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SUBJECTS AND POLICY AREAS FOR THE CONSIDERATION OF THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

96th Congress

PREPARED FOR THE

COMMITTEE ON SCIENCE AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

NINETY-SIXTH CONGRESS

FIRST SESSION

BY THE

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CONGRESSIONAL RESEARCH SERVICE
LIBRARY OF CONGRESS

Serial K

JUNE 1979

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LETTER OF TRANSMITTAL

U.S. House of Representatives,
Committee on Science and Technology,
Washington, D.C. 20515.

To the Members of the Committee on Science and Technology:

The Legislative Reorganization Act of 1970 charged the Congressional Research Service of the Library of Congress with providing Congressional Committees, at the beginning of each Congress, a "list of subjects and policy areas the committee might profitably analyze in depth." I am transmitting herewith the report "Subjects and Policy Areas for the Consideration of the House Committee on Science and Technology, 96th Congress."

This report is the fifth of its kind prepared for the committee, and is in part based on extensive interviews conducted by the CRS with the committee staff and Members' staffs.

I believe the committee will find this report a useful resource as it proceeds with its legislative and oversight activities during the 96th Congress. Moreover, the report identifies a number of emerging issues which are likely to command attention as the committee emphasizes its foresight and futures research responsibilities.

Sincerely,

Don Fuqua, *Chairman.*

LETTER OF SUBMITTAL

THE LIBRARY OF CONGRESS,
CONGRESSIONAL RESEARCH SERVICE,
Washington, D.C., March 8, 1979.

Hon. DON FUQUA,
Chairman, Committee on Science and Technology, U.S. House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: As you know, the Legislative Reorganization Act of 1970 requires the Congressional Research Service to make available to each committee, at the beginning of each Congress, "a list of subjects and policy areas the committee might profitably analyze in depth."

The report on the Act declared that the list is intended to assist committees and the Service in planning their respective research schedules for the forthcoming Congress, and it instructed the Service "to work closely with committee staffs in the preparation of that list."

As a result of discussions between Mr. William Boesman and other CRS staff and Mr. Harold Gould and other members of the committee staff, a list of subjects suggested for analysis is transmitted herewith, which we hope will be of practical value to the committee and reflect its interests during the 96th Congress.

It is understood, of course, that the inclusion of any particular subject on your list does not represent a judgment on the part of CRS that your committee has either prior or exclusive jurisdiction over that subject.

As instructed by the Joint Committee on the Library, CRS regards this list as the property of your committee; unless wider distribution is authorized, it is available only to members of the committee, upon their request.

The Legislative Reorganization Act of 1970 also requires the Service to make available to each committee:

> a list of programs and activities being carried out under existing law scheduled to terminate during the current Congress which are within the jurisdiction of the committee.

The House Committee on Rules' report on the 1970 Act declared that the purpose of this CRS function "is to inform committees of the Congress, well in advance of the dates, of the upcoming expiration of legislation within their respective jurisdictions." Pursuant to this legal requirement we enclose a list of terminating programs which may be of interest to your committee.

It is my sincere hope that these lists are useful to the committee. So far as our resources permit, we will be happy to respond to any requests for initial or further analysis of subjects on the list, or of other subjects as they arise, or for any other suitable assistance.

Sincerely,

GILBERT GUDE, *Director.*

Enclosure.

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Washington, D.C. 20540

SUBJECTS AND POLICY AREAS

FOR THE CONSIDERATION OF THE

HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

96th Congress

Submitted in accordance with Section 321(a)

Legislative Reorganization Act of 1970

January 17, 1979

Acknowledgements

This compilation of Subjects and Policy Areas for the House Committee on Science and Technology for the 96th Congress was coordinated by Mr. William Boesman of the Science Policy Research Division (SPRD). Divisional review of the final product was provided by Messrs. Charles S. Sheldon, II, James M. McCullough, and Walter A. Hahn of SPRD and Frank P. Huddle of the Senior Specialists Division. A number of persons contributed their efforts to suggesting and developing appropriate Subjects and Policy Areas for the Committee. These persons are listed below and their efforts are gratefully acknowledged. All are members of the Science Policy Research Division unless otherwise noted.

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ENR -- Environment and Natural Resources Policy Division, CRS

SS -- Senior Specialists Division, CRS

NLSBPH -- National Library Service for the Blind and Physically Handicapped, Library of Congress

TABLE OF CONTENTS

PART I. BRIEF STATEMENTS OF THE SUBJECTS AND POLICY AREAS

Section		Page
1.	SPECIFIC SCIENCE AND TECHNOLOGY POLICY ISSUES (Not Elsewhere Categorized)	3
2.	AERONAUTICAL R&D	4
3.	BIOMEDICAL RESEARCH; THE HANDICAPPED AREA	5
4.	DISASTER/FIRE R&D	6
5.	ENVIRONMENTAL R&D	7
6.	ENERGY: ADVANCED AND OTHER ENERGY R&D ISSUES	8
7.	ENERGY: FOSSIL ENERGY R&D	11
8.	ENERGY: NUCLEAR ENERGY R&D	13
9.	FEDERAL R&D SUPPORT	14
10.	INTERNATIONAL SCIENCE AND TECHNOLOGY	15
11.	MATERIALS R&D POLICY	18
12.	SCIENTIFIC AND TECHNOLOGICAL INFORMATION	20
13.	SOCIAL SCIENCE RESEARCH	21
14.	SPACE R&D	24
15.	SURFACE TRANSPORTATION	26
16.	TECHNOLOGICAL INNOVATION AND INDUSTRIAL R&D	26
17.	TECHNOLOGY TRANSFER	27
18.	UNIVERSITY RESEARCH, EDUCATION, AND MANPOWER	29
19.	WEATHER, CLIMATE, AND EARTH SCIENCES	30

PART II. DETAILED STATEMENTS OF THE SUBJECTS AND POLICY AREAS

Section		Page
1.	SPECIFIC SCIENCE AND TECHNOLOGY POLICY ISSUES (Not Elsewhere Categorized)	32
1.	Implementation of the National Science and Technology Policy, Organization and Priorities Act of 1976	33
2.	The Interaction of U.S. Science and Energy Policies	34
3.	Implementation of the Federal Grant and Cooperative Agreement Act	35
4.	Multiple Year Funding of R&D	37
5.	The Allowance of Independent Research and Development Costs for Civilian Purposes	38
6.	United States Conversion to the Metric System	40
2.	AERONAUTICAL R&D	41
1.	Supersonic Commercial Transportation	42
2.	Aeronautical Research and Development	43
3.	Collision Avoidance Technologies	44
4.	Microwave Landing System (MLS)	45
5.	Civilian Use of the Navstar Global Positioning System	46
6.	Aircraft Noise Abatement	47
3.	BIOMEDICAL RESEARCH; THE HANDICAPPED AREA	48
1.	Administration of Biomedical Research: Cost Effectiveness of Research	49
2.	Biomedical Technologies and Health Care Costs	50
3.	Aging Research	51
4.	Continuation of Oversight Research in Genetic Engineering	52
5.	Pharmaceutical Innovation	53
6.	Use of Existing Technologies for the Handicapped	54
7.	Effects of the Medical Device Amendments of 1976 on Developing Technologies Related to the Handicapped	55
8.	Federal Priorities in R&D Related to Handicapped Individuals	56
4.	DISASTER/FIRE R&D	57
1.	Earthquake Prediction Technology	58
2.	Fire Prevention and Control	59
3.	Monitoring the Federal Emergency Management Agency, Particularly as It Relates to the Fire Problem	60
Also see item:		
	19.5 Continental Scientific Drilling Program	198

