Section II
YEAR IN REVIEW

The assessments carried out by OTA cover a wide spectrum of major issues before Congress and the country and examine a broad range of policy options and their potential impacts. To provide examples of the breadth and depth of OTA's work, summaries of reports published by the Office in 1980 are presented in this section. Also included are summaries of Technical Memoranda, issued by OTA on specific subjects analyzed in recent OTA reports or on projects in progress at OTA. Technical Memoranda are neither reviewed nor approved by the Technology Assessment Board.

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


Energy Programs of the
Department of Energy
A Critique
FORECASTS OF
PHYSICIAN
SUPPLY AND
REQUIREMENTS
THE IMPLICATIONS OF
COST-EFFECTIVENESS
ANALYSIS OF
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AUGUST 1980
Impact of
Advanced Group
Rapid Transit Technology
IMPACT OF ADVANCED
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Part I
Advanced High-Speed
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Discrete Address
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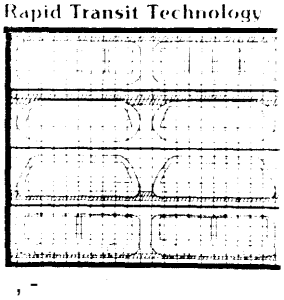
Section II
YEAR IN REVIEW

Group Rapid Transit Technology

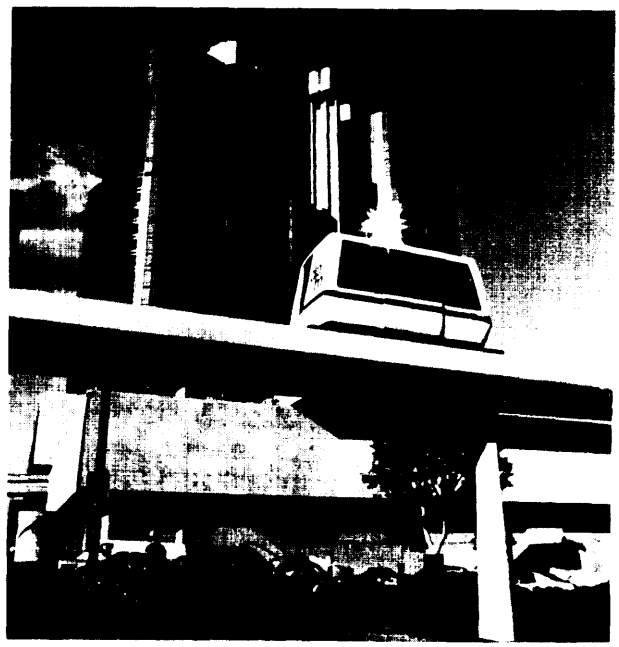
Driveless transit vehicles operating on ex - cl u sive g u i deways. known as automated guide- way transit (AGT). could with further development offer better service at less cost than current rail and trolley systems. This is among the major findings of an OTA study which evaluates the need for continued development of third-generation AGT technology. called advanced group rapid transit (AGRT), now funded by the Urban Mass Transportation Administration



First- and second-generation AGT systems are currently operating in airports, universities, hospital complexes, amusement parks, and shopping centers, Third-generation AGRT systems are being developed with vehicles that carry 12 passengers from origin to destination without transfers at speeds of up to 40 mph.

Users and nonusers alike are critical of the lack of amenities, infrequent service, unreliability, crowding, and inconvenience characteristic of transit services currently available in most cities, Technological innovations that may result from the AGRT program could help to address these problems by making transit more attractive through improved trip time, convenience, comfort, flexibility, and frequency of service. The public desires the further advances that AGT should be able to provide.

In the 1980's, cities will face increasing pressure to adopt more space- and fuel-efficient transit systems to meet the challenge of petroleum shortages, urban sprawl. and growing congestion, Barring major policy and lifestyle changes. traffic congestion in cities is expected to double by the year 2000. Automated systems are widely regarded as promising new options for addressing these in certain problem urban areas.



Downtown People Movers belng planned In several U S cities

It is too early in the development cycle, however. to predict which of several technologies currently being pursued will prove superior for most uses. The selection of a single-system con cept wou]d appear premature at this time.

Cost comparisons with existing urban rail technology look favorable, but will require validation in a real-world installation, Questions requiring further study include: reliability of new technology; community acceptance of elevated guideway designs: emergency evacuation from narrow elevated guideways; operating problems in ice and snow; and public attitudes toward sharing small, automated vehicles with strangers.

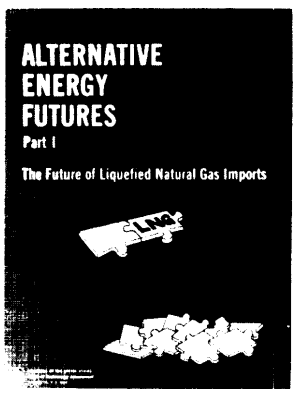
There is no guarantee that these systems will be marketed, even if the research and development (R&D) goals are met. Industry is finding it increasingly difficult to justify production of any transit technology, given a history of uncertain Federal support, unrealistic development timetables, complex institutional barriers, and the lack of established, stable markets. In West Germany

and Japan, a cooperative relationship between government and industry exists which has helped ensure an orderly program of long-range transit innovation and healthy transit equipment manufacturers. A closer examination of foreign government-industry relations is warranted.

While development of advanced AGT systems offers the prospect of improved transit services, urban transportation problems do not lend themselves to a single, all-encompassing solution. Other near- and long-term options which deserve consideration include expanded use of carpools and vanpools, transportation system management techniques, land use policies, and upgrading existing bus and rail technology.

Future of Liquefied Natural Gas Imports

Despite current administration policy of discouraging imports of liquefied natural gas (LNG) from overseas, such imports could be desirable as part of a strategy to meet future U.S. energy demand. Specific import proposals should be judged on their individual merits in the light of the following findings.



By 1990, LNG imports could double from the currently approved level of 0.8 trillion cubic feet per year (Tcf/yr) to between 1,3 and 1,8 Tcf/yr—less than one' -tenth of present domestic gas production. Imports will probably not exceed those levels because of political instability in [ran, the absence of any economic advantage in exporting gas for some other European and Japanese markets, and restrictions on trade with the Soviet Union. The likely sources of U.S. imports outside North America include Nigeria, Indonesia, Australia, Malaysia, Trinidad, Colombia. and Chile.

Since not all potential LNG exporters are major oil producers or members of OPEC, cutbacks in foreign oil supplies do not automatically mean cutbacks in gas supplies. Moreover, LNG exporters generally have a greater financial stake than oil producers do in uninterrupted shipments, because they cannot easily find alternative purchasers with appropriate terminals, and because project revenues must pay for the large amounts of debt exporters incur for liquefaction facilities. To the extent that Maritime Administration and Export-Import Bank programs promote involvement of U.S. owners and creditors in LNG ships and facilities, the exporter's stake in uninterrupted revenues diminishes. The United States could ease the adverse impacts of any interruption through the present priority curtailment system and by sales and exchanges among gas wholesalers.

