OTA Priorities 1979, With Brief Descriptions of Priorities and of Assessments in Progress

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OTA PRIORITIES 1979

With Brief Descriptions of Priorities and of Assessments in Progress

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Foreword

This report describes the first priorities list developed by the Office of Technology Assessment (OTA) as a result of a new and ongoing process for selecting possible projects for study.

OTA was created in 1972 to provide Congress with early indications of the broad range of impacts of technological applications on our society. Those impacts include the beneficial and the adverse, the physical, biological, economic, social, and political. OTA is required to bring a long-term global and comprehensive perspective to bear and to provide Congress with independent, authoritative, evenhanded assessments.

This approach provides Members of Congress with one means of stepping back from the near-term and more narrow issues which crowd their busy calendars to focus on longer term and more comprehensive issues which often crosscut the jurisdictions of several congressional committees.

OTA's projects are initiated on approval by its Technology Assessment Board of six Senators and six Congressmen. Requests for studies may be made to the Board from three different perspectives: by chairmen of congressional committees, by members of the Board, and by the Director of OTA upon consultation with the Board.

Until this year nearly all requests have come from congressional committees with a few from Board members. This report describes the first effort to complement the committee and Board perspectives with priorities suggested by the Director.

This new OTA priority-setting process has been open and broadly participatory. Between February and May 1978, over **5,000** people were asked to consider the critical technological issues that they thought were of especial importance to the United States and the world and to submit their top choices to us. People solicited included approximately **1,000** who have been advisors to OTA—consultants, contractors, and panel members. The staffs of OTA, the General Accounting Office, and the Congressional Research Service were deeply involved.

From these efforts to reach as broad and informed a public as possible, OTA received 1,530 suggested topics for study. Another **2,875** items were extracted from the published literature. To cope with this large list, OTA mobilized its staff to organize, combine, winnow, and rank the candidates into a manageable list of **30** items.

In this process the Technology Assessment Advisory Council played a major role devoting nearly all its efforts for 9 months to proposing, critiquing, and ranking items for the list. The Council members' expertise and broad experience made their contribution especially valuable to the process.

To facilitate the sorting and ranking process, OTA's senior staff developed criteria of what constitutes a preferred OTA project. The five most important criteria are as follows:

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

All members of the Board as well as their staff liaison with OTA were involved in the priority-setting process. In addition, the staffs of nearly all congressional committees were consulted. At a joint meeting of the Board and the Advisory Council called to consider the priority list, unanimous support was received for the process.

During the year-long consideration of priorities, seven were selected for activation in 1978 and approved by the Board. They are as follows:

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

Three additional topics suggested by the priorities-determining process have been started as internal methodological studies. These are topics of broad interest to all OTA projects, and should influence the style and scope of our work as well as be of substantial interest to our congressional clients:

- Effects of Technology on Risks to Humankind
- Technology and Centralization / Decentralization
- Measures of Quality of Life as a Basis for Assessing Technological Choices.

This booklet is divided into two parts. The first part covers the OTA Priorities, 1979, and includes a one-page description of each of the **30** priority projects arranged in descending order of priority. The second provides a list and brief descriptions of the active projects as of January 1, 1979.

The OTA Priorities will be used as a guide during 1979 in selecting projects for submittal by the Director to the Board for approval.

The priority-setting process will be ongoing. In the latter part of 1979 a new list will be developed for use in 1980. Your suggestions will be welcome.

Russell W. Peterson

RUSSELL W. PETERSON
Director

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Priorities

IMPACT OF TECHNOLOGY ON NATIONAL WATER SUPPLY AND DEMAND

Problem. Freshwater is a vital renewable national resource. Although the Nation's overall freshwater supply is more than adequate, its distribution causes serious problems. Some areas get too much precipitation; others have too little.

Arid regions often resort to such dangerous alternatives as pumping supplies from aquifers faster than they can be naturally replenished. Unfortunately, the legal and economic web that regulates most water supplies— even in dry areas—often does not encourage the most efficient usage. Also, many individual States regulate water with an eye to their own needs—a practice which contrasts with some effective regional management schemes.

Projected demands for water for coal gasification, liquefaction, and mining; for cooling towers; and for irrigation exceed the projected supply in some States, Some alternative water supply technologies that merit study include surface water development, such as impoundments; groundwater extraction; and interchangeable ground and surface water systems. Others include conservation aimed at major water users, waste-water recycling, desalination, undersea aqueducts, and iceberg towing. All of these systems have social, economic, or environmental impacts that must be assessed.

The effects of overuse of available water supplies need evaluation. Depletion of ground-water supplies, land subsidence, lowering of the water table, and intrusion into aquifers by saltwater, minerals, salts, and sewage are all recognized to be problems.

OTA Role. An initial OTA study would concentrate on analyses of technology affecting future water supply and demand projections. It would also provide Congress with information needed to evaluate alternatives to current Federal water programs, and would explore possibilities for better coordinating the use of the Nation's freshwater supplies.

It would also consider the following issues:

- Possible trade-offs among water uses for energy manufacture, agriculture, and recreation.
- Conservation plans, including possible Federal action, conservation through pricing systems, recycling of water, and improved irrigation techniques.
- Water management, especially the roles of the Federal, State, and local governments in managing water resources.
- The development of a nationally consistent data bank.
- Cost-sharing proposals among governments and private users that might reduce water consumption or channel available supplies in appropriate directions.
- The impact of Federal and Indian water rights on local water issues.

Priorities (Continued)

ALTERNATIVE GLOBAL FOOD FUTURES

Problem. In the early 1960's the world enjoyed substantial food reserves. Carryover grain stocks primarily in the United States, amounted to about 95 days' worth of global consumption. In addition, American farmers were paid to hold out of production 50 million acres of cropland. By 1974, however, reserve stocks had declined to merely 26 days and Government payments to keep land idle had ceased. Although in the last 3 years grain stocks have again risen, the planet had moved from an era of relative food abundance to one of food scarcity.

Although improved weather conditions over the last 3 years have helped, there is still serious concern that the present global food system will prove increasingly inadequate over the next two to three decades. Even in the best of years with substantial reserves in some parts of the world, hundreds of millions of people who cannot pay for their food are malnourished. World population growth and rising energy costs are increasing the pressures on global food production and delivery systems. Furthermore, climatologists point out that the major increases in food production in recent decades have resulted in large measure from unusually favorable climate, which history indicates is unlikely to be sustained. Even the technologically advanced American farm is feeling the pressure. Increases in agricultural production are leveling off. Additional energy no longer produces increased yield. Capital and labor costs, along with increasingly scarce and expensive water, also point to a productivity plateau. This suggests that the world cannot continue to look to the United States as a supplier of last resort. One estimate of future food requirements asserts that in order to keep pace with population growth, developing countries will have to increase their food production by at least 4 percent per year over the next quarter century; however, present production increases are well below this.

OTA Role. The proposed assessment would examine the global food system in the context of a range of supply and demand projections. The three key elements of any food system are production, marketing and distribution, and consumption and nutrition. Affecting all of these, directly and indirectly, are the policies of the respective governments. Analysis of these requires consideration of a number of variables. Production is determined by factors such as the availability and quality of land, water, energy, labor, and capital; marketing and distribution involve processing, wholesaling, and retailing practices; a study of consumption must not only explore cultural preferences and the nutritional value of food, but also reflect the fact that nutrition is tied to work performance and output, population growth and family size, disease resistance, health, and mental development.

The analysis of these variables should reveal where the greatest vulnerabilities in the system lie and what forms a breakdown might take. Technologies that can strengthen the various components of the system would be assessed. These scenarios, together with analyses of their likelihood, technological requirements, and the long- and short-term impacts of these technologies, would provide Congress with the information necessary to develop and evaluate both domestic and foreign food-related policies.

Priorities (Continued)

HEALTH PROMOTION AND DISEASE PREVENTION TECHNOLOGIES

Problem. Major factors that determine health are environment, lifestyle, biology, and health services. Health services alone cannot cure degenerative and chronic diseases and injuries, our major killers. Great increases in health care costs and the absence of commensurate improvements in health status have heightened interest in health promotion and disease prevention technologies. Congress has been asked to fund a range of these technologies from control of environmental contaminants to health education. Little is known about the widespread impacts of adopting these particular technologies in health, the health care system, and society at large. Without such information, Congress is unable to fully address many health-related problems.

OTA Role. The issues surrounding health promotion and disease prevention technologies include their effectiveness, costs, allocation, payment, and long-term impacts on health, the health system, and society. One or more of these issues will be addressed in specific assessments. The areas currently being considered for in-depth examination are:

- Technology of carcinogenic risk assessment. Environmental agents are involved in up to 60 percent of human cancers. Are current technologies adequate to identify and to quantify risks? What options exist for improving risk assessment technologies?
- Emerging health promotion technologies. The use of new technologies outside of the traditional medical care system, such as meditation or biofeedback, is increasing. Are these technologies effective and safe? What are their costs?
- Methods to evaluate social technologies for health promotion and disease prevention. Social technologies, such as obesity control programs, promote lifestyle changes. What is the state of the art for evaluating these technologies? Are present evaluation methods adequate to determine their effectiveness? What should be the Federal role in these efforts?
- Preventive technologies in dental health: a case study. Dental or periodontal diseases affect almost all Americans. Are the technologies used to promote dental health effective? What are the costs and implications of different preventive technologies?
- Smoking habits and implications of reduced smoking: a case study in integrated policymaking. How effective are the strategies used to reduce smoking? How can the impacts of reduced smoking on the tobacco industry be mitigated? Can an integrated Federal policy for tobacco and its use be designed?
- Federal roles in health promotion and disease prevention technologies. What are current Federal activities that further or limit these technologies? What are potential activities? What are the broad implications of alternative activities?

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Priorities (Continued)

TECHNOLOGY AND WORLD POPULATION

Problem. Modern medical and public health technologies have greatly improved the quality of human life. However, a significant side effect is the growth in human numbers that has resulted from the reduction in mortality and increased life expectancy. A global population that by the time of Christ had reached approximately 250 million and that took 16 more centuries to double, has now reached 4 billion with the prospect of doubling again in 40 years. A growth rate of this magnitude has major adverse implications for the global biosphere and for international economic and political stability. For the less developed countries with the highest growth rates, the problems posed by rapid population increase are particularly acute. Their economic development goals are jeopardized by the need to divert resources to meet the requirements of an expanding population and the increasing proportion of net consumers in the society (particularly the very young and the unemployed).