Section		Page
5.	ENVIRONMENTAL R&D	61
	1. Environmental Regulations, R&D, and Technological Innovation	62
	2. Hazardous Wastes	63
	3. Underground Stockpiling or Waste Storage	64
	4. Environmental R&D	65
	5. Bottle Bill	66
	6. Resource Conservation	67
	7. Resource Recovery	68
	8. Sludge	69
	Also see item:	
	8.5 Nuclear Waste Management	103
6.	ENERGY: ADVANCED AND OTHER ENERGY R&D ISSUES	70
	1. Department of Energy Programs in Alternative Energy Technologies and Energy Conservation	71
	2. Energy Technology Commercialization	73
	3. Federal Energy Conservation Programs	75
	4. Solar Commercialization: The Need for Comprehensive Federal Policy	77
	5. Oversight of the Department of Energy Geothermal Energy Program	79
	6. Development and Use of Geothermal and Ocean Energy Resources	80
	7. Stimulating Industry Participation in Fuel Cell R&D	82
	8. The Role of National Laboratories in Energy R&D	83
	9. Timing the Deployment of Alternate Energy Technologies	84
	10. Optimizing Within and Across Energy-Saving Technologies	86
	11. Recent Research on Energy Conservation: Substitutability and/or Complementarity Among Energy, Capital, Labor, and Materials	87
	Also see item:	
	14.10 Space Program Contributions to Solving the Energy Crisis	168

Section		Page
7.	ENERGY: FOSSIL ENERGY R&D	88
	1. Coal Mining R&D -- For Production and Health and Safety	89
	2. Efficient Underground Mining Systems	90
	3. Coal Liquefaction Program Goals	91
	4. Coal Liquefaction -- Government/Industry Involvement	92
	5. Coal Gasification Program Goals	93
	6. Coal Gasification -- Government/Industry Involvement	94
	7. Coal R&D Goals for Electric Power Production	95
	8. Assessment of Alternatives for the Demonstration of Oil Shale Technology	96
	Also see item:	
	19.5 Continental Scientific Drilling Program	198
8.	ENERGY: NUCLEAR ENERGY R&D	97
	1. LMFBR Program Review with Emphasis on Program Direction without CRBR	98
	2. Breeder Reactor Alternatives to the LMFBR	99
	3. Thorium versus Plutonium Fuel Cycles	100
	4. Non-Proliferation Alternative Systems Assessment Program and International Nuclear Fuel Cycle Evaluation	101
	5. Nuclear Waste Management	103
	6. Reprocessing Concepts and their Relationship to the Proliferation Issue	104
	7. Research and Development for Nuclear Safeguards	105
	8. Goals of the Fusion Program	107
	9. International Cooperation in Nuclear Energy Research and Development	109
9.	FEDERAL R&D SUPPORT	110
	1. Federal Support of Basic Research	111
	2. ASRA -- Integrated Basic Research	112
	3. NSF Support of "Big" and "Little" Science	113
	4. The Future of the National Bureau of Standards	114
	Also see items:	
	13.1 National Science Foundation Social and Psychological Sciences Research Support	145
	14.3 Federal Government Support of a Major Communications Satellite R&D Effort	160
	14.8 Federal Government Support of High-Risk Space Technology	166
	14.11 Support for NASA's Space Science Projects	169
	16.3 NSF Support for Basic Research in Industry	177
	17.2 Utilization of Federal Laboratories by the Private Sector and State and Local Government	182

Section		Page
10.	INTERNATIONAL SCIENCE AND TECHNOLOGY	115
	1. Technology and International Trade Competitiveness	116
	2. Preparation for the United Nations Conference on Science and Technology for Development	117
	3. Creation of the Foundation for International Technological Cooperation	118
	4. The Emergence of U.S. -- People's Republic of China Relationships in S and T	120
	5. Implementation of Presidential and Department of State Responsibilities for Science and Technology in Foreign Policy as Mandated in P. L. 95-426	121
	6. Multinational Corporations, Technology Transfer to the LDCs, and Appropriate Technology	122
	7. Issues Relating to the Competitiveness of Japanese Technology and Production Methods	123
	8. Fuller Utilization of World Ocean Resources: Legal, Political, and Institutional Aspects	124
	9. U.S./Latin-American Relationships in Science and Technology	125
	10. Alternative Energy Technologies and the Developing Countries	126

Also see items:

8.4	Non-Proliferation Alternative Systems Assessment Program and International Nuclear Fuel Cycle Evaluation	101
8.6	Reprocessing Concepts and their Relationship to the Proliferation Issue	104
8.7	Research and Development for Nuclear Safeguards	105
8.9	International Cooperation in Nuclear Energy Research and Development	109
12.4	Foreign Exchange of Scientific and Technical Information	140
14.6	Legal Aspects of Routine Utilization of Space	164
14.7	International Cooperation in Space	165

Section		Page
11.	MATERIALS R&D POLICY	127
	1. Research and Development Aspects of National Materials Policy	128
	2. Research and Development Aspects of Materials Conservation	129
	3. National Needs in Semiconductor Microstructure Fabrication	130
	4. Scientific Aspects of the Carbon-Hydrogen Bond	131
	5. Synchroton Program	132
	Also see items:	
	5.3 Underground Stockpiling or Waste Storage	64
	5.6 Resource Conservation	67
	5.7 Resource Recovery	68
	7.2 Efficient Underground Mining Systems	90
	10.8 Fuller Utilization of the World Ocean Resources: Legal, Political, and Institutional Aspects	124
	19.5 Continental Scientific Drilling Program	198
12.	SCIENTIFIC AND TECHNOLOGICAL INFORMATION	134
	1. Federal Scientific and Technical Information Management and Congressional Oversight	135
	2. High Level Interagency Policy Mechanism for STI	137
	3. Public and Private Sector Coordination of Scientific and Technical Information	139
	4. Foreign Exchange of Scientific and Technical Information	140
	5. Utilization of Information Systems	141
	6. Encouraging Public Utilization of Scientific and Technology Information	142
13.	SOCIAL SCIENCE RESEARCH	144
	1. National Science Foundation Social and Psychological Sciences Research Support	145
	2. Regulatory Decisionmaking	146
	3. Effects of Requirements for Social Impact Statements	147
	4. Social Indicators Research	148
	5. Criminal Sentencing Reform	149
	6. Social Science and Government: The Need for Better Methods to Determine Research Priorities	150
	7. Social Science and Government: The Need for Better Ways to Apply Knowledge Generated in Federally Funded Social Research and Development Programs	151
	8. Social Science and Government: The Need to Improve Management of the System of Funding and Dissemination	152
	9. Threats to Behavioral and Social Research Posed by Secondary Efforts of Federal Regulations Designed to Mitigate the Risks to Human Subjects of Biomedical and Behavioral Research	153
	10. Program Evaluation Research	155
	11. Domestic Violence -- The Victims	156