Over the next decade, domestic gas production will probably satisfy essential requirements, but neither domestic sources nor pipeline imports from Canada and Mexico are likely to meet additional demand except at costs equal to or greater than that of LNG. Delivered gas from LNG is likely to cost about the same as competing fuels, less than synthetic fuels and distillates from foreign crude oil, and more than currently regulated domestic natural gas. Customers also assume part of the financial risks associated with an LNG project by paying gas prices regulated to allow investors to recover portions of their initial costs, regardless of the project's subsequent commercial success or failure,

Gas from LNG imports will generally be used at least partly, and possibly entirely, in manufacturing and electric generating applications. Under the Natural Gas Policy Act of 1978. the cost of added supplies will not necessarily be borne by the customers receiving them. Industrial customers will probably pay a price close to that of alternative fuels and of LNC~ itself, and electric utilities and purchasers of electricity will receive a subsidy in the form of "exempt" prices under the Act. Although households and commercial establishments would probably receive little additional gas, at least initially, the price levels in these sectors will rise or fall in response to the higher cost of LNG and to any savings that may result from the more economical use of transmission and distribution capacity that LNG makes possible.

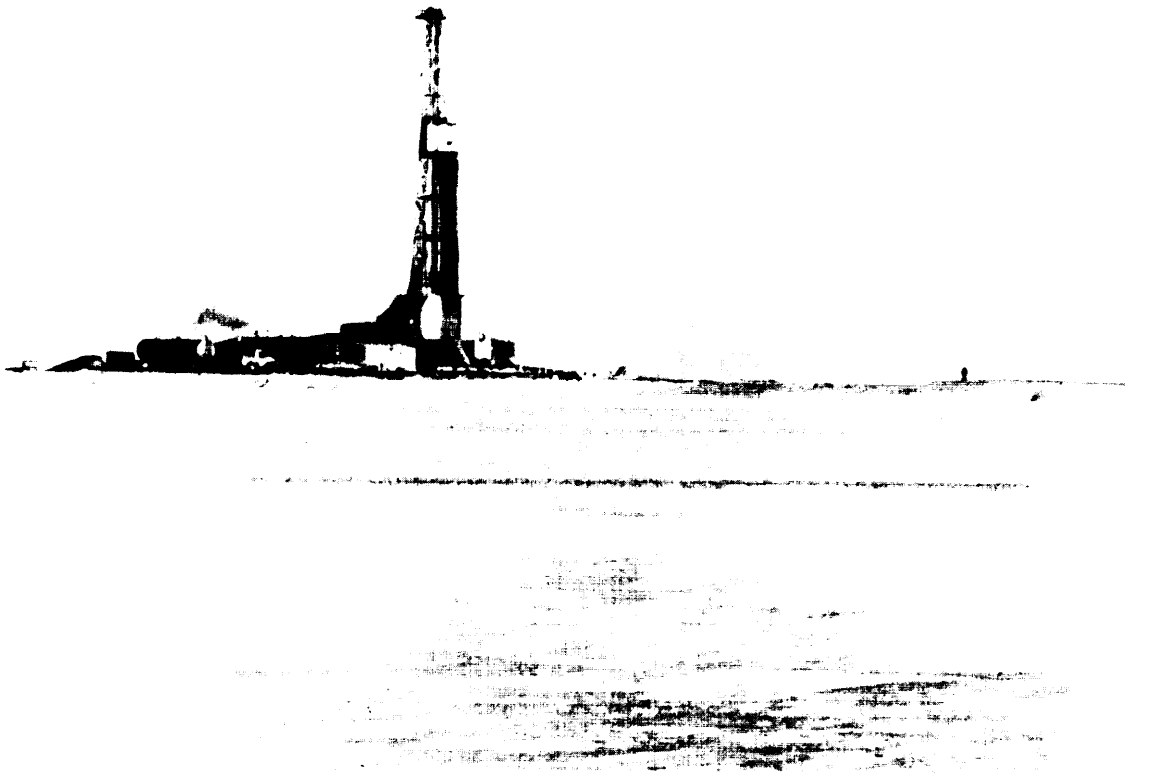


Photo credit Courtesy of American Gas Association

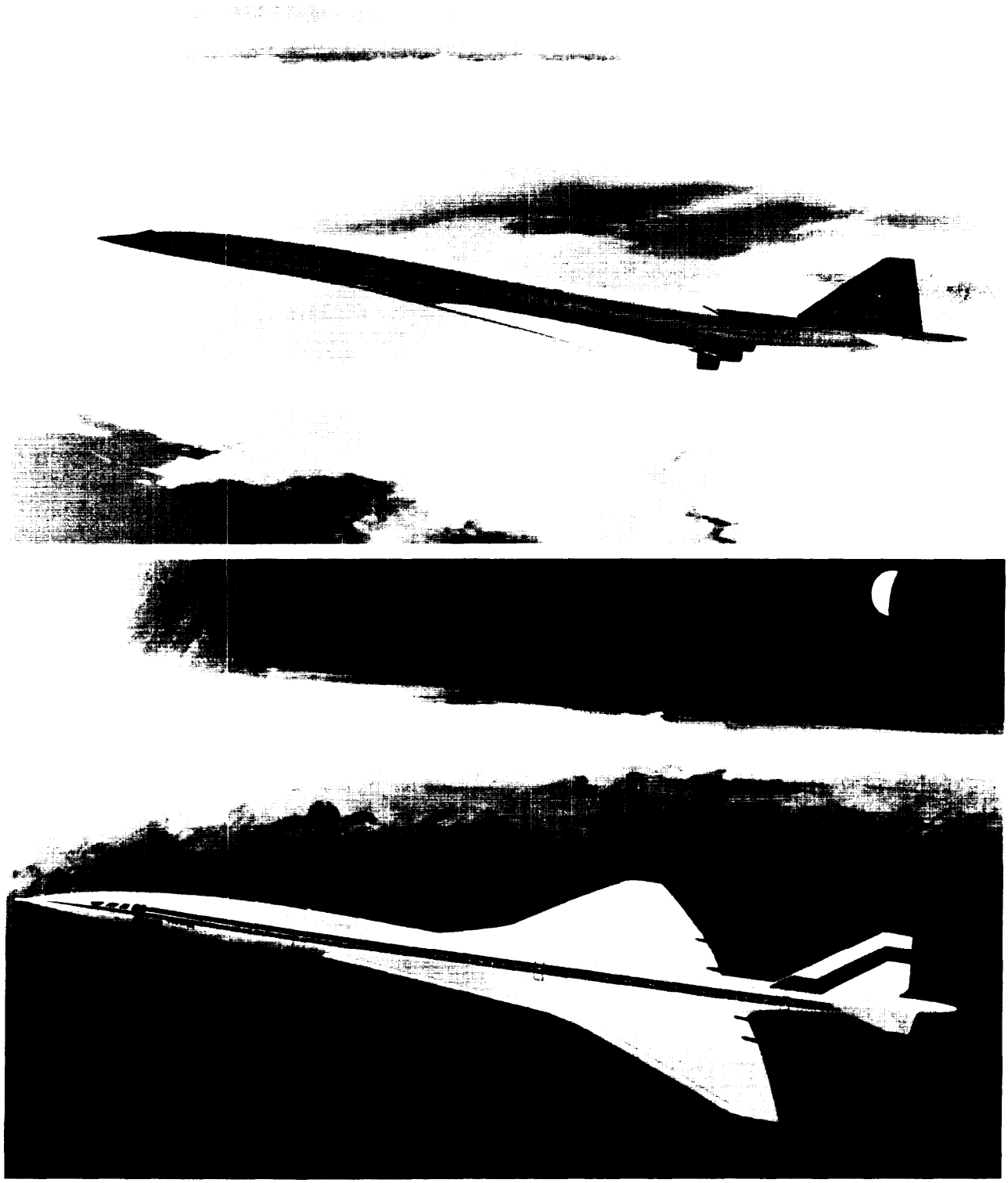
Alaska's North Slope contains new reserves of natural gas At Prudhoe Bay, this rig is typical of initial exploratory and productlon efforts