OTA Role. The proposed study would assess the implications of rapid population growth. Potential topics for inclusion are as follows:

- Basic demographic data. Has the rate of global population growth begun to slacken? If so, why? Can this trend be expected to continue? How can the successful programs best be replicated in other countries?
- 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?
- Fertility determinants. Is high fertility more a function of socioeconomic factors (e.g., the status of women) or ignorance of and lack of access to contraceptive technologies?
- Impacts of population growth upon health care, economic development, and environmental quality. What is the nature of these relationships and the gaps in present knowledge concerning them?
- Population, technology, and international conflict. Can rapid population growth interact with technological innovation under some circumstances to produce international aggression and sizable migration pressures?
- Population policy. 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?
- Institutions. What is the best institutional arrangement within the U.S. Government for formulating and administering an overseas population program?

Priorities (Continued)

IMPACT OF TECHNOLOGY ON PRODUCTIVITY OF THE LAND

Problem. There is increasing reason to believe that the primary productivity of American lands—croplands, wetlands, grasslands, and forests—are undergoing or are facing serious deterioration. Unless current productivity trends are reversed, it is estimated that the United States will be unable to meet its own agricultural needs through the next century. Further, environmental deterioration of the land will constrain U.S. efforts in assisting developing countries provide for their fast-growing populations' basic human needs. The combined adverse effects of misapplied and noncoordinated technologies have led to the present conditions of our land. Farmers, bowing to economic pressures for immediate maximum yields, commonly have resorted to strategies and procedures inappropriate to long-term sustenance of the land. In addition, the demands of a highly technological urban society have forced the wholesale conversion of productive lands to airports, highways, strip mines, and areas of general urban sprawl. Decision makers must understand the limits to the land's carrying capacity.

The social and economic benefits accruing from technological interventions in the areas of agriculture and land use are numerous. However, these gains may be reversed due to impact of inappropriate, short-term agricultural practices and the indiscriminate alteration of the land's physical and biological systems. The debilitating effects of chemical fertilizer and of erosion upon the soil, the threats posed to water quality by pollutants and by ill-conceived irrigation projects which lead to increased salinity, the depletion of ground-water resources, and the conversion of prime farmland and wetlands all are examples of the inadvertent destructive effects of common technologies.

OTA Role. What misapplied and noncoordinated technologies have wrought, properly considered technological and land use practices may repair. The development of integrated strategies by Federal, State, and local governments, and the private sector are required to halt deterioration of our land's productivity. The project will:

- assess the beneficial and adverse impacts of relevant current technologies on sustained land productivity,
- examine the quality of the present data base for forecasting rates of change in land productivity,
- present selected case studies showing how society is affected as ecological systems of the land break down,
- determine gaps in our knowledge base,
- inventory and assess new technologies to provide for sustainable land productivity, and
- outline strategies for fostering sustainable land productivity in the United States.

Priorities (Continued)

IMPACTS OF TECHNOLOGY ON PRODUCTIVITY, INFLATION, AND EMPLOYMENT

Problem. Inflation, lagging productivity, and unemployment are three of the most critical socioeconomic problems facing the United States today. Each of these problems has roots in technology as well as consequences for technology.

For example: although the mass-production of automobiles made it possible to improve labor productivity, it also displaced labor as other modes of transportation were used less. Further, the mass-produced automobile gave rise to increased reliance on petroleum-based fuels and, eventually, on foreign sources of petroleum. The recent price hikes in crude oil from abroad have been a significant factor in our current inflation. Some observers suggest that an inflation-weary workforce, whose paychecks buy less even when they rise, may itself be at least one factor in our sluggish productivity gains. And dollars that buy fewer goods and services also buy less research and capital equipment for technological development.

The interrelationships between technology and our economic system, including the problems of inflation, lagging productivity, and unemployment, are complex, critical, and little understood. As a result, technology policy is made with little knowledge of its economic impacts, and economic policy is made with little understanding or consideration of its impacts on technology. A better understanding of the links between technology and the economy is essential to the design of public policies to improve the impacts of technology on our economy.

OTA Role. An OTA study would explore the complex interrelationships between technology and the economy—with particular emphasis on the impacts of technology on productivity, inflation, and employment.

Because so little information exists concerning the techno-economic system—the set of connections between technology and the economy—the first task of an OTA study would be to develop a practical model of that system which shows the cause-and-effect connections between technology and the economy. The study would then examine the various policy mechanisms that might be employed to improve the impacts of technology on the economy.

The study would address such issues as:

- Does the operation of the techno-economic system vary with different tax climates and different patent policies?
- What effects does the investment of different amounts of manpower and resources in R&D have on the economy?
- Do diverse sectors of the economy (steel, chemicals, services) employ their technologies differently? If so, could case studies of specific industries suggest ways of improving employment or productivity in different sectors of the economy?
- How does the decisionmaker or planner “get at” those parts of the techno-economic system that serve as leverage points for policy changes or improvements?
- Can technology be employed to improve productivity in the growing service sector?

Priorities (Continued)

TECHNOLOGY AND THE DEVELOPING WORLD– MEETING BASIC HUMAN NEEDS

Problem. As many as 1 billion inhabitants of the developing countries live in abject poverty, their most fundamental needs–food, shelter, health, clothing—unmet. Traditional foreign assistance strategies employed in these countries have measured progress by aggregate growth, as reflected in gross national product (GNP). However, it has become clear that, despite the efforts of these programs and the rise in GNP in many developing countries, the economic plight of vast numbers of people has remained unaffected, or even worsened. The "basic human needs" (BHN) approach is an alternative development strategy that concentrates resources on the attainment of a minimal standard of living essential to life and dignity. The purpose of this study would be to assess the ways in which technology can contribute to and implement a BHN strategy.

A vast range of existing technologies—from the highly sophisticated to the "intermediate" or "village Ievel''—can help meet the basic human needs of the poor, In the fields of agriculture and rural development, health, education, shelter and clothing, energy, and population growth, processes as diverse as, for instance, satellite telecommunication and the construction of simple sand filters for water purification, are all relevant to the implementation of a BHN strategy. As yet, however, there is no inventory of such technologies that both covers the entire range of human needs—food, water, shelter, clothing, health care, education, employment opportunities, and basic services—and considers the spectrum of levels of technology appropriate to the provision of those needs. The development of effective and internally consistent aid packages, attractive to and answering the needs of individual countries, requires such an inventory.

OTA Role. The proposed study would develop a comprehensive inventory of technologies for implementing an effective BHN strategy which respects the goals, leadership initiative, and self-reliance of the developing countries involved. The inventory would include both existing and prospective technologies and identify areas where R&D seems to be required. Criteria for selecting and evaluating technologies (factor costs, environmental and social impacts, the local resource base, the availability of markets, etc.) would be identified and analyzed. Questions regarding methods for melding highly sophisticated and very simple technologies would be addressed. The compatibility between various technological approaches and U.S. foreign policy objectives would be considered.

Priorities (Continued)

PEACE TECHNOLOGY

Problem. An OTA study would examine a range of technologies that might be used to monitor compliance with international agreements. These technologies, by making the undetected evasion of agreements less feasible, and/or by permitting dissemination to a worldwide audience of evidence of compliance, would expand the range of workable and attainable arms control measures, and would perhaps permit new types of stabilizing international agreements. The study would review the feasibility of different approaches, determine the most appropriate national and international institutions for utilizing the equipment, assess the kinds of agreements which might be made possible through the use of such equipment, and review priorities for supporting research in the area. The strategies with which this equipment would be used would be carefully examined. The devices may, for example, reduce the need to demand "onsite" inspections of certain classes of arms limitation agreements, and arrangements might be negotiated calling for onsite proof of irregularities detected by the equipment. Techniques for escaping detection of the equipment would be carefully examined.

OTA Role. Four major categories of technologies would be examined.

- International Verification Equipment. The study would evaluate prospects for developing equipment that could be used by an international organization to monitor compliance with bilateral and multilateral arms control agreements. The concept of an international verification satellite would be one example.
- "Black Boxes. " The study would examine the feasibility of developing tamper-proof seismic, photographic, and other sensing equipment which could be placed on territory subject to an arms control agreement.
- Unmanned observatories for monitoring borders and troop movements. Such equipment could be used to monitor agreements limiting troop movements, maneuvers, and force sizes. They could also be used to monitor disputed borders and demilitarized zones without moving military personnel into sensitive areas.
- Nonproliferation Safeguards Technology. Technological innovations and devices can help reduce the likelihood of a spread of nuclear weapons by limiting access to materials and technologies which could be used to produce nuclear weapons. These technologies include new reactor designs (the "nonproliferative reactor"), alternate fuel cycles (thorium), modifications to present fuel cycles, and safeguards technology. The latter includes advanced nuclear material accounting systems, onsite containment and surveillance equipment, tamper-proof seals, external monitoring devices (atmospheric sniffers and satellite observation).

Priorities (Continued)

IMPACT OF MICROPROCESSING ON SOCIETY

Problem. The advent of microprocessing technology–the so-called "computer on a chip' '—has been heralded as an event comparable to the invention of the printing press. This technology not only fundamentally alters man's ability to organize and use information, but is making it possible to reliably and inexpensively incorporate "intelligent" functions in a growing number of products and devices used by man.

Yesterday's trip to the moon depended on microprocessors; tomorrow's kitchen ranges and washing machines will be controlled by them. Potential applications for the microprocessor abound. While it is revolutionizing the computer industry, the microprocessor is central to the marriage of the communications and computer technologies, the root source of our transformation to an information society. Few aspects of man's activities will escape the influence of this robust new species of technology.

OTA Role. The pervasive use of microprocessors will have significant and enduring consequences for the individual and for society. Some will be beneficial; others may be adverse. The proposed study would assess the potential impacts of the microprocessing revolution on society and the policy alternatives for coping with that revolution. The study would address such interrelated issues as the implications of microprocessor technology for individual rights, employment, and labor, international trade, and the functioning of government and business. The potential contribution of this technology to the communications and information industries, health and education, and banking and payments systems would also be assessed. This study would result in:

- A survey and forecast of microprocessing technology.
- Identification of likely services and applications.
- Examination of the social and economic issues.
- Examination of the policy and regulatory issues.
- Formulation of policy alternatives.
- Assessment of the consequences of implementing each policy alternative.