Section		Page
14.	SPACE R&D	157
	1. U.S. Civilian Space Policy	158
	2. Managing the Operational Space Shuttle Program	159
	3. Federal Government Support of a Major Communications Satellite R&D Effort	160
	4. Establishment of an Operational Landsat Program	161
	5. Establishment of a Space Industrialization Trust Fund	163
	6. Legal Aspects of Routine Utilization of Space	164
	7. International Cooperation in Space	165
	8. Federal Government Support of High-Risk Space Technology	166
	9. Shuttle Utilization and User Needs	167
	10. Space Program Contributions to Solving the Energy Crisis	168
	11. Support for NASA's Space Science Projects	169
	12. Utilizing Space Technology	170
15.	SURFACE TRANSPORTATION R&D	171
	1. Surface Transportation R&D	172
16.	TECHNOLOGICAL INNOVATION AND INDUSTRIAL R&D	173
	1. Industrial R&D/Innovation and Economic Growth and Productivity	174
	2. Industrial Support of Basic Research	175
	3. NSF Support for Basic Research in Industry	177
	4. Commercialization of Federally-Funded Research and Development	178
	5. Government Patent Policy	179
Also see items:		
3.5	Pharmaceutical Innovation	53
5.1	Environmental Regulations, R&D, Technological Innovation	62
6.2	Energy Technology Commercialization	73
6.4	Solar Commercialization: The Need for Comprehensive Federal Policy	77
6.7	Stimulating Industry Participation in Fuel Cell R&D	82
10.1	Technology and International Trade Competitiveness	116
10.7	Issues Relating to the Competitiveness of Japanese Technology and Production Methods	123
11.3	National Needs in Semiconductor Microstructure Fabrication	130
13.2	Regulatory Decisionmaking	146

Section		Page
17.	TECHNOLOGY TRANSFER	180
	1. Organization for Intergovernmental Transfer of Science and Technology -- The Future of Intergovernmental Science, Engineering, and Technology Advisory Panel	181
	2. Utilization of Federal Laboratories by the Private Sector and State and Local Government	182
	3. Examination of NSF State Science, Engineering, and Technology Program	183
	4. Oversight of NSF's Appropriate Technology Program	184
	5. Multinational Corporations and the Transfer of Technology	185
	Also see items:	
	3.6 Use of Existing Technologies for the Handicapped	54
	10.6 Multinational Corporations, Technology Transfer to the LDCs, and Appropriate Technology	122
	12.0 SCIENTIFIC AND TECHNOLOGICAL INFORMATION	134
	14.12 Utilizing Space Technology	170
18.	UNIVERSITY RESEARCH, EDUCATION, AND MANPOWER	186
	1. The Future of University Research	187
	2. Implementing Technology in the Educational Environment	188
	3. Science Resources and Education	189
	4. Job Opportunities for Trained Scientists	190
19.	WEATHER, CLIMATE, AND EARTH SCIENCES	192
	1. Weather Services and Research	193
	2. National Climate Program	194
	3. Effects of Increased Carbon Dioxide in the Atmosphere	195
	4. Weather Modification Policy	197
	5. Continental Scientific Drilling Program	198
	Also see items:	
	4.1 Earthquake Prediction Technology	58
	7.1 Coal Mining R&D -- For Production and Health and Safety	89
	7.2 Efficient Underground Mining Systems	90

PART I

BRIEF STATEMENTS OF THE SUBJECTS AND POLICY AREAS

The major categories of Subjects and Policy Areas discussed in this report are the following:

1. Specific Science and Technology Policy Issues (Not Elsewhere Categorized)
2. Aeronautical R&D
3. Biomedical Research; The Handicapped Area
4. Disaster/Fire R&D
5. Environmental R&D
6. Energy: Advanced and Other Energy R&D Issues
7. Energy: Fossil Energy R&D
8. Energy: Nuclear Energy R&D
9. Federal R&D Support
10. International Science and Technology
11. Materials R&D Policy
12. Scientific and Technological Information
13. Social Science Research
14. Space R&D
15. Surface Transportation R&D
16. Technological Innovation and Industrial R&D
17. Technology Transfer
18. University Research, Education, and Manpower
19. Weather, Climate, and Earth Sciences

Brief statements of these subjects and policy areas are provided in the following pages. Detailed one-page statements are provided in Part II of this report.

1. SPECIFIC SCIENCE AND TECHNOLOGY POLICY AREAS (Not Elsewhere Categorized)

1.1 Implementation of the National Science and Technology Policy, Organization and Priorities Act of 1976

To what extent has the intent of Congress been carried out in the implementation of the National Science and Technology Policy, Organization and Priorities Act of 1976?

1.2 The Interaction of U.S. Science and Energy Policies

U.S. science and energy policies are closely linked. Yet there has been little visible attention to their interrelation. Science policy has to do with the state of U.S. science and technology, with much of it addressed to research and development. Energy policy has to do with the demand for and the supply and conservation of fuels and energy. It too has a large research and development component. Congressional oversight of science and technology policy and energy policies can deal with the interactions between these policy areas.

1.3 Implementation of the Federal Grant and Cooperative Agreement Act

Lack of uniformity in Federal agencies' choice of instruments -- grant or contract -- to use in Federal procurement activities, including research and development, has been an unresolved issue of long standing. Legislation enacted in 1978 which goes into effect in 1979 will mandate agencies to use the same type of legal instrument for the same type of relationship and purpose. The effects of these requirements on the extramural funding of Federal research and development will warrant congressional attention.

1.4 Multiple Year Funding of R&D

Most federally-funded R&D programs are authorized on an annual basis. However, a longer-term approach may be more appropriate for many R&D programs.

1.5 The Allowance of Independent Research and Development Costs for Civilian Purposes

Should the concept of independent research and development funding, which has proven beneficial to defense and aerospace industries, be extended to civilian industry and to universities?

1.6 United States Conversion to the Metric System

Public reaction to the U.S. conversion to the metric system of weights and measures has generally been negative; a General Accounting Office report found that the U.S. international trade position will not suffer significantly whether the nation converts or not; the European Economic Community has declared the Systeme Internationale as the official system of weights and measures. Will these developments affect the national policy for conversion?

2. AERONAUTICAL R&D

2.1 Supersonic Commercial Transportation

Will the United States be capable of providing an economical, quiet and competitive vehicle for the supersonic transportation market now being explored by the Concorde?

2.2 Aeronautical Research and Development

Is the pace of military and civil aeronautical research and development adequate to preserve the dominant marketing and defense position of the United States in the world arena?

2.3 Collision Avoidance Technologies

The recent midair collision between an airliner and a general aviation aircraft in the San Diego, California area has rekindled debate on collision avoidance systems. The debate centers on the issue of whether or not a reliable technology exists to prevent midair collisions.

2.4 Microwave Landing System (MLS)

The microwave landing system is an all-weather precision approach and landing guidance system. The manner in which this system is implemented may greatly affect the aviation community.

2.5 Civilian Use of the Navstar Global Positioning System

There have been numerous proposals to establish a consolidated approach to radionavigation planning. Such an approach would be based on shared military/civilian facilities wherever possible to eliminate costly duplicative systems. One of the most significant developments in the area of radionavigation is the Navstar Global Positioning System (GPS) based on a system of navigation satellites designed for military use in the 1990's. Although many civilian uses for Navstar have been suggested, no policy exists to ensure civilian access to the system.

2.6 Aircraft Noise Abatement

FAA regulations which went into effect on January 1, 1977, require all commercial jet aircraft to be in compliance with the "FAR 36" noise standards by January 1, 1985. The method for implementing this regulation is still in question. The technology exists for retrofitting or replacing the aircraft not in compliance, but financing this large-scale program remains problematical.

3. BIOMEDICAL RESEARCH: THE HANDICAPPED AREA

3.1 Administration of Biomedical Research: Cost Effectiveness of Research

How cost effective is the administration of Federal biomedical research? Can it be measured adequately?