Advanced High-Speed Aircraft

Barring some major disruption in the growth of the world economy, and assuming reasonable success in coping with increasingly costly energy, the total market for air travel and commercial aircraft could continue to expand in the future. In the 1990's, the current fleet of jet transports may need replacement and the aerospace industry may want to consider technologically advanced transports of either subsonic or supersonic design. However, developing that new technology for either type of advanced aircraft will be extremely costly.

If an economically viable and environmentally acceptable advanced supersonic transport (AST) could be built in the 1990-2010 period, it could command some $50 billion of sales in 1979 dollars or about one-third of the total sales anticipated for the long-distance market through 2010. However, whether such an AST can or will be built depends on the future price and availability of fuel, the ability to meet increasing public sensitivity to noise around airports, and the ability to finance a highly advanced new commercial air transport. Such a development will almost certainly not occur in the near future without substantial Government participation.

An AST that could fly faster and haul more passengers than the Concorde would offer the



Artists' concepts of advanced supersonic transports

advantage of higher "productivity" compared to a new subsonic aircraft. ("Productivity" is a function of the speed of the aircraft, load factor, and hours used in revenue service per year,) However. higher productivity does not necessarily mean profitability, The AST now envisioned would be able to fly faster than 1,600 mph, allowing it to carry twice as many passengers a day on long-distance flights as a subsonic aircraft of equivalent size,

The major operating cost drawback to an AST is fuel consumption. An AST could burn two times more fuel per seat-mile than an advanced subsonic aircraft. This factor offsets the higher productivity of an AST and could mean higher fares–possibly up to one-third more than for the advanced subsonic plane. Passengers who highly value their time may tolerate this fare difference, However, greater fuel consumption raises energy concerns as well as objections to Government support for a project perceived by some as serving only selected classes.

In the United States a Supersonic Cruise Research (SCR) program, conducted by the National Aeronautics and Space Administration since the American SST was canceled in 1971, has made significant advances in the areas of aerodynamics. structures. propulsion, and noise reduction. While foreign manufacturers are becoming more competitive in the subsonic field, their willingness to embark on an AST is tempered by the same uncertainties as those facing the U.S jndustry,

Given the possibility of an expanded market. and the importance to the U.S. economy and international trade balance of capturing a share of that market, it would appear that. if Congress wishes to keep the supersonic option alive, the existing level of Federal support in the generic R&D is not adequate. While further generic R&D to validate the supersonic technologies should facilitate a decision on whether or not to initiate an AST development. it will not answer critical questions such as price and availability of future fuel supplies, sensitivity of the public to aircraft noise, and the ability to finance such a major capital commitment.

Forecasts of Physician Supply Requirements

The supply of physicians is growing at an unprecedented rate The United States is expected to have 600,000 physicians by 1990, as against 378,000 in 1975. As a result, Federal concern has shifted from the total number to the kinds needed and where they are needed.

FORECASTS OF PHYSICIAN SUPPLY AND REQUIREMENTS

Wide variations in forecasts of the number and kinds of physicians needed and where they should practice make it difficult to develop effective legislative policies.

Two main physician-forecasting efforts exist. The Bureau of Health Manpower (BHM) of the Department of Health and Human Services (DHHS) provides annual reports which include estimates of the present and future supply of and need for physicians and other health professionals. In addition, DHHS has chartered a Graduate Medical Education National Advisory Committee (GMENAC) to make recommendations on present and future requirements of physicians. their specialty and locational distribution, and methods for financing graduate medical education programs. These two groups use different forecasting methods. BHM relies on standard economic techniques, while GMENAC uses a medical opinion approach.

Forecasts of needed medical services reflect projected population growth and changes in its age, sex, and income distribution, as well as per capita use. Different assumptions about demographic changes, per capita use, and 'or physician productivity lead to different estimates of how many physicians are required. Adjusting only for demographic changes, BHM estimates that 415,000 physicians will be required in 1990. Decreases in productivity and/or increases in per

U.S.-Trained Physicians, Graduates (MD and DO); Projected 1978-79 Through 1989.90

Academic year	Total graduates	MD graduates	DO graduates
1978 -79 ....., ...	16,044	15,048	996
1979 -80., ...	16,375	15,346	1,029
1980-81	16,997	15,789	1,208
1981-82	17,662	16,354	1,308
1982 -83	18,333	16,956	1,377
1983-84	18,699	17,241	1,458
1984-85	18,818	17,322	1,496
1985-86	18,928	17,394	1,534
1986-87	19,036	17,464	1,572
1987-88	19,142	17,532	1,610
1988-89	19,201	17,554	1,647
1989-90	19,289	17,604	1,685

SOURCE *Interim Report of the Graduate Medical Education National Advisory Committee to* the Secretary, *Department of Health* Education, *and* Welfare, Washington DC Health Resources Administration, DHEW publication No (HRA) 19.633, p 147

capita use would increase the requirements. With the further assumption of increased per capita use, the BHM projection rises to 600,00().

Adequate forecasts of how many physicians are required in each specialty cannot be made until agreement is reached on what these specialties are. Experts disagree on what primary care is and what specialties it includes.

The Health Manpower Shortage Area (HMSA) designation is the vehicle for providing Federal support through the National Health Service Corps, determining eligibility for certain Federal grant programs, and obtaining Federal reimbursement for nurse practitioners' and physicians' assistants' services. In contrast to forecasting techniques for aggregate and specialty requirements, the methods used to identify HMSAs and the number of physicians they require contain assumptions on how physicians should be distributed and how much the Federal Government should be involved in such efforts.

Projections of physician supply and requirements depend on historical data to predict future events, but even recent historical data reflect past policies, not current ones. The limits of forecast must be fully understood if they are to serve as effective tools in the shaping of Federal medical policy. Those limits could be made clearer by explicitly describing the assumptions behind any forecasts, by making alternative forecasts based on different sets of assumptions, and by expanding the forecasting process to include policymakers as well as technicians in establishing the parameters.

Taggants in Explosives

A new technology to place "taggants" (miniature labeling devices) in commercial explosives and gunpowders could be a useful tool against many terrorist and other criminal bombers. However, there are questions of safety which would have to be resolved before a taggant program could be put into effect.