In addition to the consideration of effects outside the information and telecommunications sectors, this assessment would complement the ongoing OTA studies of National Information Systems and the Impacts of Telecommunications Technologies by specifically focusing on microprocessing technology.

Priorities (Continued)

APPLICATIONS OF TECHNOLOGY IN SPACE

Problem. Decisions made over the next several years will set the course of activities in the U.S. space program for decades to come. In the two decades since the Nation placed its first satellite in orbit, the space program has been the subject of vigorous debate concerning its goal and implementation, The decision to pursue project Apollo focused policy attention and the Nation's resources on the specific goal of manned lunar exploration. But the effort to achieve this goal deferred development of a comprehensive national space policy for nearly two decades.

With the successful use of near-earth-orbital space, the proposed uses of space are expanding rapidly—beginning with the development of increasingly large and sophisticated space stations, moving to space industrialization, and perhaps to space habitation. Space colonization, once a field of visionaries and science fiction writers, now attracts scientists, who advocate the mining of the moon and asteroids for raw materials.

The promise of space industrialization, however, is clouded by economic, political, and social uncertainties and by equally perplexing questions about the capabilities of technology to perform the tasks required. The space budget will not be large enough to meet all the demands placed on it and choices will have to be made. Space activities thus are both glamorous and uncertain, and objective analysis is needed.

OTA Role. An OTA study would address such issues as:

- What should be the relative priorities of manned and unmanned missions? Is there a future potential for manned lunar, asteroidal, and planetary exploration and exploitation?
- Space-based manufacturing and/or energy production in space require large-scale technologies, such as large orbiting spacecraft and manned space operations. Will benefits of such activities be great enough to justify the major investments required?
- The United States currently has four, largely separate, space programs: military, intelligence, civilian government, and civilian nongovernmental. What are the optimal relationships among them?
- What balance can be struck between developing a space-based military capability and seeking arms control agreements to prevent the militarization of space?
- Other nations are undertaking major space programs with scientific, commercial, and military objectives. As-a result of these additional entries into space, what new international agreements might be required?

This listing of issues is intended to suggest the great variety of factors involved in future space policy decisions. It is far from exhaustive, but only suggests the complexity of public policy issues related to space activities.

Priorities (Continued)

DESIGNING FOR CONSERVATION OF MATERIALS

Problem. In the past, resource demands have paralleled population growth, but new studies indicate that future resource needs will be more closely related to rates of urbanization and growth of the middle class. Both rates are at least double the rate of population growth. Thus, it is expected that in the future, escalating demands will be made upon the Earth's resources to satisfy a growing, urban, middle class. Designing for conservation can relieve this expected growth in materials and energy demand.

There are many approaches to materials conservation. These have been identified in an earlier OTA assessment, and three strategies stand out:

- Products would be designed so that they could be rebuilt or remanufactured.
- Use of renewable resources or more abundant resources could be encouraged in the design and construction of commercial buildings.
- Fewer products might be used, or products might be designed for multiple uses in transportation, residences, and institutions.

Materials conservation is not now a policy of the U.S. Government. There are those who claim that government policies, in fact, promote waste. Thus, the central issue is "to conserve or not to conserve. " Conservation would be a cost borne currently by society to gain future benefits. Critics argue that revamping material usage or changing lifestyles is a tremendous task to undertake for an uncertain future benefit. They claim that the current market system will function adequately to employ new technologies or lower cost substitutes—that conservation, in other words, will take place without governmental interference. Others argue that this is not so; selection of a material for action is the result of a short-term decision process with little or no consideration of long-term consequences.

OTA Role. An OTA assessment of materials conservation would focus on the following questions:

- Will materials conservation have a sufficiently positive impact on national growth and prosperity to warrant consideration as a national goal?
- If conservation is to be a national goal, should it apply to all materials or should it be applied on a case-by-case basis according to the criticality or cost of the material?
- If conservation is to be a national goal, what are the best methods of achieving it? Information? R&D? Regulation? Investments?
- For each implementation approach, what are the current costs? What are the materials savings? What are the future derived benefits?

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FUTURE OF MILITARY EQUIPMENT

Problem. There is need for a broad survey of the kinds of new military technology likely to be developed during the next two decades and for a systematic review of their potential impact on international stability, as well as on the security of the United States and its allies. It is hoped that such a survey could give early warning about technologies now in early stages of research. The project would not examine items receiving or likely to receive major funding during the next 5 years.

OTA Role. Suggestions for systems to be reviewed by OTA would be solicited from the Department of Defense and other organizations concerned about future military equipment. The review of each technology would attempt to answer the following kinds of questions:

- What defensive measures could be taken against it; would the weapon stimulate a major arms race?
- Would it increase or decrease the likelihood that civilians would be injured by a conflict?
- Would it increase or decrease the stability of the current "deterrent" relationship?
- Would it increase or decrease the amount of warning received before an attack?
- Would it increase or decrease the credibility of war with modern weapons?
- Would the weapon advantage an aggressor or a defender? Given geographic and other asymmetries, would it advantage the Western alliance or its adversaries?
- What reaction from our allies is likely, what are the prospects for transferring the technology, is the technology likely to proliferate outside the alliance?
- What are the manpower and budgetary implications?

Priorities (Continued)

IMPACT OF TECHNOLOGY ON THE MOVEMENT OF GOODS

Problem. The movement of goods by highway, rail, air, water, and pipeline is a major element in the U.S. economy. In 1976, over 8 percent of the ‘GNP resulted from the movement of goods. Distribution costs consume more than 13 percent of the sales dollar for manufacturing industries. National policy concerning the current goods movement system is in a state of significant transition, as is the development and use of technologies in that system. It is anticipated that Congress will be considering several substantial changes to current rail and truck regulation. The administration is expected to submit legislation in both of these areas.

OTA Role. An OTA study would explore the two-way interaction between technology and Federal policy in goods movement. It would assess the degree and manner in which Federal policy, especially regulatory policy, can be expected to inhibit or promote the development and utilization of technology. It would also be concerned with the ways in which technology might change the future structure of the goods movement industries and their operations and investments, and thus change the regulatory framework which will be appropriate for such a structure. The study would address the following major issues:

- Reducing Unnecessary Goods Movement
- Intermodal Transfer
- Transport Information and Control Technologies
- Railroad Electrification
- Transportation Rights of Way
  —Railroad rehabilitation
  —Truck size and dimension limits
- Urban Goods Movement
- The Impact of Regulation on Technology and the Impact of Technology on Appropriate Regulatory Structures.

WEATHER AND CLIMATE TECHNOLOGY

Problem. In the winter of 1976-77, half the United States found itself suffering under record low temperatures while the other half waited for rainfall to end a severe drought. This destructive combination was the consequence of a temporary change in normal world weather patterns. Some experts believe that within decades we will be able to accurately predict these changes, possibly a year in advance. The implications of such a capability would be considerable. Consider, for example, the impact on agriculture if farmers knew what weather they would face a year in advance of planting a crop.

At the present time there is no consensus on any single forecasting technique. There is general agreement, though, that the global climate machine is extremely complex and that the most crucial piece of the puzzle is the interaction between the atmosphere and the ocean. Researchers are presently experimenting with a variety of forecasting tools.

The better known include:

- Quantitative computer models that simulate the atmosphere and which some day may be used to predict global weather.
- Three-month forecasts based on links between surface temperatures in the Pacific and changes in weather over North America.
- Analysis of long-term climate changes over the past several thousand years. Study tools include tree rings, sea bed sediment, and polar ice samples. Technologies range from satellite monitoring to carbon dating.

OTA Role. An OTA study would:

- Analyze the long-term implications of weather trends for food, energy use, demographics, transportation, and foreign policy.
- Explore ways of reducing man's adverse impact on global weather and climate.
- Review assessments of Federal R&D and data collection in this area.
- Assess present and prospective weather prediction technologies.
- Assess present and prospective weather modification technologies and the potential economic, social, and diplomatic implications of various levels of weather modification capability.

ALLOCATING THE ELECTROMAGNETIC SPECTRUM GLOBALLY

Problem. In September of 1979, delegates from the 154 member nations of the International Telecommunications Union (ITU)—the UN agency concerned with the international use of the radiofrequency spectrum—will attend the World Administrative Radio Conference (WARC) to review and revise the International Radio Regulations which govern the use of the spectrum throughout the world. This Conference, the first in 20 years with the power to consider all uses of the spectrum, will set the basic framework for world use of the spectrum for the rest of this century. Its results will guide the development of national and international telecommunications systems into the next century.

The radiofrequency spectrum is a critical and limited resource whose use must be coordinated on the global, regional, national, and local levels in order to accommodate the many conflicting demands upon the spectrum and to prevent systems from interfering with each other.

At WARC 79, the developing nations will, for the first time, have an organized majority of the votes in deciding how the uses of the spectrum are allocated among nations. Third-World nations seek a "New World Information Order" which would redress the current imbalance in the control of information technology, systems, and resources between the developed and the developing nations.

Under current rules, frequency assignments are made largely on a first-come, first-served basis, which gives priority to the established and most technically advanced users of the spectrum. The developed nations generally favor this approach. The developing nations, on the other hand, favor a "fixed allotment" or "equal access" approach which apportions "rights" or "shares" to the spectrum among all nations whether or not they are, or will be, technically able to use their share. Through bloc voting in the ITU, the developing nations have recently secured the adoption of "fixed allotment" plans for a few bands of the spectrum. They will probably seek to extend that approach to the allocation of additional bands of the specturm at the 1979 WARC.

OTA Role. An OTA study would explore the long-term implications and impacts of the likely outcomes of WARC 79. The different allocation strategies that may emerge from WARC 79 will affect the development of future technologies and systems in different ways and have varying economic, political, and social consequences.

IMPLICATIONS OF INCREASED LONGEVITY

Problem. The number of older Americans is growing. In the last 25 years, the proportion of the total population 65 or older grew from less than 7 percent to more than 10 percent. Current population projections indicate that by the year 2030 almost 20 percent of our population will be elderly.