3.2 Biomedical Technologies and Health Care Costs

There has been some recent speculation that the emerging technologies and methodologies applied to health care, such as computerized axial tomography (CAT scan) and open heart surgery may be contributing substantially to rapidly increasing health care costs. The crux of this issue is whether it can be determined compellingly that, indeed, there is a direct correlation between emerging, expensive health care technologies and health care costs, and if so, what can be done to reverse the trend.

3.3 Aging Research

In order to meet the needs of a growing elderly segment of the population, funding for research on aging has grown considerably in recent years. The relatively new National Institute on Aging (NIA) has been charged with lead responsibility for this broad new field. Is the coverage and emphasis of this program adequate and are research results being utilized?

3.4 Continuation of Oversight of Research in Genetic Engineering

Regulation of research in genetic engineering, including recombinant DNA technology and other areas of applied genetics, will continue to be a legislative science policy issue in the 96th Congress. Recombinant DNA research is a technique of molecular biology used in the biochemical study of genetic mechanisms in plants and animals. The science policy question to be addressed by the Congress is whether this research and technology, as well as other aspects of applied genetics,should be regulated by the Federal Government. Congress has already addressed the recombinant DNA issue in the form of hearings, reports, and legislation (none of which was enacted during the 95th Congress.) The legal, ethical, and social implications of other aspects of applied genetics will also no doubt be major issues for the Congress in the future.

3.5 Pharmaceutical Innovation

There has been no major revision of the Food, Drug, and Cosmetic Act since 1962. The FDA approval process for new drugs is considered by many to be too stringent, ponderous, and expensive to promote the development of chemical entities with which to treat new and existing medical pathologies. Prior to 1962 drugs were approved on the basis of safety alone. The 1962 amendments to the FD&C Act further required a drug to be proven effective for its indicated use. Many feel that the additional requirement of demonstrating effectiveness has placed a burden on the drug industry which has resulted in a "drug-lag" in the research and development of new pharmaceutical products in the U.S.

3.6 Use of Existing Technologies for the Handicapped

The adaption or application of existing technologies to the cure or containment of handicapping conditions and for the betterment of handicapped individuals may require Federal policy directions.

3.7 Effects of the Medical Device Amendments of 1976 on Developing Technologies Related to the Handicapped

There is some apprehension that recently enacted medical device regulations will have an adverse effect on the emerging biomedical technologies.

3.8 Federal Priorities in R&D Related to Handicapped Individuals

Federal priorities in R&D related to the handicapped may need to be reviewed and focused.

4. DISASTER/FIRE R&D

4.1 Earthquake Prediction Technology

The extrapolation of work on technology to predict earthquakes in the Western States, to the Eastern and Central U.S., will require innovations.

4.2 Fire Prevention and Control

Ever increasing applications of polymeric materials have created demands for developing a standardized screening test to evaluate the relative toxicities of these materials.

4.3 Monitoring the Federal Emergency Management Agency, Particularly as It Relates to the Fire Problem

Monitoring implementation of Reorganization Plan No. 3 of 1978, with particular reference to how the transfer of the National Fire Prevention and Control Administration (NFPCA) to the Federal Emergency Management Agency (FEMA), under the Reorganization Plan will affect the focus on the fire problem.

Also see item:
19.5 Continental Scientific Drilling Program

5. ENVIRONMENTAL R&D

5.1 Environmental Regulations, R&D, and Technological Innovation

Federal pollution regulations and R&D attempt to stimulate the development and application of less-polluting technology. There is some question whether the programs actually stimulate or discourage innovation and how the impacts on technology compare to the benefits of these programs.

5.2 Hazardous Wastes

Pollution episodes in the last two years have identified a number of problem areas. Hearings and legislation may be appropriate to address issues of siting of waste management and disposal facilities, compensation of victims, and assessing the cost of cleaning up abandoned polluting waste disposal sites.

5.3 Underground Stockpiling or Waste Storage

The use of wells, salt domes, and underground caverns for waste disposal or stockpiling of strategic materials.

5.4 Environmental R&D

At issue is whether EPA's research and development is adequate to provide information on which to base regulations and to assess their benefits.

5.5 Bottle Bill

In early 1979 the interagency Cabinet-level Resource Conservation Committee will be making a recommendation to the President and Congress on the desirability of nationwide mandatory deposits on beverage containers. Do the benefits of a bottle bill outweigh the disadvantages?

5.6 Resource Conservation

"Causes of high waste and low recycling have deep historical roots in the economy and public institutions. Major progress in waste reduction and resource recovery will require a broadly based, long-term strategy that considers ways of improving the market incentive system as well as more direct efforts at technological and institutional development." (EPA Fourth Report to Congress: Resource Recovery and Waste Reduction, p. xi).

5.7 Resource Recovery

Should EPA's resource (materials and energy) recovery activities be transferred to another agency? Both in absolute and percentage terms, is the United States recovering any more values from waste than it did, say, a decade ago?

5.8 Sludge

What are the long-term strategies for dealing with the disposal of sewage sludge?

Also see item:

8.5 Nuclear Waste Management

6. ENERGY: ADVANCED AND OTHER ENERGY R&D ISSUES

6.1 Department of Energy Programs in Alternative Energy Technologies and Energy Conservation

The Department of Energy appears to be limiting, or reducing, its programs to develop new energy technologies in favor of promoting the early commercialization of existing technologies which may not be able to be made commercially competitive. In addition, the Department of Energy has yet to mount a coherent and effective energy conservation program, even though existing knowledge and technologies could produce considerable energy savings, particularly in city operations. It may be appropriate to review DOE's priorities and objectives in each of these areas.

6.2 Energy Technology Commercialization

The Department of Energy is making a concerted effort to effect the early commercializations of the technologies which it has been developing for (1) the production of energy, (2) the production of energy fuels, and (3) the conservation of energy. This raises questions about whether an emphasis on commercialization will weaken DOE's effort to discover totally new technologies and to make major improvements to known technologies, and about whether the possible economic problems and impacts of large scale commercialization are able to be handled.

6.3 Federal Energy Conservation Programs

Efforts to promote energy conservation involve the operations of cities, of industry, and a great many areas of personal decision and lifestyle. As a result, the various Federal offices which need to address facets of the energy conservation program are spread through a number of agencies. Their efforts could well be better coordinated under effective leadership if greater energy efficiency is to be achieved.

6.4 Solar Commercialization: The Need for Comprehensive Federal Policy

There is some evidence that solar technologies will have difficulty penetrating commercial energy markets even after their technical and economic feasibility has been demonstrated. Federal action may be required to help move technologies into commercial use after the R&D phase is completed. It is yet unclear, however, exactly when, how, and to what extent the Federal Government needs to become involved in the solar commercialization process.

6.5 Oversight of the Department of Energy Geothermal Energy Program

After a period of very little growth, the geothermal industry is showing signs of increased activity. With institutional constraints to geothermal commercialization being studied, and in some cases removed, the technical aspects of the resource (an area of DOE responsibility) will become more important to future geothermal development success. Committee oversight may be warranted in this area.

6.6 Development and Use of Geothermal and Ocean Energy Resources

In view of the present energy situation, it is prudent to explore all possible avenues to clean and adequate energy supplies. Renewable energy resources, like geothermal and ocean energy resources, are of particular interest and importance, as part of a future mix of energy sources, in fulfilling the Nation's energy needs.

6.7 Stimulating Industry Participation in Fuel Cell R&D

One industrial company has dominated the field of first generation (phosphoric acid) fuel cell technology. Many people believe that development of second generation (molten carbonate) technology and fuel cell commercialization could be hastened if there were greater industrial participation and competition in fuel cell R&D.