Two different kinds of taggants could be used for different purposes. Identification taggants are microscopic chips containing a code. designed so that the chips could be recovered from the debris of a bomb explosion. The code would provide law enforcement officials with a list of the last legal purchasers of the explosive material used in the bomb, and thus assist in finding the bomber. Detection taggants emit a vapor which would escape from a suitcase package containing a bomb, and which could be detected by a sensing machine placed at an airport, public building entrance, or other suitable site.

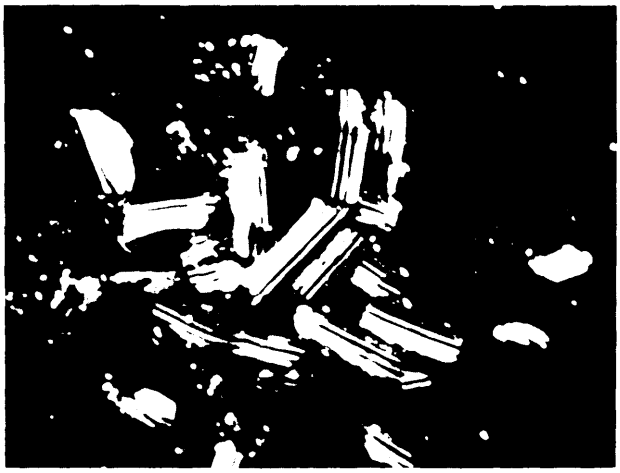


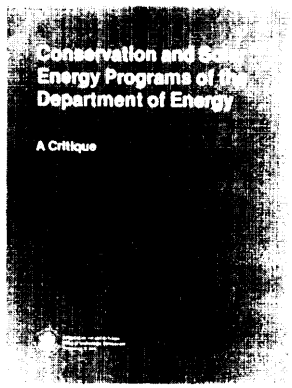
Photo credit U S Department of [he Treasury

Recovered taggants from OTA-sponsored test of low-power dynamite

There has been considerable controversy over the technical development, safety, cost and law enforcement utility of such taggants. OTA found that the taggants would probably work, although some of the claims made by those developing them are exaggerated. Questions about the safety of adding such taggants to explosive materials would have to be resolved before a program could go forward. The cost of a program varies depending on how extensive the program is; OTA assessed the costs of one possible program at about $25 million per year for either identification or detection taggants, and $45 million per year for both. A taggant program would be of significant value to law enforcement; however, it would not help much against bombings which caused little damage and the most sophisticated terrorists and professional criminals could probably find ways to evade the effects of a taggant program.

Conservation and Solar Energy Programs: A Critique

A lack of direction and leadership by the Department of Energy (DOE) management is hampering the progress of the DOE Conservation and Solar Energy (C&SE) Programs. Many C&SE programs suffer from inadequate planning, frequent and debilitating management changes and reorganizations, and other internal difficulties, although some are doing well and are staffed by many dedicated and competent people. This is the main finding of an OTA review of C&SE programs conducted with the aid of two panels of experts. The membership of the panels was designed to provide a balance of skills and viewpoints.



The national goals for solar energy outlined in the Administration's 1979 Domestic Policy Review (DPR), and endorsed in administration messages to Congress, have not been universally accepted within DOE, and C&SE programs have not been designed to meet them. No effort similar to the DPR has been made to establish conservation goals, which presently are defined implicitly. Conservation investments currently represent the most economic opportunity for dealing with the energy crisis.

Critical C&SE management problems include lack of both procedures and funding for program evaluation, extraordinary delays in processing contracts and filling staff vacancies, changing

Comparison of the DOE Fiscal Year 1981 Budget Request With DPR Solar Energy Goals for 2000 or Conservation Savings Expected in 1990

	Fiscal year 1981 budget request	Quad goal (2000)	Ratio	Ultimate potential (Quads)	Economics	Stage of development	Institutional and market barriers
Solar							
Active heating and coolIng ., .	$57.7	2	$ 30	B	B	A	c
Passive heating and cooling . . .	33.9	1	30	B	B	A	c
Industrial and agricultural.	49.0	2.6	20	B	B	B	A
Biomass	66.7	3.6'	20	A	B	A	A
Photovoltaics	175.6	1.0	180	A	7	c	B
Wind	80.0	1.7	50	A	A	B	c
Solar thermal (electricity) ...	117.5	0.4	290	A	?	c	c
Ocean ., . . .	39.2	0.1	390	A	7	c	c
Conservation		(1990)					
Residential/commercial	97.6[b]	9.5	10	c	A	A	c
Industrial.	58.9	25,9	2	c	A	B	A
Transportation ., ...	113.0	10.4	11	c	A	A	B

A = favorable outlook B = intermediate C = limlted potential or dIfficult problems

[a] Excl udes the 1 8 Quads already beIng used

[b] Does not include $202 5 million for th, Schools and Hospitals Grant Program or $19895 for the Weatherization Assistance Program The energy contribution of these programs presumably is includedin the 95 Quads but the highbudget levels result from the actual Implementation being done by DOE u nlike the other programs which are limited to R&D or demonstration projects

SOURCE Off Ice of Technology Assessment

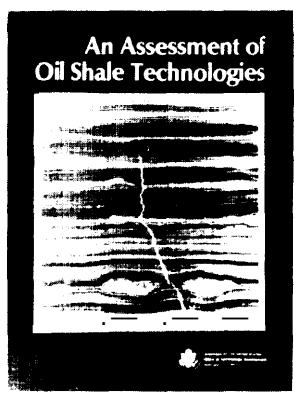
management and frequent reorganization, insufficient coordination between solar and conservation incentives, and difficulties in defining and implementing "commercialization" efforts.

C&SE also exhibits a number of institutional problems in such areas as coordination of energy policy and action within the Federal Government, assistance to the States, commercialization of solar conservation technologies, and questions of competing or conflicting roles among various units of the organization—headquarters offices, regional offices, the Regional Solar Energy centers, the Solar Energy Research Institute. and the National Laboratories.

From the view of specific program elements, OTA concludes: wind energy is a nearer term technology than DOE appears to believe; photovoltaics may not meet stated goals unless DOE acts more aggressively; biomass management should be tightened and the staff augmented; transportation should reevaluate its efforts in both advanced engines and electric vehicles; and solar active, passive, and conservation technologies must be integrated to achieve optimum energy use in new and existing residential and commercial buildings.

Oil Shale Technologies

An oil shale industry could benefit the Nation's economy and security and help ease the liquid fuel supply problem. However, the rapid deployment of a large industry (500,000 barrels per day (bbl/d) or more by 1990 would entail economic, environmental, and social risks, Financial incentives could spur production. Production tax credits, purchase agreements, and price supports would be the most effective. Federal debt guarantees or debt insurance would help smaller firms,



The high-grade oil shale reserves of the Western United States could, with existing technologies, produce at least 400 billion bbl of oil. This equals 57 years' worth of current U.S. petroleum consumption, and is over 2.5 times the estimated reserves of Saudi Arabia.

Recent increases in the price of world oil may make shale oil price-competitive with foreign crude, depending on: the reliability of current cost estimates for plants, the continuation of oil price increases, the effects of Federal and State regulatory action, and the required rate of return on capital.