Technological breakthroughs in the next 30 years could significantly increase American life expectancy through disease control. In addition, the development of alternative technologies to control aging processes could extend lifespan itself. Because these technologies will primarily affect mortality rates among the middle-aged and the old, the proportion of the elderly to the total population could rise even more dramatically than anticipated.

Changing the size and age composition of the U.S. labor force will have a substantial impact on the general economy. The ratio of active workers to retired citizens is predicted to be only 3 to 1 by the year 2030. On the other hand, the proportion of dependent children in the population will also decline. The current trends indicate that during the next 100 years the dependency ratio—the number of people under 20 and over 64 divided by the number from 20 to 64—will never be as high as it is today.

The elderly now constitute 10 percent of the population, but 25 percent of the poor. Increasing numbers of the elderly will strain social service systems and could lead to their eventual breakdown.

OTA Role. The proposed assessment would examine the following issues:

- Technology prospects: The range of innovations in medical technology that promise to increase human life.
- Technology development, use, and distribution, including national policies on priorities for funding research among technologies that could affect life expectancy; mechanisms for screening technologies to identify and eliminate those which might have significant negative consequences; and means of distributing new technologies equitably among the population.
- Economic implications of an aging society: retirement policies and their consequences; alternatives for more flexible career patterns; the adequacy of existing private and public pension funds for meeting the financial needs of the elderly and possible alternative mechanisms for providing income maintenance.
- Implications of increased longevity for the health care system, housing, transportation needs, and social and community services; projected costs for each sector with the special needs of the elderly taken into account; and alternatives to the present organization of services to improve the quality of life for the aged.
- Alternative roles for the elderly in American society: programs designed to improve their abilities and resources, such as special education; the relationship of public policies to the role of the elderly in the family, in the community, and in the political arena.

Priorities (Continued)

CONTROLLED THERMONUCLEAR FUSION

Problem. Currently the United States is spending $500 million per year on research into controlled fusion, with the aim of building a power-producing reactor by 2005. Although the potential of fusion is great, major questions concerning cost, feasibility, and impacts remain. These indicate the need for a thorough assessment of just what the world is buying by this investment in fusion R&D. The purpose of this assessment is to examine the potential of fusion and the implications of a fusion economy.

Controlled fusion is a nuclear reaction by which hydrogen isotopes are joined in a way that permits capture and conversion of the nuclear energy to produce useful power, most probably electricity. The two major paths being pursued are magnetic confinement and laser compression. The former, which uses a magnetic field to contain the elements being heated to fusion conditions, is likely to achieve scientific demonstration before the latter, which uses laser power to achieve fusion. Beyond the scientific challenge, there remains the considerable engineering task of building a power reactor using either method and of solving the many potential environmental and safety problems. The current best guess is that a commercial power reactor using magnetic confinement can be built by 2005 to 2010.

OTA Role. An OTA study would examine such major issues as the following:

- Fusion appears to be less hazardous than present nuclear fission technologies, but formidable environmental and safety problems exist and will require careful, continued review.
- Successful attainment of fusion could provide the world with an unlimited source of energy. That achievement would be without precedent and would present society with a set of benefits and possible problems for which we are unprepared. The utility of fusion energy, of course, would be dependent upon the full cost of the process to be developed.
- Manmade fusion would be a centralized very high-technology energy source that could raise a number of problems about control of the energy economy and compatibility with the dispersed technologies based on solar energy, the natural fusion energy.

TECHNOLOGY AND MENTAL HEALTH

Problem. Mental health and mental disorders now constitute a major health issue in the United States. Mental health care is needed by 10 to 15 percent of the population; yet only 2% percent receive such care annually. Still, mental health care costs $17 billion per year. This cost represents almost 15 percent of the total cost of health care and more than l percent of the gross national product.

Physical, psychosocial, and social mental health technologies meet many health care needs, thereby improving the quality of life for many Americans. Demands for such technologies will increase in the future for two main reasons: an increase in elderly persons who have prolonged chronic health conditions likely to be accompanied by emotional stress, and an increasing acceptance by the general public of mental health technologies.

Federal, State, and local government responsibility for the provision of mental health services has grown since the early part of this century, particularly with the passage of Medicare and Medicaid. If national health insurance is enacted and if the recommendations of the President's Commission on Mental Health are implemented, the Federal role in mental health care will increase substantially.

Such an expansion necessitates a comprehensive assessment of the efficacy, safety, and cost-effectiveness of technologies designed both to promote mental health and treat mental disorders. The increase in use of mental health technologies by persons who do not perceive themselves as mentally ill should be assessed. Policy decisions also need to be made concerning the use of and reimbursement for mental health technologies used as preventive services.

OTA Role. The proposed study would assess the efficacy and safety of mental health care technologies as well as the social, legal, and ethical questions raised by their use. Examples of such issues include:

- Protection of consumers from ineffective and/or harmful technologies.
- Definition of the boundaries between mental, physical, and environmental health, education, and welfare and other social services.
- Protection of privacy with respect to seeking or refusing treatment, and with respect to data collection and use.
- Access to services for all who want or need them.
- Delineation of the diversity of service that can be publicly supported.
- The potential of mental health care as an alternative to drug abuse, alcoholism, and violence.

TECHNOLOGY AND EDUCATION

Problem. At least since World War II, a perpetual hope and a recurrent disappointment has been the idea that technology can enhance preschool elementary, secondary, and higher education. Technology-assisted education is also seen as a means of outreach to populations at large to meet knowledge needs and to enhance the quality of life. A review of what is known about the successes and failures in this area and an assessment of future opportunities for the employment of technology are particularly timely. The lessons of experience should be brought to bear on the new opportunities presented by cable, microwave, communications satellites, information packeting, video tapes, discs, and many other new developments.

Education, using such technologies, may move from a parochial, local level to a national, continental, and global level. The potential U.S. role as a unilateral, bilateral, and international participant in these new technological possibilities should be assessed.

Technology will affect not only the medium of education, but also the message. Science and technology as a major cultural subject, rivaling history and English in importance, is basic to a healthy democracy.

OTA Role. An OTA assessment would examine a number of broad topics concerning the relationship between technology and education. These include the following:

- Technology as a means of improving the quality and availability of education in the formal and informal education systems.
- The implications of gIobal educational technology for U.S. educational and foreign policy.
- The cost-benefit calculus for technological innovation in education.
- The role of institutional factors in the successful introduction of new educational technologies.
- The effect of new technologies of education on students' ability to acquire basic skills (e.g., reading) and personality traits (e.g., persistence).

PRESCRIPTION DRUG USE

Problem. The use of prescription drugs in the United States has increased approximately 400 percent since 1950. About 10 percent of the Nation's health care dollar is currently spent on drugs. Americans purchase more than 2 billion prescriptions every year at an estimated cost of $10 to $13 billion. On the average, each outpatient physician visit generates 1.6 dispensed prescriptions. The elderly acquire nearly three times as many outpatient prescriptions as do younger individuals.

Used judiciously, many prescription drugs provide cost-effective treatment that helps people overcome or tolerate their medical problems. Unfortunately, as much as 25 percent of prescription drug use may be ineffective, unnecessary, or even harmful. Adverse drug reactions, many of which are predictable, may kill as "few" as 24,000 or as many as 130,000 people annually.

Several factors influence the use of prescription drugs, including promotion by the pharmaceutical industry, prescribing habits of physicians, and public demand for drugs. These three factors and others may influence drug use more than objective analysis of a drug's particular ability to correct or ameliorate a medical problem.

Most drug use in hospitals is paid for through public and private health insurance. Conversely, most outpatient drug use is paid for solely by the individual. In 1974, Americans purchased about 1.7 billion outpatient prescriptions at an estimated cost of $8 billion. According to a 1973 survey by the National Center for Health Statistics, about 75 percent of these prescriptions were paid for solely by consumers. In 1973, private health insurance companies spent an estimated $528 million for outpatient drug use. In 1974, Federal and State governments spent about $753 million for the same purpose.

OTA Role. Each year, Congress is asked to allocate more Federal funds to expand health care benefits, including the use of outpatient prescription drugs. In order to help Congress assess the potential implications of expanding drug coverage under publicly financed health insurance, the proposed OTA analysis would address the following items:

- An analysis of current prescription drug use.
- An assessment of benefits and costs associated with this drug use.
- An assessment of mechanisms available to help ensure appropriate drug use.
- An assessment of means of reducing the need and demand for drugs.
- An analysis of potential effects of publicly financed drug insurance.

Specific issues include selection of drug products, selection of health insurance beneficiaries, new applications of technology to finance and administer a drug benefit program, and the development of drug use monitoring systems.

Priorities (Continued)

FOREST RESOURCE TECHNOLOGIES

Problem. Forests are dynamic systems that help support the life-sustaining capacity of the global environment. They are living factories supplying renewable sources of energy and materials, generating food and oxygen through photosynthesis and ensuring continued productivity of land and water by filtering degradable wastes, storing CO_2, regulating water flow, and protecting against erosion and flooding. Although outwardly impressive and apparently enduring, forests are in fact frail ecosystems. It takes from **20** to 100 years for a tree to grow to maturity. Policy decisions made today will affect the availability of forest resources in the 21st century.

Forests cover nearly one-third of the Earth's land area, yet trends in forest exploitation have resulted in a reduction of global forest area of 15 percent since 1963. The global demand for wood and forest products is estimated to be increasing at a yearly rate of 3 percent. Expected increases in population and economic growth suggest a large increase in the demand for forest products. In the developing countries, **90** percent of wood consumption is for fuelwood. Existing forested areas are rapidly being depleted through overcutting, overgrazing, and clearing for crop and pasture lands, Failure to reforest depleted areas has led to erosion, flooding, siltation, and in some cases, desertification of once fertile land.

The United States is blessed with abundant forest resources; one-third of the land area is forested. Commercial forests, those capable of producing harvestable volumes of wood, compose 66 percent of U.S. forest lands. Fifty-nine percent of commercial forest lands are held by private, nonindustrial owners, 13 percent by the forest industry, 22 percent by the Federal Government, and the remaining 6 percent by State and local governments.