6.8 The Role of National Laboratories in Energy R&D

The Department of Energy, as successor to the R&D facilities and capabilities of the Atomic Energy Commission and the Energy Research and Development Administration, possesses an R&D resource of international stature. The issue is whether DOE is managing this resource effectively enough to satisfy both national energy and national energy R&D goals.

6.9 Timing the Deployment of Alternate Energy Technologies

Developments of recent years suggest that historical patterns of transition from older to newer technologies may be changing. For example, it has been noted that the transitions from wood-burning to coal-burning, and from coal-burning to oil-burning required about 60 years. Some persons now think that looming constraints, such as exhaustion of some resources, or the possible discovery of deleterious effects of some technologies arising from greater attention to environmental research, may require more rapid transitions, and fewer gradual transitions, than in the past. Consequently, some persons believe that shorter transition periods would have to be more explicitly and more centrally planned.

6.10 Optimizing Within and Across Energy-Saving Technologies (Are We Planning for Use of Energy and Other Technologies Suboptimally?)

This issue concerns the difference between designing more efficient physical objects and devices to do substantially the same job that previous objects and devices did -- and the creation of new conceptual complexes of objects and devices which could accomplish similar social and personal purposes, but eliminate or radically alter some of the intermediate means to these purposes.

6.11 Recent Research on Energy Conservation: Substitutability and/or Complementarity Among Energy, Capital, Labor, and Materials

There is much disagreement among members of Congress on the role of energy in our economy. This disagreement may reflect in part conflicting viewpoints of the "experts" who advise members of Congress: specifically, those whose professional background leans more toward engineering and physical science or more toward economics. Research to resolve such conflict is proceeding and recent results, or results soon to come, may gain the attention of the 96th Congress.

Also see item:

14.10 Space Program Contributions to Solving the Energy Crisis

7. ENERGY: FOSSIL ENERGY R&D

7.1 Coal Mining R&D--For Production and Health and Safety

Coal-mining productivity has dropped continuously in the past 10 years, partly due to the health and safety requirements of the law enacted in 1969.

7.2 Efficient Underground Mining Systems

The development of safer and more efficient underground mining systems is necessary to increase both the safety of the miners and their productivity.

7.3 Coal Liquefaction Program Goals

Over the next few years, DOE's coal liquefaction program is expected to require the expenditure of vastly increased sums of public monies. A careful evaluation of ongoing programs, future plans, expected results, and objectives might be conducted during the 96th Congress. Specification and clarification of program goals for the near, middle, and long-term time frames seem beneficial.

7.4 Coal Liquefaction--Government/Industry Involvement

Continued advancement of coal liquefaction technology will require increased financial support from public and private sectors. In order to maintain an aggressive liquefaction research, development, and demonstration program, government/industry relationships must be maximized and problems impeding progress need to be resolved or reduced. New arrangements for government/industry involvement in DOE's liquefaction efforts may be necessary.

7.5 Coal Gasification Program Goals

DOE's program seeks to advance low-, medium-, and high-Btu coal gasification processes that can be used in a variety of markets. Specification of program goals, priorities, management of current efforts, and planning for the future might be evaluated as part of the authorization process providing funds for these diverse efforts.

7.6 Coal Gasification--Government/Industry Involvement

Continued advancement of coal gasification technology will require increased financial support from the public and private sectors. In order to maintain an aggressive gasification research, development, and demonstration program, government/industry relationships can be maximized and problems impeding progress need to be resolved or reduced. New arrangements for government/industry involvement in DOE's gasification program may be necessary.

7.7 Coal R&D Goals for Electric Power Production

Coal and coal-derived gases are projected to be the predominant fossil energy resource for electric utilities in the future. DOE is conducting a variety of programs with the objective of advancing technology to allow increased utilization of coal to offset the use of oil and gas in the utility market. A review of these diverse efforts with attention focused on coordination, program goals, and the utilities view of DOE programs, might be conducted.

7.8 Assessment of Alternatives for the Demonstration of Oil Shale Technology

Oil shale remains a relatively undeveloped energy resource. Although the Department of Energy is funding an intensive research, development, and demonstration program (estimated budget authority for FY 79 is about $29 million), shale oil is unlikely to contribute substantially to U.S. energy supply before 1990. Two specific questions bear consideration: 1) What alternative means are available to expedite the demonstration of oil shale technology? 2) Is the DOE program focused on the demonstration of the most promising oil shale processing technologies?

Also see item:

19.5 Continental Scientific Drilling Program

8. ENERGY: NUCLEAR ENERGY R&D

8.1 LMFBR Program Review with Emphasis on Program Direction without CRBR

The future of the liquid metal fast breeder reactor (LMFBR) demonstration project at Clinch River, Tennessee was not decided during the 95th Congress although proposals were heard to either suspend or cancel the Clinch River project (CRBR). In the event that the Clinch River project is canceled, the question arises as to what will happen to the rest of the LMFBR program.

8.2 Breeder Reactor Alternatives to the LMFBR

In the 1960's, the Atomic Energy Commission chose the liquid metal fast breeder reactor (LMBBR) as the breeder reactor concept on which to focus research and development attention. In making that decision, the AEC passed over other breeder reactor concepts which are now being revived as possible alternatives to the LMFBR.

8.3 Thorium versus Plutonium Fuel Cycles

Breeder reactors can operate on either the plutonium or thorium fuel cycles. Since better performance is obtained using plutonium, the thorium option has not received much attention in the past. President Carter's concern over the possible proliferation of nuclear weapons because of the increased availability of plutonium in an era of breeder reactors, however, has revived interest in the thorium option.

8.4 Non-Proliferation Alternative Systems Assessment Program and International Nuclear Fuel Cycle Evaluation

In 1977, President Carter invited other nations to join with the United States in an International Nuclear Fuel Cycle Evaluation (INFCE). Subsequently, INFCE was given statutory standing in the Nuclear Non-Proliferation Act of 1978. U.S. participation in INFCE is supported by analysis and research funded by DOE's Non-Proliferation Alternative Systems Assessment Program (NASAP). How effective the United States will be in persuading other nations to accept its non-proliferation ideas will depend in part upon the quality and effectiveness of NASAP work.

8.5 Nuclear Waste Management

The disposal of radioactive wastes is one of the major issues involved in the debate over the future of nuclear power generation. Growing dissatisfaction with past and present nuclear waste policy has been reflected in numerous hearings and legislative proposals in the past two years.

8.6 Reprocessing Concepts and their Relationship to the Proliferation Issue

Reprocessing of spent nuclear fuel would conserve energy resources, but a danger exists that the plutonium thus produced could be diverted and used to produce nuclear weapons. Because of this possibility, U.S. nuclear reprocessing work was halted in April 1977. New reprocessing concepts have since been suggested which might reduce or eliminate the proliferation hazard.

8.7 Research and Development for Nuclear Safeguards

The purpose of nuclear safeguards is to limit the risk of the spread, or proliferation, of nuclear weapons from civil use of nuclear power by providing timely warning of diversion of nuclear materials that might be used to make nuclear explosives or weapons. Four U.S. agencies, an international and a multinational, regional agency, and many foreign governments are conducting research and development to improve nuclear safeguards systems.

8.8 Goals of the Fusion Program

Nuclear fusion is a potential source of energy which poses comparatively fewer environmental problems than current fission plants and relies on low-cost, readily available, inexhaustible fuels. As one of the most attractive long-term solutions to U.S. energy demands, the progress of the fusion R&D program is of direct congressional concern.