About 80 percent of the richest shale is on Federal land. Four tracts (in Colorado and Utah) have been leased under the Federal Prototype Leasing Program. None of the extensive private holdings are now being developed commercially. Production beyond about 400,000 bbl/d is possible only if additional Federal land, with high-grade shale, is made available.

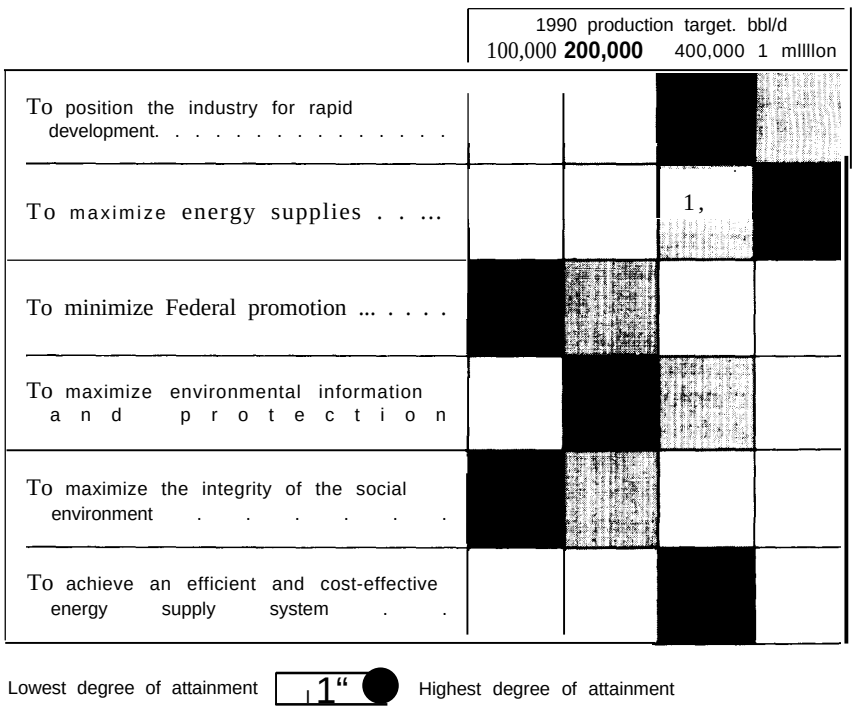
Of the three major processes for converting raw shale to oil, one is now being commercially developed, Crude shale oil, upgraded and refined, is a somewhat better source of jet and diesel fuel than of gasoline.

Oil shale development could have important environmental impacts. Many impacts are regulated by existing State and Federal environmental laws, although some wastes pose unique challenges and a number of serious uncertainties exist. The Clean Air Act, the only existing environmental law that might limit the industry, could hold production in Colorado to about 400,000 bbl/d, although additional production could occur in Utah.

A 500,000 -bbl/d industry would increase approximately 1.5 percent the surface water demands projected for the Upper Colorado River Basin in 2000. Surplus surface water could support this industry until at least 2000: some time after 2000, scarcities may limit all types of regional growth. Any large-scale industry will require additional storage and transportation of water within the region.

Development will change the communities in the sparsely populated rural region. Adverse effects could occur, especially if oil shale development accompanies other industrial expansion. Without strong preventive measures, social and personal distress (boomtowns) will happen. Between 1985-90, communities in Colorado could probably accommodate the growth of 200,000 -bbl/d industry. Anything larger would require extensive impact mitigation programs.

The Relative Degree to Which the Production Targets Would Attain the Objectives for Development



SOURCE Off Ice of Technology Assessment

Federal Prototype Oil Shale Leasing Program

This report is a companion to volume I of the OTA oil shale assessment. It describes the history and status of the Prototype Oil Shale Leasing Program.

About 80 percent of the U.S. high-grade oil shale is on Federal land in Colorado, Utah, and Wyoming. Under the Prototype Oil Shale Leasing Program, about 20,000 acres—less than 1 percent of the Federal oil shale land—have been leased to private developers. Four tracts, two each in Colorado and Utah, are under lease, but so far development has taken place only in Colorado.

The Department of the Interior (DOI) in May 1980 announced it would offer four more Prototype tracts. A permanent leasing program also is being planned with a target date for its establishment of 1982-83. DOI intends to foster oil shale development by asking Congress to amend the Mineral Leasing Act of 1920 and the Federal Land Policy and Management Act of 1976.

The stated goals of the Prototype Program are to provide a new energy source by stimulating development of a commercial industry, to ensure environmental integrity while developing safeguards and land restoration techniques, to permit an equitable return on development of the public resource, and to establish sound management practices.

Unforeseen problems have resulted in only partial realization of these goals. They have included economic, environmental, legal, and technological uncertainties. The difficulties led to suspension of the Prototype leases in 1976-77. Development has resumed, but there have been major changes in the technologies being used. The development may not attain the level of production they expected when the Program started, and it will take about twice as long as originally estimated to achieve commercial production.

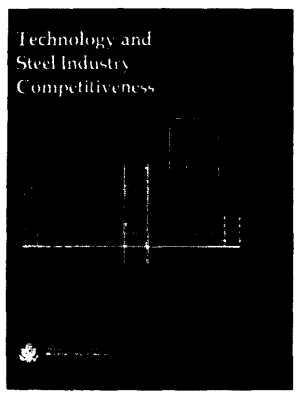
Several uncertainties remain. Unpatented mining claims from before 1920 cloud the picture. The U.S. Supreme Court recently found in favor of certain unpatented claimants in Colorado; the possible consequences of an extension of this doctrine to other Federal lands are unclear.

The Prototype Programs grew out of an unsuccessful DOI leasing effort during the 1960's. The effort failed to attract any private participation. The Prototype Program obtained responses to four of the six tracts offered. Increased interest in oil shale development should provide better prospects for success of additional leasing.

The outlook for shale development under the Prototype Program will depend on how the remaining uncertainties are resolved and on the success of overall Government efforts to solve the problems. Some of the Programs' goals are being met outside DOI'S framework. DOE and the Environmental Protection Agency are both involved in oil shale development, which complicates evaluation of the Prototype Program.

Technology and Steel Industry Competitiveness

Steel will probably remain the world's most important engineering material and the steel industry is vital to the Nation's security and economic prosperity. However, unless action is taken, continued low profitability and some Federal policies, such as long depreciation times for new facilities, will cause the domestic steel industry to contract substantially. Many jobs could be lost, and the Nation might become vulnerable to scarce and high-priced imports, which by 1990 could account for 40 percent of the domestic market, compared with recent levels of about 15 percent.