OTA Role. A study of the future of forests and forest resources would examine the increasing pressures on the forests of the world from population growth and economic development, assess the interaction of the elements of forest growth and harvesting and wood processing and uses, and analyze the impacts of technology on all parts of the system, It would concentrate on three principal issue areas:

- Forest management technologies and methods in the United States: Current trends and alternative future policies for domestic forest resources.
- Current international trends in supply and demand for wood: Implications for world forest resources and the global environment.
- Present and potential uses of renewable forest products for materials of construction, chemical feedstocks, and energy including technological innovations which will influence those uses.

Priorities (Continued)

HEALTH TECHNOLOGIES AND THIRD-WORLD DISEASES

Problem. The developing countries contain more than half the world's people, and more than one quarter of those people live in absolute poverty. Lacking a decent diet and clean water, they are, in overwhelming numbers, easy prey to a whole host of infectious diseases. Infant mortality rates are extremely high; the health status of adults is poor. The rapid population growth in the Third World exacerbates the problems of malnutrition, unsanitary environments, mortality, and morbidity.

People are one of the Third World's most basic and abundant resources. To improve the health of those people is to help build the base for successful and sustainable economic development and eventual population control in that World.

Many of the technologies required to control the impacts and incidence of a wide range of Third-World diseases and disorders already exist. For example, the greatest need in most developing countries is for simple primary and preventive health care, proper nutrition, and environmental sanitation. There are, in addition, a variety of technologies for treating and preventing such widespread Third-World diseases as tuberculosis, neonatal tetanus, measles, and Yaws. Yet, Third-World countries are currently unable to realize the potential benefits of a whole array of technologies including many pharmaceuticals and chemotherapies which, according to the World Health Organization (WHO), are "too cumbersome, too crude, and too costly for effective widespread use." WHO stresses the need for the development of more effective, nontoxic chemotherapies that can be supplied at a lower cost.

OTA Role. The proposed OTA assessment of Third-World diseases would examine three major areas: (1) research and development in health technologies; (2) the application of those technologies; and (3) the delivery of those technologies. Major issues in each of those areas include:

Research and development:

- an inventory of the most common Third-World diseases and available technologies for dealing with them;
- the adequacy of U.S. resources, public and private, now devoted to research into Third-World diseases;
- the value and need for expanding research and development efforts and the specific directions such research might take.

The application of health technologies:

- the present and potential applications of health technologies;
- missed opportunities to eradicate and/or mitigate the adverse effects of common Third-World diseases;
- the effects of fragmented responsibility in international health assistance, including research and development and technological transfer and applications.

The delivery of health technologies:

- the relative appropriateness of investing in capital-intensive medical care and sophisticated physician services located in urban centers or in primary and preventive health care centers using regional and community level workers;
- the possible roles the United States might play in helping developing countries build suitable health care infrastructures.

Priorities (Continued)

ELECTRIC VEHICLES: APPLICATIONS AND IMPACTS

Problem. Recent concern for petroleum conservation and clean air has led to a renewed interest in the electric vehicle (EV) for personal and commercial transportation. The EV can use nonpetroleum fuel and emits virtually no local pollutants. However, the present-day EV does not compare favorably with the petroleum-powered automobile on a cost or performance basis. Considerable research is being directed at improving the characteristics of the electric vehicle. Travel surveys indicate that much of the Nation's daily transportation needs could be met by electric vehicles, although market projections do not indicate high usage rates of EVs even by **2000.** Difficult technical, economic, and institutional problems must be overcome for large-scale EV commercialization to be successful, and the impacts of widespread application have not been comprehensively examined.

In 1976, the Congress enacted—over an executive veto—a law requiring that **7,500** to 10,000 EVs be put into operation by the mid-1980's for demonstration purposes. Various pieces of legislation designed to encourage the development and use of EVs have since been introduced.

OTA Role. The proposed study would explore and assess the potential impacts of an increasingly widespread use of EVs over the next 40 years. The study would assume that, by the year 2020, EVs would displace some 50 to 75 percent of petroleum-powered vehicles for both passenger and commercial use. Different "transition scenarios" likely to lead to that high level of displacement would be developed. The energy, environmental, economic, social, and institutional impacts of these different transition scenarios, and of the widespread use of EVs by 2020, would be determined and described.

Priorities (Continued)

R&D PRIORITIES FOR U.S. FOOD PRODUCTION

Problem. The agriculture industry is by far the largest in the United States. Agricultural products are one of the largest items in U.S. exports and, in times of crop failure elsewhere in the world, the ability of the United States to produce more food than we need has meant the difference between starvation and survival for millions of people. U.S. agriculture is also one of the great success stories of American technology—as is, in large part, the Green Revolution, which has spurred such enormous advances in food production in some areas of the developing world. Yet rising fertilizer and fuel costs have largely brought the Green Revolution to a standstill and the increase in yield-per-acre of American agriculture has, in recent years, begun to flatten out.

The basic question is whether and how the productivity of American agriculture—whose products and whose technology are already so critical to world food supply—can continue to grow at adequate rates over the long term in the face of a large and increasing array of constraints and costs. Some scientists, for example, question whether the soil can remain productive with ever-increasing yields removing larger and larger amounts of soil nutrients, and with the application of increasing amounts of pesticides and fertilizers which may ultimately cause drastic adverse effects on soil microorganisms and the productivity of the soil itself. The loss of prime farmland to urbanization and other uses; the growing shortages of water in some agricultural areas of the country; the rising cost and relative scarcity of fuels to support high-energy agriculture; the need for U.S. agricultural exports to help offset rising costs for imported fuel and materials as the export of U.S. manufactured goods continues to decline; the prospect of increased reliance on the United States to meet rapidly growing food demand around the world—these are a few of the factors that combine to underscore the need for ensuring the long-term productivity of American agriculture.

OTA Role. An OTA study would assess R&D priorities for U.S. agriculture in terms of the growing constraints upon productivity and the technological possibilities for easing these constraints and ensuring long-term productivity. The study would evaluate such technological “functions” as soil fertility and management, energy, breeding, water resource management, and harvesting in the various commodity sectors in relation to their present and future importance to U.S. food production, their present constraints, their interrelationships, their research requirements and the likely success of such research.

Priorities (Continued)

ALTERNATIVE MATERIALS TECHNOLOGIES

Problem. Increasingly, at many points along the materials cycle, the present system of supply, use, and disposal of materials must be balanced against other important public concerns, such as occupational health and safety, energy conservation, environmental quality, industrial innovation, and inflation.

Nevertheless, the production and exchange of material products remain central to the U.S. industrial economy. There is concern in some quarters about the availability of a continued expanding supply of resources to meet future demands.

These and other concerns reflect three fundamental changes that have occurred in the U.S. and world economies during the last three decades: 1) Resources have become potentially scarce rather than plentiful. 2) The environment is no longer regarded as an infinite sink for wastes, but is recognized instead as our vital life-support system. 3) American technology and industry are no longer preeminent, but are increasingly subject to sharp competition from other countries.

Alternative materials technologies may provide significant opportunities to help resolve these conflicts. Candidate technologies might include: aerial and satellite remote-sensing technology; deep-drilling technology; geostatistical supply modeling and computer mapping technologies; product remanufacturing; and materials substitution.

OTA Role. An OTA study would assess selected alternative materials technologies, and the policies necessary to implement them from the perspective of environment, energy, health and safety, and inflation as well as materials availability and conservation.

Priorities (Continued)

DEEP OCEAN MINERALS DEVELOPMENT

Problem. A quarter of the world's oil production now comes from offshore fields—about double the seabed production of a decade ago. In addition, there is increasing interest in the undersea mining of such hard minerals as manganese nodules.

Undersea petroleum drilling is a rapidly changing field. In 1972, the record water depth for drilling reached 1,200 feet. Now, with the development of advanced platform positioning, special well control systems for deeper water, and other newly designed equipment, the maximum water depth has been extended to almost 3,500 feet.

Because the petroleum industry is operating at increasing ocean depths and in a more hostile environment in its search for gas and oil, the possibility of serious and unanticipated technological problems becomes more likely. Solutions to some of these problems may be transferable to the undersea exploitation of hard minerals such as manganese nodules, which may be a major future resource. The economics of ocean drilling and mining merit study, as do the jurisdictional problems that might arise from operations in international waters. The output of this study should be helpful to ongoing Law of the Sea negotiations.

OTA Role. An OTA study of deep ocean minerals development would contain four major elements:

- Analysis of the current drilling and mining technology, and an identification of future research and engineering requirements.
- Estimation of the total potential recoverable resources from the deep seabed—both regionally and globally.
- Identification of the economic and environmental impacts of deep ocean mining, including special deep-water drilling and mining costs.
- Analysis of the legal and institutional questions associated with ocean mining, including those covering jurisdiction in international waters and existing and proposed treaty obligations.

ENERGY EFFICIENCY IN INDUSTRY

Problem. The transition from oil and gas to direct coal, electricity, and direct solar energy over the next several decades will be accompanied by-an increase in energy costs. This in turn will necessitate substantial efforts by industry to hold down those costs. Options range from massive substitution of labor for energy to installations of entire new technological processes that use the coming energy forms efficiently.

Industry is the largest single sector in the energy problem. It uses close to 40 percent of the Nation's energy supply. Currently, substantial efforts are underway in industry to increase energy efficiency because of rising prices. These efforts, however, concentrate on existing technologies and fuels. Less effort is going into research on new processes that could most economically use the energy sources that some day must replace oil and natural gas. Such research might include substitution of electrochemical for thermochemical processes and development of chemical or physical methods that could effectively use direct solar energy. The alternative to finding new technologies to combat high energy costs will probably be large-scale substitution of labor for energy.

OTA Role. An OTA study would examine the range of options for increasing energy efficiency in industry and their impacts on society and the economy, and identify the policy options for encouraging the efficient use of the new energy sources.

The proposed study would explore such issues as:

- The potential impact of new efficient process technologies on productivity and employment.
- The potential contribution of more efficient energy use to environmental quality.
- The role of Government incentives in stimulating needed technological innovation.
- The problem of capital availability for installation of new technologies.
- The role of oil and gas pricing in stimulating the development of more energy-efficient equipment and processes.