8.9 International Cooperation in Nuclear Energy Research and Development

One method for reducing the financial burden on any one country for development of expensive technologies, such as fission and fusion reactors, is to form international groups which split the costs. Such a method also allows for coordination of design parameters which may determine the licensability of the reactor in participating countries.

9. FEDERAL R&D SUPPORT

9.1 Federal Support of Basic Research

There is general agreement from the President on down that the Federal support of basic research by the NSF and mission agencies is desirable and necessary. One problem is that there are admitted differences between funders and performers in distinguishing basic research from applied research activity. How can the Congress ascertain whether basic research is indeed receiving adequate Federal support from the NSF and mission agencies? What effects will recent regulations related to allowable costs of research, and legislation setting a ceiling on salaries of faculty receiving research grants from NSF, and the implementation of the Federal Grant and Cooperative Agreement Act of 1977 have on universities, the principal performers of basic research?

9.2 ASRA -- Integrated Basic Research

The Directorate for Applied Science and Research Applications (ASRA), which was established in February 1978 to improve the National Science Foundation's management of its science applications activities, warrants continuing oversight by Congress, particularly the Integrated Basic Research activity. That activity is a key to bridging the gap between basic research and the applications of that research to many national problems.

9.3 NSF Support of "Big" and "Little" Science

The balance of NSF funding for "big" and "little" science needs to be reviewed, as well as decision-making procedures for initiating and managing "big" science activities.

9.4 The Future of the National Bureau of Standards

Does the National Bureau of Standards have the necessary resources to discharge the wide range of responsibilities which have been assigned to it? Is its present internal organizational structure and its location as a research establishment within the Federal Government optimum for the discharge of its responsibilities?

Also see items:

13.1 National Science Foundation Social and Psychological Sciences Research Support
14.3 Federal Government Support of a Major Communications Satellite R&D Effort
14.8 Federal Government Support of High-Risk Space Technology
14.11 Support for NASA's Space Science Projects
16.3 NSF Support for Basic Research in Industry
17.2 Utilization of Federal Laboratories by the Private Scector and State and Local Government

10. INTERNATIONAL SCIENCE AND TECHNOLOGY

10.1 Technology and International Trade Competitiveness

Concern is increasing among industrial and Government leaders that the United States is losing ground with respect to international trade competitiveness in advanced-technology products, which have traditionally been a source of favorable U.S. trade balances. One of the reasons posited for this declining position is a decrease in R&D and innovation in American industry relative to competitor nations.

10.2 Preparations for the United Nations Conference on Science and Technology for Development

What initiatives should this Nation take to satisfy LDC demands for a greater share of the world's S and T resources and the economic benefits of the application of technology? U.S. preparations for the United Nations Conference on Science and Technology for Development, where these issues will be discussed, apparently are not proceeding as rapidly as many persons would like. Government agencies, labor, industry and significant other interest groups apparently have not been able to reach consensus on these issues.

10.3 Creation of the Foundation for International Technological Cooperation

It is expected that President Carter will include funding for creation of the Foundation for International Technological Cooperation in the FY 1980 budget and that the proposed foundation will constitute a major initiative of the United States at the U.N. Conference on Science and Technology for Development, planned for August 1979. The proposed foundation will be organized by assuming functions of S and T, development assistance, and research from existing institutions under the aegis of the proposed new International Development Cooperation Administration.

Several potential legislative issues are involved. One is that of government reorganization. The foundation will be organized by assuming the functions of S and T transfer, development assistance and development-oriented research from existing Federal agencies under the aegis of the proposed new International Development Cooperation Administration. An involved second issue is more in the nature of a policy shift since the proposed foundation is intended to develop a new pattern of technological and scientific cooperation with the developing countries to insure significant improvement upon the oft-criticized U.S. foreign assistance efforts.

10.4 The Emergence of U.S.-People's Republic of China Relationships in S and T

It is expected that scientific exchange activities and agreements between the United States and the People's Republic will become more systematic, larger and more formal during the 96th Congress. Recently the scientific exchange activities administered by the National Academy of Sciences have been augmented by negotiated agreements for two-way exchanges of scholars, formal exchanges of high-level scientific advisory and administrative personnel, and agreements on specified types of scientific and technological cooperation, such as in energy. Oversight may be needed of the National Science Foundation funding programs in these areas and of the commitments embodied, the coherence, and the consistency of formal cooperative agreements for science and technology.

10.5 Implementation of Presidential and Department of State Responsibilities for Science and Technology in Foreign Policy as Mandated in P.L. 95-426

Title V of P.L. 95-426, the Fiscal Year 1979 Foreign Relations Authorization Act gives the President and the Department of State special responsibilities for systematically improving the formulation of foreign policies dealing with science and technology. Annual reports are required on steps taken to implement these actions.

10.6 Multinational Corporations, Technology Transfer to the LDCs, and Appropriate Technology

Technology transfer is a vital element in a country's growth and development since it provides the means by which nations can acquire new technologies without extensive research and development. In the developing world, multinational corporations (MNCs) are a primary conduit for technology transfer and, as such, the activities of these companies impact significantly on the less-developed countries (LDCs). The transfer of appropriate technologies by the multinational company can encourage the utilization of technologies designed to reflect the technical skills, indigenous resources, and needs of the LDCs.

10.7 Issues Relating to the Competitiveness of Japanese Technology and Production Methods

Japanese technological prowess and industrial production processes have proven significant competitive threats to American technological and industrial markets overseas. How can the United States learn from these experiences in order to improve its competitiveness abroad?

10.8 Fuller Utilization of World Ocean Resources: Legal, Political, and Institutional Aspects

Since the development, exploration, and fuller use of world ocean resources pose a new dimension of legal and institutional problems, the legal and political implications of this development -- with a view toward international scientific planning, analysis, and cooperation -- could be examined concurrently with that development rather than after the fact.

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10.9 U.S./Latin-American Relationships in Science and Technology

Scientific and technological relationships between the United States and the Latin American nations take on new meaning as this Nation attempts to devise policies to cope with conflicts between Latin American demands for a "New International Economic Order," and U.S. domestic needs to open up new markets for U.S. products, gain favorable terms of trade to insure access to Mexican oil, and meet national security and foreign policy commitments toward Latin America. Public and private policies, both bilateral and multilateral, may not be adequate to cope with these conflicting requirements.

10.10 Alternative Energy Technologies and the Developing Countries

The increasing cost for conventional energy has stimulated interest in developing and adapting alternative energy technologies. The need for new energy technologies based on renewable resources is especially great in the developing world where currency to purchase fuel supplies is limited, where a large portion of the population lacks the means to buy and use conventional energies, and where other resources which can provide fuel are more abundant.

Also see items:

8.4 Non-Proliferation Alternative Systems Assessment Program and International Nuclear Fuel Cycle Evaluation
8.6 Reprocessing Concepts and their Relationship to the Proliferation Issue
8.7 Research and Development for Nuclear Safeguards
8.9 International Cooperation in Nuclear Energy Research and Development
12.4 Foreign Exchange of Scientific and Technical Information
14.6 Legal Aspects of Routine Utilization of Space
14.7 International Cooperation in Space

11. MATERIALS R&D POLICY

11.1 Research and Development Aspects of National Materials Policy

Federal programs for various national goals (particularly those affecting energy and the environment) have impacted adversely on materials industries, both supply and processing. Research and innovation in materials technology are lagging and warrant attention to restore balance.

11.2 Research and Development Aspects of Materials Conservation

The U.S. domestic materials posture has deteriorated steadily over the past several decades as evidenced by declining reserves of key industrial raw materials and increased imports of these materials from abroad. Consequently, accelerated research, development, and innovation in materials conservation appears necessary to help achieve, where feasible, a better balance between domestic production and consumption of these materials.