The U.S. steel industry can be revitalized through increased investment in R&D and the adoption of new technology. For that to happen, however, OTA estimates that steelmaker must

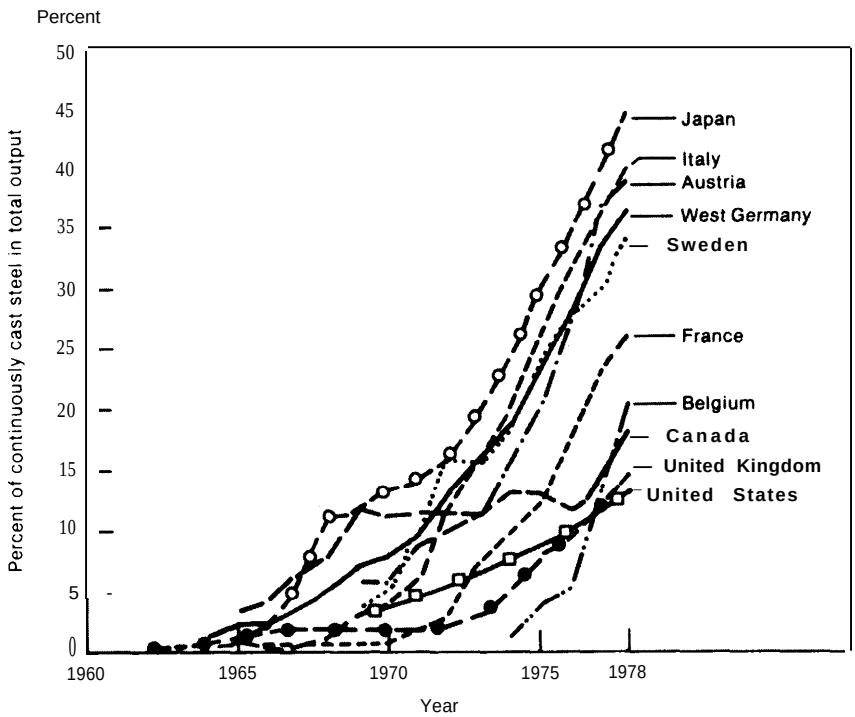
increase their capital spending on production facilities by at least 50 percent during the next decade, to approximately $3 billion per year as compared to industry estimates of $4.9 billion (1978 dollars), in order to modernize existing mills, expand capacity modestly, and bring profitability up to the level of most other domestic manufacturing industries. At the $3 billion level, supportive Federal policies would be required to generate at least $600 million of this additional capital per year.

Small nonintegrated steel plants that rely on ferrous scrap rather than iron ore to produce the simpler steel products could nearly double their market share (now at about 13 percent) in the coming decade, provided that adequate electricity and scrap are available in specific market areas. Considerable market potential could be exploited to increase exports by the highly competitive alloy /specialty steelmaker in the next 10 years, if the new Multilateral Trade Agreement is enforced vigorously.

Following restructuring, modernization, and expansion in the 1980's, the industry could adopt major new steelmaking innovations if the Federal Government supports more basic research in steelmaking, provides incentives for more industry R&D, and assists in pilot and demonstration projects. Such major process innovations could then bring the domestic industry a competitive advantage, rather than mere parity with foreign industries. This is the type of long-range strategic technology planning that the industry has not done well.

A well-designed and vigorously implemented government policy has nurtured the Japanese steel industry's expansion and adoption of new technology. The U.S. steel industry, on the other hand, has been hurt by a long series of Federal policies that have frequently been uncoordinated, contradictory, and inattentive to critical issues. A Federal policy that coordinates the industry's needs, the Nation's interests, and specific technical concerns is an important option.

The Diffusion of Continuous Casting, 10 Countries, 1962-78

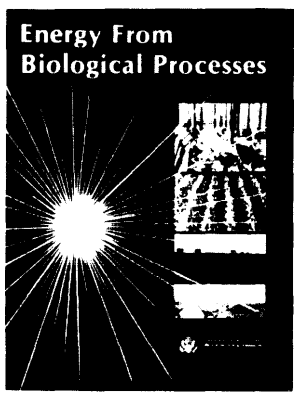


SOURCE Organizatlon for Economic Cooperation and Development

Neither technology nor capital, alone, will solve the steel industry's problems. New technologies could be adopted by the domestic industry if problems of insufficient capital and uncertain import policies are resolved. One such technology already used by major foreign competitors is the continuous casting of molten steel which reduces energy consumption, increases productivity, and expands steelmaking capacity. Another, the coal-based direct reduction of iron ore to produce a low-cost substitute for ferrous scrap and blast furnace iron, may be developed commercially within the next 5 to 15 years. Potential advantages include reduced capital costs, reduced pollution, and increased use of coal.

Energy From Biological Processes

By 2000, energy from biomass (wood and other plant material) could supply as much as 12 to 17 quadrillion Btu (Quads) of U.S. energy per year, depending on cropland availability and resource management. Of this, up to 10 Quads could come from wood and 1 to 6 Quads from plant herbage, including crop residues.



The most efficient processes for replacing oil with biomass energy are direct combustion and gasification for space-heating and process steam and heat. Combustion technology is now commercially available, and suitable gasification units are likely to be developed soon. With favorable conditions these technologies could supply the United States with as much as 10 Quads /yr by 2000 beyond 4 to 6 Quads/yr that probably will be used anyway. Ten Quads / yr are enough to displace the energy equivalent of 4,5 million bbl/d of premium fuels (oil and natural gas).

Biomass also can be converted into the liquid fuels ethanol (grain alcohol) and methanol (wood alcohol). Only ethanol is now produced commercially from biomass. Growing and converting crops to ethanol requires roughly the same amount of energy that the ethanol contains. However, each gallon of ethanol can save nearly a gallon of premium fuels if: 1) ethanol distilleries are not fueled with premium fuels and 2) the ethanol is added to gasoline as an octane booster rather than used as a stand-alone fuel. Methanol seems the least expensive near-term option for producing liquid fuels from wood and plant herbage. Although no biomass-to-methanol facilities are in operation in the United States, the needed technologies for alternative feedstocks either exist or can be developed soon.

The behavior of wood harvesters will critically affect both the amount of biomass energy the United States can produce on a renewable basis and the economic, environmental, and other impacts of doing so. For example, careless forest management could damage the forests and sharply reduce the amount of wood available for energy. Furthermore, the production of fuel from cropland (except from residues) can drive food prices up. Significant price increases could occur at ethanol production levels as low as 2 billion gal/yr, but this estimate is uncertain. Also an expansion of the acreage in intensive crop production will add to the already damaging level of soil erosion from U.S. croplands.

The development of bioenergy poses a number of policy issues that Congress may want to address. If Congress chooses to promote the rapid expansion of energy from biomass, vigorous policy support including economic incentives—will be needed. In addition, severe environmental and other impacts may be unavoidable unless the expansion of bioenergy production is accompanied by strong incentives for careful resource base and the adequacy of existing policies. Bioenergy is now accorded a low priority by DOE and the U.S. Department of Agriculture. A decision to promote it aggressively will require a significant shift in the priorities of these departments as well as extensive coordination among Federal agencies and among National, State, and local governments.

Photo credit USDA Soil Comservaton Service

Commercial forests: an excellent source of energy from biomass

Implications of Cost-Effectiveness Analysis of Medical Technology

The need to control the rapidly rising costs of health care while improving its quality and accessibility has heightened interest in using cost-effectiveness analysis [CEA) and cost-benefit analysis (CBA) as a means of making the medical care system more efficient. CEA and CBA are methods for comparing alternative ways to allocate resources.