Priorities (Continued)

ROLE OF TECHNOLOGY IN MEETING HOUSING NEEDS

Problem. As a result of the widening gap between family incomes and the cost of housing, substantial segments of the population cannot afford to buy a home. A substantial body of research exists to support the contention that only a major shift toward capital-intensive processes can bring the costs of housing back to levels middle-income families can afford, and that these technological innovations could have other benefits relating to land acquisition patterns, finance costs, and operating and maintenance costs. However, many contend that the regulation of the building industry through antiquated, capricious, and voluminous building codes is discouraging the needed technological innovation that could help control costs.

The traditional role of the Federal Government has been as guarantor of loans and provider of subsidies, leaving the construction of houses to private industry except in the cases of the very poor, the aged, and the military. The support of research within the Department of Housing and Urban Development has largely been targeted away from technology-related research.

OTA Role. The proposed study would focus on those technologies most likely to contribute to improved future performance of the housing industry. These include the creation of new materials and composites; the use of minicomputers in housing design, engineering, and management; new rehabilitation technologies; advanced computational techniques for risk analysis and new design; and increasing knowledge of human responses to housing. Other related issues would include:

- The need to reduce the cost of housing and all of its subsystems: land acquisition, land development, financing, and maintenance.
- The need to reduce overall energy consumption and dependence on fossil fuels.
- The need to remove unnecessary regulations that discourage innovation.
- The need for new training programs to redress the continuing lack of skilled labor.
- Factory-built homes versus onsite construction.

OCEAN WASTE DISPOSAL

Problem. Nobody really knows how waste affects the ocean. Some experts think current volumes of pollution are very dangerous. Other specialists disagree, claiming that the seas are robust and elastic enough to absorb large amounts of discharge. Given proper handling, the ocean may be the most reasonable repository for some types of wastes. But we still need to know which wastes the ocean could accommodate and in what amounts. Also, the least destructive disposal methods should be identified.

Waste reaches the sea in many ways. For example, some cities and private companies barge material out into the Atlantic. Others pump waste to the sea via long outfall pipes. The ocean receives chemical pollution through natural runoff from farmlands. Sewage pumped into waterways finds its way into the ocean. Waste is also generated every time a channel is deepened. Spoil, from dredging operations, is the most voluminous of waste materials and probably the most benign. Industrial waste consists of anything left over after a manufacturing or agricultural process. Federal laws have substantially reduced the deliberate discharge of much of this, but accidents still occur. Municipal waste, probably the most important source of ocean pollution, is a mixture of raw city sewage, treated sewage and residual sludge.

OTA Role. An OTA study of the use and abuse of the oceans through waste disposal would examine such questions as:

- What are the gaps in present knowledge? How and when might those gaps be closed?
- Are we running out of safe disposal sites? OTA would attempt an estimate of total "holding capacity" of both the ocean and land to gauge whether or when we might face a crisis.
- Should any or all methods of ocean waste disposal be eliminated? We would assess the competing technologies and their relative costs.
- What further action should Congress consider? OTA would identify areas that might benefit from further congressional review, analyze technologies most likely to relieve ocean pollution, and identify the risks that accompany the various waste disposal alternatives.

TECHNOLOGY AND THE HANDICAPPED

Problem. Within the last decade, several developments suggest major changes in national policy toward the handicapped and new life-enhancing roles for technology to play in implementing that policy.

Understanding of the origins of handicaps and the scope of the situation is increasing. Improved standards of public health and data collection reveal problems whose scope we were unaware of. According to one estimate, 8 percent of school children are handicapped. Another estimate is that **2.5** percent of the U.S. population are severely disabled. With the steady increase in average lifespan, the impairments of aging will be a growing social concern. Developments in medicine, health, epidemiology, electronics, and materials are creating a new base. of knowledge which should have a major effect in enhancing the quality of the lives of the handicapped by preventing, correcting, relieving, or stopping the worsening of their conditions.

There is an extremely limited private sector market base for developing new technologies for the handicapped, and public institutions have been conspicuously unsuccessful in developing an effective, well-structured program for dealing with this constellation of social needs and major human opportunities. Yet this problem area offers a major opportunity for technology to lift a burden from a large sector of our society.

The handicapped are increasingly active in civil and equal rights movements. Recent legislation, notably Public Law 94-142, is creating wide-sweeping, public obligations for the education of handicapped children. In addition, there are major issues involving transportation, health care delivery, architecture, design, housing—all areas of major governmental action and expenditures. These developments will undoubtedly generate a great demand for preventive, corrective, and rehabilitative social and health care measures. The movement towards bringing the handicapped into the mainstream of public education will ultimately lead to similar “mainstreaming” in occupational sectors. The movement of the handicapped into the work force will also be facilitated by the growth of telecommunications technology and the expansion of information industries.

OTA Role. The proposed project would first determine the present and future scope of the demography of the handicapped, the nature and severity of their limitations, and the scientific and technological potential for preventing, alleviating, or correcting handicapping conditions. The study would then explore and assess the broad impacts on and implications for society of the technologies required to serve the handicapped—including the impacts on the life of the handicapped and the costs and benefits to society.

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ENERGY, MATERIALS, AND GLOBAL SECURITY

ENERGY

Alternative Energy Futures

During 1978, considerable congressional interest was expressed in a comprehensive study of the Nation's energy future. In this study, OTA is providing a comprehensive picture of supply and demand patterns for energy in the future and their effects on society, the economy, and the environment. OTA is also analyzing various transition paths from our present dependence on dwindling fossil fuels to a system fueled by renewable energy sources. In addition, the study is providing the basis for responsible formulation of public policy by identifying and analyzing the critical issues that must be resolved for such policy. Specifically, OTA is examining various energy futures scenarios and their impacts. These include three possible levels of energy demand, and conditions such as intensive electrification, high use of synthetic fuels, energy self-sufficiency, or high solar use. The study is establishing the requirements needed to meet energy demand for each of the various scenarios in a general way and then determining the energy efficiencies and resources needed to meet those demand structures. Also, the economic, environmental, and social effects, as well as the technical requirements of meeting each demand structure, are being analyzed.

Within the framework of the Alternative Energy Futures study, OTA is assessing the economic as well as the international issues involved in importing LNG (liquefied natural gas). The study is exploring such issues as availability, costs, potential markets for LNG and the consequences of Government actions, including incremental pricing, standards for price and other contractual arrangements with supplying countries, and indirect incentives.

Home Energy Use—Conservation Issues

Before the 1973 oil embargo and the last two unusually severe winters, little attention was paid to future energy shortages. Since then, several Federal programs and regulatory initiatives have been designed to reduce residential energy consumption and increase the efficiency of home energy use. In 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. The effectiveness of Federal, State, and local conservation programs as well as the status of research and development in energy conservation and opportunities for technological advances are also being examined. In addition, the study will identify impacts of reducing residential energy use.

The Direct Use of Coal

Coal is expected to be the foundation of the Nation's energy future because it is the only domestic fuel whose use can be greatly expanded. However,

the impacts of the anticipated growth in coal use are, in many respects, uncertain. In this study, OTA is seeking a broad understanding of how coal is used, what role it could play in the future, and what impacts will result. OTA is also examining how coal production can be increased, and the impacts of an increase; and how negative impacts can be reduced and the effects that would have on production. Specifically, the study is examining such issues as: (1) present and future mining, combustion and air pollution control technologies; (2) labor issues such as miner health and safety, and labor-management relations; (3) factors affecting coal production and use (availability, regulations, environmental and transportation restrictions); (4) environmental impacts of combustion (air, water, and land); and (5) present Federal policy towards coal.

Solar *Power Satellites*

Considerable interest has been shown in the feasibility of obtaining solar energy by using satellites to convert solar radiation to microwaves and beam them to Earth for conversion to electricity. In this assessment, OTA is identifying issues that need clarification and resolution. These issues include the cost of constructing these satellites, their reliability, the affects 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. In addition, OTA is assisting Congress in oversight of programs already underway. OTA is also comparing solar satellite systems with other inexhaustible energy systems.

Energy From Biological Processes

In the search for renewable and non-polluting sources of energy, many experts see a potential for obtaining increasing amounts of energy from plants and plant wastes (commonly called biomass). In this assessment, OTA is analyzing the potential for and impacts of biomass. The study will examine various conversion processes such as direct combustion, pyrolysis, and distillation, analyze policies that could accelerate commercialization, and examine what research and development is still needed. OTA is also exploring the range of biomass fuels—from crop and wood residues to forests and crops grown specifically for energy. In addition, OTA is looking at end uses of biomass-derived fuels or chemicals. Emphasis will be given to the possible uses of liquids and the technical, economic, and systems trade-offs between possible uses.

NATIONAL SECURITY

Effects of Nuclear War

At the request of the Senate Foreign Relations Committee, OTA has undertaken a study of the effects of nuclear war. The study is examining the effects which nuclear attacks of various sizes might have on the civilian population, economies, and societies of the United States and of the Soviet Union, and will in addition discuss the long-term effects of a major nuclear war on

Assessments in Progress (Continued)

areas elsewhere in the world. Because a report was requested within a few months, OTA is pulling together existing knowledge rather than undertaking original research, but the study will be unusual in its effort to examine the entire range of effects—direct and indirect, physical and social, short term and long term—rather than confining itself to consequences which lend themselves to rapid quantitative treatment.

Nuclear war is not a comfortable subject, but the fact that nuclear war is possible lies at the foundation of U.S. national security policies. The OTA study will not pretend to predict what an actual nuclear war would be like, but rather it will give a sense of what kinds of consequences should be expected, and of the nature of the uncertainties which dominate serious consideration of such a war. A careful explanation of the extent of these uncertainties, and the reasons why many of them cannot be resolved, is just as important as a summary of what we do know about the effects of nuclear weapons.

TECHNOLOGY AND WORLD TRADE

Foreign Policy Implications of Global Trends in Energy Supply and Demand

This assessment will examine the linkage between the global trends in energy supply and demand, the impact of major supply and demand technologies on those trends, and the achievement of U.S. foreign policy objectives. It will identify and analyze areas in the world where energy shortages or high prices are likely to create political and economic difficulties during the next three decades, the nature of those difficulties, the impact of these developments on the economic and security interests of the United States, and the policy options and technological innovations available to mitigate negative impacts here and abroad.

Requested by the Senate Committee on Foreign Relations, the assessment is proceeding in three basic stages. The first is a review of existing information concerning present world energy resources, energy demand, and programs to increase supply and moderate demand now under way in key areas throughout the world.