11.3 National Needs in Semiconductor Microstructure Fabrication

Solid state microstructure fabrication is fundamental to a wide range of microelectronic applications in the computer, electronics, and telecommunications industries, as well as in other areas of science, technology, and medicine. The competitive strength of U.S. industry in this very important area is being seriously challenged by other nations, particularly the Japanese.

11.4 Scientific Aspects of the Carbon-Hydrogen Bond

At the interface of materials and energy are such questions as the substitution of plastics and other organic materials in place of metals; the production and processing of biomass; and the capture and conversion of solar energy into useful forms by organic routes.

Central to these technological matters is the need for an understanding of the fundamental science of the chemical interactions of carbon and hydrogen, common to virtually all organic chemical processes and products.

11.5 Synchrotron Program

Emergence of an apparent need warranting assessment for an array of new research tools employing synchrotron radiation.

Also see items:

5.3 Underground Stockpiling or Waste Storage
5.6 Resource Conservation
5.7 Resource Recovery
7.2 Efficient Underground Mining Systems
10.8 Fuller Utilization of the World Ocean Resources: Legal, Political, and Institutional Aspects
19.5 Continental Scientific Drilling Program

12. SCIENTIFIC AND TECHNOLOGICAL INFORMATION

12.1 Federal Scientific and Technical Information Management and Congressional Oversight

Congress long has been concerned with the effective and efficient collection, management, dissemination, and use of scientific and technical information (STI) by the Federal Government. Previous legislation, dealing both directly and indirectly with STI, has created a framework by which information programs and policies in the public and private sectors could be delineated. This attitude was continually fostered in the 95th Congress with the introduction of still more STI-related measures. Initiatives on the part of the executive branch to coordinate and standardize STI activities have coincided from time to time with these congressional efforts. No "national information policy" currently exists, however, and the examination and oversight of STI practices and procedures by Congress continues.

12.2 High Level Interagency Policy Mechanism for STI

Is a high level interagency policy mechanism for handling scientific and technical information (STI) matters needed; if so, what would be its character and organizational placement?

The scope and nature of Federal management of scientific and technical information activities has been of concern to both the public and private sector entities involved, over a period of 20 years. The placement, charter, and controls over such an interagency policy mechanism have found no present day solution.

12.3 Public and Private Sector Coordination of Scientific and Technical Information

STI activities often receive a low priority during policy and budget considerations in the executive branch. In addition, little effort is made to formally optimize existing resources within the public and private sectors through coordination of STI programs.

12.4 Foreign Exchange of Scientific and Technical Information

Currently U.S. policy on exchange of STI with foreign governments is handled in several arenas. Questions regarding what priorities should be addressed have been raised recently in light of the growing concern over the declining U.S. international economic standing.

12.5 Utilization of Information Systems

Substantial investments have been made in the development of large-scale information systems which contain data of potential value to both scientists and non-scientists. However, these systems and possible applications of them often are not known to user communities which might benefit from them.

12.6 Encouraging Public Utilization of Scientific and Technology Information

The encouragement of scientific and technical information dissemination is predicated on the policy of effective utilization of federally funded efforts. Implementing this policy has been difficult in that coordination and integration processes of programs have not always been effective. Concerns have been focused on appropriate channelling of scientific and technology information, research and development findings, and related information that is consistent with national goals.

13. SOCIAL SCIENCE RESEARCH

13.1 National Science Foundation Social and Psychological Sciences Research Support

The NSF social and psychological sciences research support programs have undergone many changes in the last 10 years, i.e. since the Committee's last in-depth review. While funding has increased, criticism has been heard that congressional actions regarding the NSF's social and psychological sciences research budget are not based on sufficient appreciation for subtleties in the growth of the disciplines. Issues identified in a 1977 committee oversight report on NSF support programs in these disciplines might warrant attention.

13.2 Regulatory Decisionmaking

There is a need to examine the decisionmaking process of Federal regulatory agencies. What are the general problems? What is the impact of organization and process on the outcome of regulation? Are there means of comparing the results of regulation against predetermined objectives? Do the agencies have valid information for decisionmaking?

13.3 Effects of Requirements for Social Impact Statements

Both benefits (especially more informed decisionmaking and enlargement of public participation in decisionmaking) and costs (especially paperwork costs) accrue from the burgeoning number of governmental requirements for the preparation of impact statements. Improved identification of adverse consequences of program or policy actions which presumably result from impact statement preparation will not insure improved decisionmaking. Data, more quantitative understanding, and analysis do not always improve decisionmaking. But tradeoffs should be determined.

13.4 Social Indicators Research

Oversight may be required of Federal agency programs for the support and utilization of social indicators research. Involved agencies include: NSF, the Department of Commerce, and the Office of Management and Budget. Issues include progress of research, Federal policies to promote refinement and use of new measures, and institutionalization of social indicators systems.

13.5 Criminal Sentencing Reform

Judges across the Nation do not have a uniform system of deciding terms of imprisonment for convicted criminals. How can this situation be remedied? Would more research into possible guidelines for sentencing be a step in the right direction? What can Congress do to help alleviate this problem?

13.6 Social Science and Government: Better Methods to Determine Research Priorities

Although Federal obligations for social and psychological sciences research are approaching $1.5 billion annually, there seem to be important research and policy topics which are not receiving attention. Current research priority patterns seem not to make maximum use of the Nation's storehouse of such knowledge nor do they permit adequate growth of the knowledge base of social science disciplines.

13.7 Social Science and Government: Better Ways to Apply Knowledge Generated in Federally Funded Social Research and Development Programs

Approximately $500 million is obligated annually for research and development to apply or adopt the findings of federally funded social and psychological sciences research and development to solve public policy problems. However, much of this knowledge is never applied. Problems arise from difficulties in disseminating research, involving decisionmakers in priority setting and problem identification, and from faulty communications between researcher, administrator, and decisionmaker.

13.8 Social Science and Government: Possible Need to Improve Management of the System of Funding and Dissemination

Federal obligations for social and psychological sciences research are approaching $1.5 billion annually. A recent National Academy of Sciences study indicates considerable deficiencies in the management, production and use of such research. "Rapid turnover of leadership at the highest levels of government, combined with arbitrary staff ceilings and unresponsive hiring policies for support agencies" is said to undermine the system. There is little stability in funding and little appreciation for use of contract versus grant, and other research support instruments for producing different types of research products.

13.9 Threats to Behavioral and Social Research Posed by Secondary Effects of Federal Regulations Designed to Mitigate the Risks to Human Subjects of Biomedical and Behavioral Research

As a result of being regulated by many of the same factors that govern biomedical and behavioral research, social research encounters legal and ethical dilemmas in protecting confidentiality of personal data, welfare of participants in some experimental situations and individuals in predictive studies. Various research and regulatory methods have been proposed to minimize conflicts between the researcher's need for high quality information and legal and ethical standards. The recent signing of P.L. 95-622 established a presidential commission to study these subjects and further refine protective mechanisms, recommend their adoption to Federal agencies and report annually on measures taken to protect human subjects. OMB, GAO and the courts share these concerns as do researchers who see conflicts between the issue of accountability to sponsors and confidentiality of participants.