THE IMPLICATIONS OF COST-EFFECTIVENESS ANALYSIS OF MEDICAL TECHNOLOGY

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The process of analyzing costs and benefits can improve decision-making in the field of health care by structuring the problem, allowing an open consideration of all potential effects of a decision, and forcing the explicit treatment of key assumptions. However, CEA/CBA have too many limitations to serve as primary determinants of decisions in health care, Information produced by CEA CBA should be only one of several components of a decision process.

In CBA, both cost and benefits are expressed in dollars, resulting in a net plus or minus dollar figure or in a numerical ratio. With CEA, however, costs are expressed in dollars but effectiveness is measured in nonmonetary units such as lives saved or life years gained. Thus, both CEA and CBA are mainly designed to integrate the economic and the health aspects of decisions. However, CEA and CBA are only tools. Their use will not substitute for cost-containment programs. CEA and CBA could perhaps influence the distribution of expenditures, especially where

a program has a constrained budget, but in neither case would they limit the absolute amount of expenditures.

Health decisionmakers have only rarely used CEA and CBA in setting policy for medical technologies. Reimbursement programs, such as medicare, do not explicitly take costs into account in deciding whether or not to cover specific technologies. Professional Standards Review Organizations, which review the appropriateness of services provided under programs such as medicare, have not used information from CEAs or CBAs, though they potentially could incorporate that type of information in their review criteria. Health planning agencies have a mandate to consider both the costs and the benefits of a technology or service in making certain types of decisions. Yet those agencies have very infrequently used formal CEA or CBA. CEA and CBA have significant potential for use in health maintenance organizations because their budgets are fixed during any one time period.

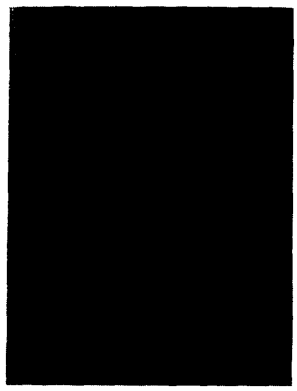
The use of CEA and CBA is likely to increase substantially. Users, however, should be cautious in interpreting results and avoid relying too heavily on numerical result, which tend to obscure ethical considerations and uncertainties in data.

Many of the limitations of CEA and CBA can be ameliorated by following 10 principles of CEA/CBA: Define the problem, state objectives of analysis, identify alternatives, analyze all relevant benefits, analyze all relevant costs, differentiate the perspective of the analysis, perform discounting of future costs and benefits, analyze uncertainties, address ethical issues, and interpret the results. In addition, to lessen the problems associated with a numerical 'bottom line," analysts should refrain from combining into an aggregate number the often complex sets of calculations, especially when nonquantifiable elements are important to the decision.

Technical Memoranda

Ocean Margin Drilling

Prepared in response to a request from the Chairman and the Ranking Minority Member of the HUD~Independent Agencies Subcommittee of the Senate Appropriations Committee. the Technical Memorandum evaluates the National Science Foundations' (NSF) plans for the development of an ocean margin drilling (OMD) program. The $700 million, 10-year program is both a continuation of deep ocean drilling under NSF auspices, and a new thrust to explore the geology of continental margins (the borders between the continents and the deep ocean) and ocean crust where deep drilling is required to penetrate unknown regions. Some of the margin regions could contain substantial oil and gas resources, according to most experts, but very little evidence of that has been collected.



Some major findings in OTA's analysis are:

1. The NSF plan for ocean margin drilling developed during 1980 contains many worthwhile scientific objectives. The plan is supported by NSF and the Joint Oceanographic Institutions (JOI) who assisted in its development, and a scientific consensus on the present program is developing. A major concern of many scientists has been the lack of specific plans for geophysical surveys that must precede the drilling: however, a planning effort did begin in late 1980.

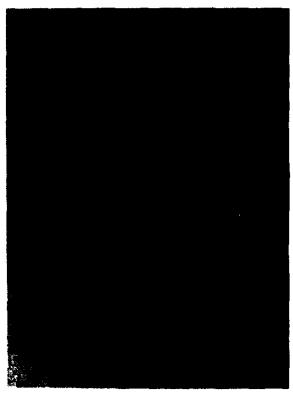
2. The probability of achieving the scientific objectives through the holes drilled and information collected will, in large part, be determined by the capabilities of the technology which is not yet developed. Some of the deep holes may not be completed as planned because of the technological uncertainty associated with deep ocean drilling in **as** yet unknown environments.
3, The potential for oil and gas resources in the continental margins is a subject of much speculation, but competent geologists claim that these areas hold significant promise at least to the extent that they should be carefully explored. The ocean margin drilling would provide better scientific information on which to base further speculation on oil and gas resources, but it is not a logical oil and gas exploration program.
4. A more sharply focused science program with fewer options than the present plan is advocated by several of the scientists OTA contacted. They have suggested alternatives which might result in lower initial costs and a postponement of the decision to fund major technology developments.

It is planned that NSF's ocean margin drilling program will be jointly funded by the Federal Government and the petroleum industry. The program calls for 4 years of preparation and 6 years of drilling. In carrying out the program, NSF plans to convert the Government-owned Glomar Explorer to a deep drilling ship, and to develop a riser system (a large pipe which channels drilling fluid down to the ocean floor and back up to the ship). The system will be used for controlled drilling at approximately 13,000-ft water depths and up to 20,000 ft below the ocean floor.

The scientific objectives stated in the plan include the investigation of: 1) passive and active continental margins; 2) the Earth's crust beneath the ocean; and 3) deep sea sediments that could reveal historical environmental information about the Earth, particularly the opening of the Atlantic Ocean and the Gulf of Mexico.

Recent Developments in Ocean Thermal Energy Conversion

Ocean thermal energy conversion (OTEC) is a proposed system for extracting energy from the solar heat stored in the surface water of tropical seas. The method uses the temperature difference between surface and cold, deep ocean water to operate huge, ocean-based electricity generating plants.



Prepared in response to a request from the Chairman of the Subcommittee on Energy Development of the House Committee on Science and Technology, this Technical Memorandum updates a 1978 report on OTEC. Since the original report, several significant technical accomplishments have occurred in the OTEC program. The Technical Memorandum discusses these achievements as well as technical uncertainties that remain.

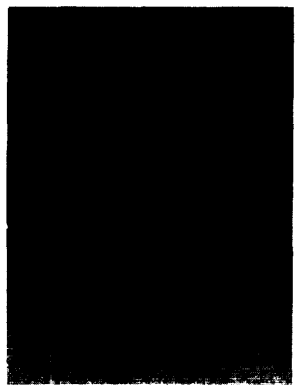
DOE is currently sponsoring a major effort to develop OTEC as a future energy resource. Funding for the program has grown from approximately $15 million to $40 million annually in the past 2 years. Recent DOE and industry reports were reviewed by OTA experts in order to provide an accurate update on the status of OTEC technology.