The second stage will comprise a series of credible scenarios regarding the price and availability of depletable energy resources during the next 30 years. These scenarios illustrate, among other things, the potential impact of aggressive energy conservation policies, unexpected discoveries or failures to discover 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 which could weaken various national economies, seriously threaten the aspirations of developing nations, and jeopardize U.S. security in-

terests. U.S. foreign policy and policy responses, including U.S. foreign assistance in energy technologies, will be analyzed.

Technology Transfer

At the request of the House Committee on International Relations, and the Senate Commerce Committee, OTA has undertaken a project designed to identify the opportunities and obstacles posed by technology transfer, analyze a range of appropriate policy responses, and assess their likely consequences.

The project is divided into three distinct components: technology transfer between the United States and the Communist world; the impact of technology transfer between the United States and the developing countries; and transfer between the United States and other OECD countries.

These studies will examine 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 viability of technology transfer as a political lever or tool of diplomacy. A case study approach will be used.

Because of congressional interest, the study of East-West transfer is being undertaken first. The study will examine techniques for evaluating the impact of Western technology on the economies of Communist countries, and provide a basis for weighing economic costs and benefits along with political and national security interests which will be affected by this trade. The study will evaluate 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.

The Impact of Technology on Competitiveness of U.S. Industries

A growing number of people have become concerned recently that U.S. industries are losing, or have already lost, their position of technical leadership in critical areas. Further, there is fear that this change will adversely affect their ability to compete in world markets. At the request of several congressional committees, 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. OTA is analyzing the role played by technology in the fate of the U.S. steel industry and in steel manufacture around the world. This assessment will examine the kinds of technologies now available worldwide and attempt 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 regulations, environmental controls, and health and safety regulations) are also being explored. A broad range of possible legislative solutions to problems identified will be suggested and their impact assessed.

MATERIALS

Analysis of Laws Governing Access Across Federal Lands for Minerals Development

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 set aside in parks, wildlife refuges, national forests, and wild and scenic rivers, and how much would be available for development of natural resources.

To lay a basis for congressional consideration of the issues involved, OTA undertook an assessment of the major environmental, land planning, and Federal land management laws applicable to Alaskan lands. The final report is being published for use by the 96th Congress.

Management of Fuel and Nonfuel Minerals on Federal Land

This assessment, requested by OTA Board member Senator Stevens of Alaska, analyzes the Federal land management laws and practices that govern physical access to and exploitation of minerals on Federal onshore land, exclusive of Indian land, and the interaction of the Federal laws and practices with State and local controls and payment requirements. The analysis seeks not only to identify problems, but also to indicate possible approaches to a more efficient and equitable system.

The assessment focuses on the important role Federal onshore land plays in the provision of both mineral and nonmineral resources to the people of the United States. It describes the mineral development process and the role of the various participants in the process, and outlines the history and main elements of the Federal laws governing mineral development on Federal onshore land. Specific issues and options are presented in each of three major areas: (1) the coordination of mineral development activities undertaken by different individuals and firms; (2) the coordination of mineral development activities with nonmineral activities and values; and (3) the coordination of regulatory and payment requirements imposed on mineral development activities by different agencies of the Federal Government and by the different levels of government (Federal, State, and local) in our Federal system.

Assessments in Progress (Continued)

Materials and Energy From Waste

This study examines the potential for, and barriers to, recovering and recycling resources from municipal solid waste. The final report will identify and analyze both the policy options for realizing the potential and the likely impacts of implementing such options. Requested by the Senate Committee on Commerce and the House Committee on Science and Technology, the assessment considers: (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) economic policies to stimulate the demand for recovered resources; (5) the effect of freight rates on the movement and sale of recovered goods; and (6) mandatory deposits on beverage containers.

Conservation of Metals to Reduce Losses in the Materials Cycle

This assessment examines the materials cycle from mining through product disposal to identify and quantify materials wastes and losses and to suggest techniques for reducing these losses. Various conservation objectives are being defined and the applicability of each conservation approach is being evaluated in terms of those objectives. The final report will evaluate public and private policy options for encouraging conservation as a means for coping with short-term cyclical problems in materials supply and demand which may develop in the future.

Federal Coal Development Rights

OTA has been directed by Congress to conduct an analysis of all outstanding Federal coal development rights, which include over 500 leases and 200 preference-right lease applications in effect in August 1976. This assessment will analyze all mining activities on Federal leases, determine the present and potential value of the outstanding coal development rights, estimate revenues to the Federal Government, and examine the feasibility of using deep mining technology in leased areas.

Oil Shale—A Case Study of Recovery of Minerals From Subeconomic Resources

Rich oil shale deposits, containing approximately 1 trillion barrels of shale oil that could be ultimately recovered, are located within a relatively small area in Colorado, Utah, and Wyoming. However, various technological, environmental, and economic uncertainties associated with oil shale processing must be resolved before shale oil can make a significant contribution to the Nation's energy supply mix. Accordingly, at the request of the Senate Committee on Energy and Natural Resources, OTA is investigating the issues relevant to oil shale development, including an analysis of the technological, social, environmental, economic, institutional, political, and other impacts—both beneficial and harmful—that may accompany the evolution of an oil shale industry. The final report will identify and analyze legislative policy options related to the development and use of oil shale technology.

Assessments in Progress (Continued)

Opportunities and Vulnerabilities of U.S. Dependence on Imported Nonfuel Minerals

Requested by the House Committee on Science and Technology, and endorsed by other House and Senate committees, this study is to examine the future availability of selected mineral imports, the role of these commodities in the domestic and international economies, and the public policy implications of U.S. reliance on foreign sources of supply. Unresolved situations arising from dependence on imported minerals will also be explored.

HEALTH AND LIFE SCIENCES

HEALTH

Cost-Effectiveness of Medical Technologies

Health technologies have contributed substantially to rapidly rising health care costs. 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, originating from OTA's priority list and requested by the Senate Committees on Finance and 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, the potential ethical, economic, political, and legal aspects; and (4) the feasibility of expanded use.

Pneumococcal 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 seeks to identify selected issues in three general areas: vaccine R&D 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 general and vaccines in particular.

This report is also analyzing the cost-effectiveness of using pneumococcal vaccine as a preventive health measure in selected segments of the population.

Further, this report is identifying various factors that affect the use of vaccines, such as consumer awareness of vaccine benefits and risks, vaccine 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 prevent or to help treat disease.

Computer Technology and the Quality of Physician Services

Physician training involves the accumulation of knowledge and the application of that knowledge in the care of patients. OTA is examining how various computer technologies might be used to assess and/or improve 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.

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.

Health Data Systems

The Federal Government lacks a coherent policy on gathering, analyzing, and using statistical information on people's health and the use of medical care resources.

Because of the lack of attention given to the numerous statistical activities of various Federal health programs, OTA undertook a study to 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.

FOOD

Drugs and Chemicals in Livestock Feeding

Farmers and ranchers have widely adopted the use of 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.

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.

At the request of the Senate Committee on Agriculture, Nutrition, and Forestry, 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 assessed. 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.

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 food packages now have an open date in one form or another, whereas in other areas food packages lack 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.

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.

Requested by the Senate Committee on Agriculture, Nutrition, and Forestry, 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 strate-

gies to manage pests. The third objective is to assess the potential adaptation and impact of U.S. advances in pest management strategies on crop protection in developing countries.

Environmental Contaminants in *Food*

In the past decade, various foods have become contaminated by identified toxic substances in the environment. Polybrominated biphenyl (PBB) contaminated livestock feed and products in Michigan, and kepone in the James River of Virginia contaminated fish and other seafoods. This type of food contamination has led to actual or potential human health risks 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.

GENETICS AND WORLD POPULATION

Impacts of Applied Genetics

"Applied genetics" refers to those technologies which 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, risks of inadvertent harm stem from these advances, many of which have not been fully examined for such risks.

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?

Assessments in Progress (Continued)

- 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 innovations.)

Arising out of OTA's initial priority-setting process, this assessment will focus on the use of applied genetics technologies in agriculture and commercial /industrial processes and the prevention and treatment of inherited human defects.

SCIENCE, INFORMATION, AND TRANSPORTATION

OCEANS

Siting of Coastal Energy Facilities

In the short term at least, meeting the U.S. demand for energy will require new generating facilities, and this inevitably raises the question of where these facilities should be. This study is intended to identify broad issues associated with the siting of new powerplants in the coastal States of the United States.

The study concentrates on coastal States partly because this is where the sharpest increases in population and energy demand are expected and partly because of the new Federal Coastal Zone Management Act, which should influence siting decisions.

Over 200 interviews have been conducted with key people including Federal and State officials, businessmen, utility and energy company officials, labor representatives, and spokesmen for environmental and other special interest groups. Questions were designed to provide an energy profile of selected States, with an emphasis on determining the influence of the various governmental units and whether some of these units are at odds with others.

Renewable Energy From the Oceans

The rush to find energy alternatives to petroleum has led many people to consider the potential of the world's oceans. Currently, the most discussed ocean energy extraction method is Ocean Thermal Energy Conversion (OTEC), which aims to use the temperature difference between deep cold ocean waters and warmer surface waters to produce power. OTA has already issued an assessment of OTEC technology.

That assessment prompted a logical question: what are the current prospects for other known renewable ocean energy systems which do not receive the support and level of Department of Energy R&D funding enjoyed by OTEC?

These "other" renewable ocean energy sources include ocean winds, tides, currents, waves, and salinity gradients.

OTA is commissioning studies of each of these candidate energy systems to pinpoint the status of the research efforts. Tidal technology is proven already and in place in France, where the French Government has constructed an electricity-generating plant.

Disposal of Nuclear Waste

Although we are more than three decades into the nuclear age, the ever-growing volume of high-level waste from weapons manufacture and power-plant operations is almost all still in "temporary" storage. Permanent isolation of this radioactive waste is essential since exposure to some of its elements can pose a threat to human life for over 1 million years.

OTA is now assessing the state of the art of disposal of high-level radioactive wastes generated by nuclear powerplants. Also to be investigated are the social and environmental aspects of the issue, which are sometimes not addressed in more narrowly focused studies.

