Section III

ASSESSMENT GROUP ACTIVITIES

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

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

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

Section III
ASSESSMENT GROUP ACTIVITIES

ENERGY, MATERIALS, AND GLOBAL SECURITY DIVISION

Energy

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

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

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

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

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

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

Coal Slurry Pipelines

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

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

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

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

Onsite Solar Energy

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

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

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

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

The Direct Use of Coal

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

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

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

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

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

Residential Energy Conservation

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

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

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

Bioenergy Conversion

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

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

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

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

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

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

This assessment is scheduled for completion in mid- 1979.

Solar Power Satellites

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

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

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

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

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

Alternative Energy Futures

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

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

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

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

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

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

Alternative Energy Futures—Liquefied Natural Gas

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

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

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

This study is expected to be completed early in 1980.

Materials

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

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

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

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

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

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

Access Across Federal Lands for Minerals Development

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

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

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

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

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

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

Management of Minerals on Federal Lands

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

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

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

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

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

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

Conservation Options for Reducing Metal Losses

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

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

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

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

Materials and Energy From Waste

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

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

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

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

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

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

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

Recovering Commodities From Subeconomic Resources— Case Study of Oil Shale

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

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

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

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

Federal Coal Development Rights

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

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

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

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

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

Completion of this study is expected in early 1980.

U.S. Dependence on Imported Minerals

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

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

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

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

National Security

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

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

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

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

Effects of Nuclear War

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

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

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

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

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

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

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

Technology and World Trade

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

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

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

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

Technology Transfer

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

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

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

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

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

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

This assessment is scheduled for completion in mid- 1979.

Competitiveness of U.S. Industries.

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

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

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

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

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

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

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

Foreign Policy Implications of Global Trends in Energy Supply and Demand

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

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

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

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

The project will be completed in mid- 1979.

HEALTH AND LIFE SCIENCES DIVISION

Food

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

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

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

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

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

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

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

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

Nutrition Research Alternatives

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

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

Emerging Food Marketing Technologies

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

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

Drugs and Chemicals in Livestock Feeding

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

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

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

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

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

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

Open Shelf-Life Dating of Food

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

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

This study is expected to be completed in early 1979.

Pest **Management** Strategies

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

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

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

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

Environmental Contaminants in Food

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

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

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

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

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

Genetics and Population

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

Impacts of Applied Genetics

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

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

Thus, issues requiring attention include:

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

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

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

Technology and World Population

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

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

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

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

Health

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

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

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

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

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

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

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

Policy Implications of Computed Tomography (CT) Scanners

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

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

Assessing the Efficacy and Safety of Medical Technologies

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

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

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

Cost-Effectiveness of Medical Technologies

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

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

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

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

Pneurnococcal Vaccine

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

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

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

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

This study is expected to be completed early in 1979.

Computer Technology and the Quality *of Physician Services*

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

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

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

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

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

Health Data Systems

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

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

SCIENCE, INFORMATION, AND TRANSPORTATION DIVISION

National R&D Policies and Priorities

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

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

During the calendar year, the R&D Group

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

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

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

Demonstrations in Federal R&D Policy

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

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

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

Government Actions Affecting **Innovation**

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

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

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

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

Science and Technology Education

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

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

National Laboratories

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

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

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

Reorganization of Federal Science and Technology Activities

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

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

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

Carcinogens in the Workplace

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

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

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

Technology for Local Development

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

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

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

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

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

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

Technological Innovation and Health, Safety, and Environmental Regulation

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

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

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

Oceans

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

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

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

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

Ocean Thermal Energy Conversion

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

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

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

Renewable Energy From the Ocean

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

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

Siting of Coastal Energy Facilities

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

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

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

Transportation. It is scheduled for completion in early 1979.

Disposal of Nuclear Waste

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

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

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

Panama Canal Zone

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

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

Telecommunications and Information Systems

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

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

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

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

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

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

National Information Systems

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

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

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

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

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

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

Telecommunication Systems

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

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

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

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

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

Transportation

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

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

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

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

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

Railroad Safety

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

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

Railroad Safety: A U.S.-Canadian Comparison

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

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

The Automobile Transportation System

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

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

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

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

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

Impact of Advanced Air Transport Technology

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

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

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

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

Impact of Advanced Group Rapid Transit Technology

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

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

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

Exploratory and Planning

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

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

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

OTA Priorities Project

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

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

Natural Hazards

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

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

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

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

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

Approaches to Risk Assessment

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

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

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

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

Technology and Centralization

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

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

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

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

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

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

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

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

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

Methodology and Orientation

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

IVon-ionizing Radiation Hazards

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

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

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