Some of the major findings in OTA's analysis are:

1. Outstanding technical achievements over the past 2 years have been: a) the operation of Mini-OTEC during the summer of 1979 in Hawaii, demonstrating that a small (10 kilowatt), barge-mounted system can generate net electrical output, and b) improvements in heat exchanger performance through laboratory and sea tests. The heat exchanger is the most important component for the OTEC plant due to its size, weight, and cost.
2. Over the past 2 years, the technology base for OTEC has improved, reducing the risk involved in building a midsize (10 to 40 megawatt) pilot plant. (The major technical risks include cold water pipes, heat exchangers, and electrical transmission cables.) However, development has not reached the point where the costs of large, commercial plants can be estimated.
3 Little has been done to assess the potential ocean thermal energy resources available for major OTEC commercialization. According to OTA, current DOE studies do not adequately consider future resource availability y.
4 OTA's analysis also questions whether DOE's project team, even though it is comprised of many competent technical groups, could adequately respond to a major acceleration requiring pilot plant construction before fiscal year 1982.

World Petroleum Availability: 1980-2000

Prepared partly in response to a request from the Senate Committee on Foreign Relations, this



Technical Memorandum critically assesses the prospects for world oil production for the rest of the century. It examines, on a country-by-country basis, current production capabilities, the likelihood of new discoveries, and the political, economic. and other factors that will affect actual production levels.

Even under favorable circumstances, there will most likely be little or no increase in world oil production * from conventional sources over the rest of the century, the Memorandum concludes. Not only will the United States be unable to expect increased imports over current levels, but the United States will probably face much stiffer competition for world supplies at even lower levels of imports. That is the likely future that current U.S. plans and efforts to reduce our heavy dependence on oil should prepare us to meet.

Forecasts of petroleum availability, in general, have fallen since the recent events in Iran. Never-

""0]1 production" includesliquids associated with the production of natural gas

theless, the range of OTA estimates falls much below those of other organizations. For example, Exxon has recently forecasted world petroleum availability from conventional sources in 2000 at 60 million bbl/d • which is at the upper end of the OTA range. Compared with earlier estimates, both the OTA study and the Exxon forecast are pessimistic on production possibilities for the United States. Exxon forecasts U.S. production at 6 million bbl/d in 2000, while OTA estimates a range of 4 million to 7 million bbl/d. All of these estimates are considerably below the 1979 production level of 10.2 million bbl/d.

While it may be physically possible to increase world oil production by perhaps as much as 33 percent by the 1990's, no substantial increases are likely to occur because the countries that must contribute to an increase of this size (such as the Arab OPEC countries or Mexico) have little financial or political incentive to do so and because any attempt to increase production would run into a number of practical as well as political problems.

Oil production in the non-Communist world could begin to decline by the early 1980's. Assuming political stability in the major exporters, and thus no interruptions in their production, OTA estimates that non-Communist world oil supply is likely to range between 45 million to 60 million bbl/d in 1985 and 40 million to 60 million bbl/d in 2000, compared to 52 million bbl/d in 1979. As a group, OTA projects, non-Communist industrialized countries will experience no significant increase in production, and may, in fact, experience a decrease of as much as 50 percent by 2000.

•Millions of (42 gal) barrels per day

U.S. production may decline from its current level of 10.2 million bbl/d to a level of 7.2 million to 8.5 million bbl/d in 1985 and to a level of 4 million to 7 million bbl/d in 2000. The high estimate of 7 million bbl/d for 2000 assumes both the annual addition of 1 billion bbl to proven reserves and the extensive use of enhanced recovery techniques.

The Communist countries may cease being a net exporter of oil to the free world by the early 1980's as a result of declines in Soviet production. The entry of the Eastern European countries (now more than 80 percent dependent on the Soviet Union for their imported oil) and conceivably the Soviet Union itself as buyers on the world oil market will intensify the pressure on world oil prices and have potentially serious implications for U.S. foreign policy.

OTA believes that OPEC production during the next 20 years will range around its current level of 31 million bbl/d. Except in Iran, only Saudi Arabia, Kuwait, and United Arab Emirates have the reserves, and Iraq the estimated potential, to increase production rates. Thus, substantial dependence on Arab OPEC is likely to continue.

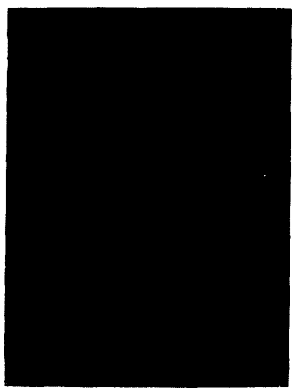
Although production in the non-OPEC less-developed countries (LDCs) will exceed current levels (mainly as a result of increases in Mexican production), much if not all of that increase will be absorbed by increases in LDC demand.

Although some large discoveries are possible outside the Middle East, there appears little possibility—outside of Mexico—that giant oil fields, such as those found in the Middle East, will be discovered elsewhere. Major additions to the

world's known oil supplies will likely come from additional recovery in known fields rather than from new field discoveries. These additions are not likely to alter the dominance of the Middle East, since over half of the new additions are expected to be in the Middle East. Moreover, experts generally agree that the world distribution of ultimately recoverable oil will not differ significantly from the known distribution today.

Compensation for Vaccine= Related Injuries

The issue of compensation for vaccine-related injuries came to congressional and public attention dramatically in 1976 in connection with the Federal Government's sponsorship of a mass immunization program against swine flu. The memorandum is OTA's response to a request from the House Interstate and Foreign Commerce Committee. It expands on a chapter in the 1979 OTA report, Federal Vaccine and Im-



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The 1979 OTA report pointed to a major decline in the number of active vaccine manufacturers and of licensed vaccine products, noting that some researchers-blamed Federal policies for at least part of the decline. That report suggested that liability problems may be eroding the commitments of vaccine manufacturers, Congress, and State health departments to public immunization programs.

All vaccines, even when properly manufactured and administered, may pose risks to users. Under the existing legal liability system, persons injured from vaccination must establish fault in court in order to receive compensation. The injured person generally sues one or more of the participants in the vaccination process (e. g., a party that manufactures, distributes, pays for, encourages the use of, or administers the vaccine). In four major cases in the past 11 years, including the recent swine flu decision, plaintiffs have won large judgments against vaccine manufacturers for injuries caused by nondefective and properly administered vaccines. This situation has affected manufacturers' willingness to produce and supply vaccines.

The Memorandum does not analyze the arguments for and against a Federal compensation program. Rather, it starts with the assumption that establishing such a program is desirable. The primary case for establishing a vaccine-injury compensation program is that society is obligated to minimize the consequences of injury when a vaccinee is harmed instead of protected in public immunization programs.

Six nations and the State of California have vaccine-injury compensation programs. These programs contain the elements that Congress may wish to consider in formulating a Federal compensation program: 1) the vaccines to be covered, 2) the injuries to be included, 3) the kinds of compensation, 4) the administrative mechanisms, and 5) the relationships with existing compensation programs (lawsuits, social insurance).

The memorandum sets out the Federal Government's current approach to compensation, the major arguments for and against a compensation program, the costs of such programs, the types and estimated numbers of vaccine-related injuries, current approaches to vaccine-injury compensation, and compensation in light of future developments in vaccines.