The study is exploring such questions as:

- What steps are involved in selecting, evaluating and licensing potential waste repository sites?
- What is involved in developing and managing a full-scale waste disposal system?
- What is the role of State and local governments in management of nuclear wastes?
- What additional research and development work is needed to demonstrate the ability to safely dispose of nuclear waste?

NATIONAL R&D PRIORITIES AND POLICIES

Technology *for Local Development*

Technologies now being developed, such as land disposal of waste water, distributed residential energy systems, and housing rehabilitation techniques, provide an alternative and possibly more effective approach to community and regional development. These technologies stress self-help, the use of renewable resources, and are compatible with local capital and environmental requirements. Such technologies have often been characterized as "appropriate technologies." This project will examine several prototype technologies in order to assess the extent to which appropriate technologies can contribute to attaining domestic urban and rural community goals. The project will assess the feasibility and potential impacts of these technologies, as well as the institutional structures necessary to develop and apply them. It will also identify and develop policy options for the Congress which deal with proposals for Federal program coordination, financing R&D, and other relevant means of

Assessments in Progress (Continued)

enhancing beneficial impacts and minimizing adverse impacts of technologies for local development.

Technological Innovation and Health, Safety, and Environmental Regulation

Regulatory policies to minimize the risks posed by technology to health, safety, and the environment have become the focus of increasing controversy. The purpose of this project is to evaluate alternative regulatory policies with regard to their effectiveness and efficiency in ensuring that the rate and direction of technological change are compatible both with health, safety, and environmental goals and with the goal of maintaining economic vitality. Achieving this objective requires understanding how regulatory policies, when integrated with technical, market and financial considerations at the corporate level, influence private investments in innovation. This assessment will frame the issues, and examine some specific cases in order to begin developing a knowledge base that will be useful for forming policy decisions in this area.

The National Laboratories Assessment

The purpose of the national laboratories assessment is to evaluate the role and performance of federally funded research and development centers and civil service laboratories. The assessment addresses three aspects of these laboratories: 1) their present institutional structure; 2) the role they play in the overall scientific endeavor of the country; and 3) ways in which they can be directed toward the solution of national problems. Intergovernmental access, quality control, and the capacity for the labs to serve an early warning function in national problem areas round out the assessment.

TELECOMMUNICATION AND INFORMATION SYSTEMS

Societal Impacts of Information Systems

Through three broadly representative case studies—the National Crime Information Center, emerging electronic message systems, and electronic funds transfer systems—OTA is assessing the impacts of national information systems on society. The study includes multiple services such as criminal justice, mail, research, education and marketing, and includes personal services such as banking, shopping, and library services. National and international issues and policies are being examined. Particular attention is being given to issues of privacy and civil liberties and alternative policies to encourage use of information technologies while limiting or controlling adverse societal impacts of such systems.

Telecommunication Systems Assessment

The Telecommunication Systems study is examining the impacts of emerging telecommunication technologies on society. Areas being studied in-

elude: economic, social, legal, and policy issues; national and international industry structure; governmental uses and regulation of telecommunication systems; and potential biological and environmental effects. Also included are major international issues such as: the timing of new undersea cable and transoceanic satellite facilities; emerging impediments to transborder data flow; and satellite broadcasting impacts.

TRANSPORTATION

Railroad Safety: Canadian Comparison

At the request of the House Commerce Committee, OTA is conducting a detailed comparison between railroad safety conditions in the United States and Canada. The OTA comparative analysis identifies the similarities and differences between the United States and Canadian rail systems and safety practices. Findings thus far indicate that the differences in rail-related fatality rates are primarily a function of the differences in size and exposure levels of each nation's population. The study also suggests that the different approaches to safety in the two countries are a function of the size and structure of the Canadian rail system and the structure and size of the government entities with responsibility for safety. In addition, the economic deregulation of Canadian railroads, which occurred in 1967, created a more favorable economic climate for the rail industry, which, in turn, provides a better environment for safety improvements.

The Future Use and Characteristics of the Automobile Transportation System

The automobile is the predominant form of personal transportation in the United States. Over 85 percent of all 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 social and economic benefits conferred by the automobile have come certain problems. 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 automobile-related facilities take up land and contribute to urban sprawl. Maintaining the present automobile and highway system and meeting the future personal transportation needs of the country will call for large capital investments.

Requested by the Senate Committee on Commerce, Science, and Transportation, this assessment addresses changes in the future use and characteristics of the automobile transportation system, potential technological developments and their anticipated effects to the year 2000 and beyond, and factors that could influence the evolution of the system.

Assessments in Progress (Continued)

Impacts of Advanced Air Transport Technology

The civil aviation industry in the United States has dominated the free world aircraft market for the past 40 years largely because of the technological base provided by NASA and DOD R&D, and by an industry oriented toward technological development. This superiority is now being challenged by consortiums in Western Europe, backed by their respective governments, with developments such as the A-300 Airbus.

Potential new developments in aviation should permit the U.S. industry to continue its contribution to the Nation's economy, but at issue is the question of the extent of Federal support of civil aviation technology, particularly where long-term and high-risk R&D projects are concerned.

Requested by the House Committee on Science and Technology and the Senate Committee on Commerce, Science, and Transportation, this assessment addresses the potential technological developments and their impacts in the field of advanced transport aircraft for passengers and cargo over the next 15 to 30 years. Included in the study are advanced supersonic transport, commuter, cargo, hypersonic, V/STOL, and energy efficient subsonic aircraft, lighter-than-air vehicles, and general aviation. The study examines the potential economic, environmental, energy, safety, social, and political implications of the introduction, or the nonintroduction, of such aircraft. The study is intended to provide Congress with information needed to determine the appropriate level of Federal support.

Impacts of Advanced Group Rapid Transit Technology

Advanced Group Rapid Transit (AGRT) is a public transportation system concept embodying fully automated small vehicles operating at short headways on exclusive guideways. The system is being developed by the Urban Mass Transportation Administration. OTA is conducting a preliminary analysis at the request of the House Appropriations Committee. At issue is the cost of the program and its potential for enhancing urban mobility and ameliorating other problems associated with urban transportation.

EXPLORATORY AND PLANNING

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 on

natural hazards and their social, economic, environmental, and political consequences. Staff studies and workshops identified and clarified issues and trends, and offered some policy options. An operational and policy framework based on the lifecycle of a natural hazard has been developed.

A five-volume preliminary analysis to be completed in January 1979 will include:

- Confronting Nature: A Preliminary Analysis of U.S. Policy Needs Related to Natural Hazards
- Issues and Options in Flood Hazards Management
- 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

Currently, inadequate understanding of the parameters of risk prevents governments from being able to plan and execute comprehensive activities to deal with the full range of risks resulting from both natural and manmade causes. OTA is undertaking a comprehensive review and analysis of risks to which humankind is exposed on an individual, regional, national, international, and global basis. A systematic inventory of the scope, scale, intensity, numbers of people affected, and trends with regard to technological risks will be provided as a basis for improving public policy dealing with risk.

This comparative analysis of a large number of risks will develop systematic information with regard to each risk and attempt to develop a time history, including the rates of change of risks over an interval useful to public policy.

The project will directly serve OTA's internal needs for a more systematic approach to risk. It is also planned to provide a framework for improved congressional interpretation and deliberation on risks and hazards.

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

Growing dissatisfaction with such economic measures as GNP (gross national product) are based on the fact that they do not and cannot fully reflect prevailing social conditions. GNP counts market-priced goods and services but disregards activities outside the market and ignores the reasons for a transaction. Thus, GNP includes as positive measures the costs of dealing with systems breakdowns, waste disposal, repair and maintenance—despite the fact that these are negative symptoms with regard to quality of life. New measures are needed to deal with life quality, attitudes, aspirations, goals, and satisfactions. Various branches of the Federal Government recognize this need for a

Assessments in Progress (Continued)

more adequate expression of human impacts and conditions and have begun delineating approaches such as social accounting, social indicators, etc. The U.N. and the OECD have also initiated similar investigations, realizing the absolute necessity of measures other than economic to determine real development in the Third World. To date, however, no consensus exists on 1) what should be measured and how, and 2) the framework by which the meaning of the indicators can be presented in a useful way.

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:

- An analysis of current efforts by government agencies, academia, and the private sector to develop various social indicators and methods of social accounting.
- An evaluation of strengths and weaknesses of current indices and measurement category gaps to result in the development of a new index for quality of life to reflect the interconnection of various human activities and new conceptions of value, such as time vs. money, pain vs. death, the work/play ratio needed for psychic health.
- Evaluation of alternative methods for data display of the results of quality of life indexing to ensure utilization by those who require the information.
- Estimation of the impact on technologically related decisionmaking of the existence of good quality of life data; evaluation of ways in which the Congress can both foster this development and utilize it in preparing legislation.

Non-Ionizing Radiation Hazards

In response to a request of the House Committee on Interstate and Foreign Commerce, OTA is conducting a preliminary anaysis of the issues associated with microwave and other non-ionizing radiation hazards. The study is considering 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.

The preliminary analysis seeks to explore the principal public policy issues confronting the Congress in this area and identify the technological factors which give rise to them. It 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. This analysis, based on recent reports and interviews, also aims to identify relevant statutes, responsible authorities, existing standards, and centers of governmental and nongovernmental activity and analysis, and indicate some of their limitations.

Completed Assessments

Application of Solar Technology to Today's Energy Needs
A Technology Assessment of Coal Slurry Pipelines
Enhanced Oli Recovery Potential in the United States
Gas Potential From Devonian Shales of the Appalachian Basin
Analysis of the Proposed National Energy Pian
Nuclear Proliferation and Safeguards
A Review of the U.S. Environmental Protection Agency's Environmental Research Outlook—1976=80
Comparative Analysis of the 1976 ERDA Plan and Program
An Analysis of the ERDA Plan and Program
An Analysis identifying issues in the Fiscal Year 1976 ERDA Budget
Nutrition Research Alternatives
Organizing and Financing Basic Research to increase Food Production
Perspectives on Federal Retail Food Grading
Food information Systems
Emerging Food Marketing Technologies: A Preliminary Analysis
Assessing the Efficacy and Safety of Medical Technologies
Policy implications of the Computed Tomography (CT) Scanner
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Cancer Testing Technology and Saccharin
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