problem.

By year-end, OTA was completing the final report on its assessment of the safety problems

and issues in the railroad industry. The safety problems of people are reflected in the injuries and fatalities suffered by railroad employees, passengers, and the general public. Those problems of property are reflected in the loss and damage to railroad equipment, tracks, roadbeds, and freight. Hearings are planned to be held on this assessment early in 1978.

Urban Transit *Vehicle Demonstrations*

As part of its program to improve service and encourage increased ridership, the Federal Government has sponsored research, development and demonstration of new mass transit vehicles. At the request of the House Committee on Appropriations, OTA assessed whether the demonstration programs for three such vehicles: Transbus, State-of-the-Art Car (SOAC), and the Advanced Concept Train (ACT-1)—have made effective and appropriate use of Federal research dollars.

The Urban Mass Transit Administration (UMTA) of the Department of Transportation has sponsored demonstrations of Transbus, a prototype for the next generation of urban mass transit buses, the State-of-the-Art Car and the Advanced Concept Train rail transit cars to show how existing technology can be incorporated into car design and to encourage cost reduction through standardization. OTA examined alternatives for Federal R&D on transportation systems and assessed whether standardization of urban transit vehicles is a viable policy objective for R&D.

In 1977 the Subcommittee on Transportation of the House Committee on Appropriations used preliminary findings from this assessment during hearings on UMTA's R&D budget. The OTA preliminary findings also contributed to UMTA deliberations about mandating specifications derived from the Transbus demonstration.