13.10 Program Evaluation Research

Obligations for program evaluation research totaled approximately $243,000,000 in the fiscal year 1977. Such research is intended to measure efficiency and effectiveness of Federal programs. According to experts most of this research is of poor quality or not used, although requirements for performance of evaluation are increasing. The General Accounting Office recently identified nine major inadequacies with the Federal program evaluation effort and by virtue of authority in P.L. 93-344 initiated major programs intended to improve Federal program evaluation and to help committee staff refine legislative requirements for evaluations. Issues of importance include cost and effectiveness in relation to methodology used, adequacy of findings for policymaking, and dissemination methods. Probable passage of sunset legislation compels attention to these issues.

13.11 Domestic Violence -- The Victims

Concern for domestic violence victims has significantly increased over the last few years -- especially for abused children and battered wives. What are the causes of violence within the family? What methods can the Federal Government utilize in providing assistance for the victims?

14. SPACE R&D

14.1 U.S. Civilian Space Policy

Twice in 1978, President Carter issued directives relating to U.S. space policy. These policies were viewed in some quarters as giving little more direction to the U.S. space program that there had been prior to the directives, and that a stronger policy statement is needed.

14.2 Managing the Operational Space Shuttle Program

The space shuttle is expected to make its first manned orbital flight late in 1979 and to start operational activities shortly thereafter. How the operational space transportation system should be managed, and what organization, inside or outside of the Federal Government, should do it, is of increasing concern to the Congress, NASA, and many public and private sector potential users.

14.3 Federal Government Support of a Major Communications Satellite R&D Effort

The United States no longer has a major communications satellite R&D effort sponsored by the Federal Government. Given the inability of private industry to assume large-scale projects in this area, the issue of reassigning to the National Aeronautics and Space Administration (NASA) a major communications satellite R&D effort has emerged.

14.4 Establishment of an Operational Landsat Program

Landsat is an experimental Earth resources satellite program. Although Landsat imagery has proved useful in such areas as agriculture, environmental monitoring, hydrology, cartography, and geology, there is no operational Landsat program, and indecision as to its future remains.

14.5 Establishment of a Space Industrialization Trust Fund

In order to facilitate industry involvement in the industrialization of space, especially materials processing in space, it has been suggested that a space industrialization trust fund be established to provide funding for innovative industry-sponsored experiments which might lead to production of superior products marketable on Earth.

14.6 Legal Aspects of Routine Utilization of Space

The first space shuttle flight is scheduled for launch in 1979. Operational flights will begin in 1980. Although a body of space law exists, many legal questions relating to operational aspects of shuttle utilization remain unanswered.

14.7 International Cooperation in Space

International cooperation has been a major aspect of the U.S. space program since the creation of NASA. Throughout the years, cooperation has been achieved in one form or another with over 50 nations, including American's main competitor in space, the Soviet Union. As space projects become more expensive and available money diminishes, international cooperation may provide a mechanism for funding projects which otherwise could not be undertaken.

14.8 Federal Government Support of High-Risk Space Technology

There is a continuing philosophical debate as to who should pay for high-risk space technology R&D -- the private industry which gains economic benefit from the research or the Federal Government.

14.9 Shuttle Utilization and User Needs

The space transportation system (STS) was designed to enable many economies in routine space operations because of the shuttle's reusability and because of the benign launch environment it promises. However, realizing these economies will depend on achieving a high level of shuttle utilization. Whether this expected utilization will materialize, how utilization is being encouraged by NASA, and how user needs are integrated into the shuttle program are areas of concern at this time.

14.10 Space Program Contributions to Solving the Energy Crisis

As a result of its experience in building spacecraft and launch vehicles, NASA can contribute to solutions to the energy crisis in a variety of ways, including construction of electrical generating plants in orbit about the Earth (satellite power stations); research and development in support of other agencies' programs on conventional energy sources such as coal and alternative energy sources such as photovoltaics and fuel cells; and locating deposits of energy materials such as coal, uranium, oil and geothermal energy with Earth resources satellites.

14.11 Support for NASA's Space Science Projects

The past decade has seen a decline in the level of activity in the space science area, based partially on the overall decline in NASA's budget and partially on the large funding requirements for another NASA program, the space shuttle. Criticism of this decline has become more vocal in the past few years, as the lack of support for space science in the early 1970's is emphasized by few space science launches now.

14.12 Utilizing Space Technology

The President, in his new civilian space policy, evidenced concern with obtaining the maximum return for the resources invested in space activities and deriving the greatest benefit from space technology by increasing its utilization, rather than starting major new space initiatives. In the Congress, space program proponents and critics alike perceive the necessity for the greatest possible return on the space investment through utilization of space technology.

15. SURFACE TRANSPORTATION R&D

15.1 Surface Transportation R&D

Should there be a R&D agency (such as NASA for space) for surface transportation? Is it appropriate for the Federal Government to support R&D? What would be the most effective institutional mechanism? Is there sufficient coordination among the various Administrations of the Department of Transportation (DOT)? Do we need a national transportation policy?

16. TECHNOLOGICAL INNOVATION AND INDUSTRIAL R&D

16.1 Industrial R&D/Innovation and Economic Growth and Productivity

Concern continues to grow that the economic performance of the United States is slipping compared to past performance and relative to other nations. One of the causes that has been cited for this is a relative decline in the level and quality of U.S. industrial R&D and innovation. Additionally, since the demise of the National Center for Productivity and Quality of Working Life at the end of FY 1978, the Federal Government has had no focus for improving productivity.

16.2 Industrial Support of Basic Research

Industrial interest in maintaining broad-banded basic research programs has declined over the past 18 years. Industry spokesmen cite a number of reasons for this trend, and have suggested revisions to our tax, patent, and regulatory laws to remedy the situation. It seems appropriate to ask whether the reasons for their recommendations are fundamental, or whether other forces are at work.

16.3 NSF Support for Basic Research in Industry

National Science Foundation policies and programs with respect to the support of basic scientific research in private industry appear to warrant examination with respect to the objective of stimulating technological innovation and the solution of national problems.

16.4 Commercialization of Federally-Funded Research and Development

Examination of mechanisms to encourage the commercialization of federally-funded research and development so that these technologies are brought to the marketplace where they can contribute to the economic and technological growth of the nation.

16.5 Government Patent Policy

The ownership of inventions resulting from federally supported R&D is an important aspect of the Nation's increasing concern with the state of U.S. industrial R&D innovation.

Also see items:

3.5 Pharmaceutical Innovation
5.1 Environmental Regulations, R&D, Technological Innovation
6.2 Energy Technology Commercialization
6.4 Solar Commercialization: The Need for Comprehensive Federal Policy
6.7 Stimulating Industry Participation in Fuel Cell R&D
10.1 Technology and International Trade Competitiveness
10.7 Issues Relating to the Competitiveness of Japanese Technology and Production Methods
11.3 National Needs in Semiconductor Microstructure Fabrication
13.2 Regulatory Decisionmaking

17. TECHNOLOGY TRANSFER

17.1 Organization for Intergovernmental Transfer of Science and Technology -- The Future of the Intergovernmental Science, Engineering, and Technology Advisory Panel

A major initiative to emerge from the efforts at developing an intergovernmental science and technology coordination mechanism is the creation of the Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP) within the Office of Science and Technology Policy. Established by the National Science and Technology Policy, Organization, and Priorities Act of 1976, ISETAP was mandated to identify and promote Federal programs to increase State and local utilization of federally-funded R&D. An analysis of the present operation and organization of the Panel raises the question whether ISETAP is reaching its intended audience and whether its impact has been commensurate with policy intentions.

17.2 Utilization of Federal Laboratories by the Private Sector and State and Local Government

Examination of the potential for utilizing the technological resources of Federal laboratories for problem-solving State and local government and the private sector.

17.3 Examination of NSF State Science, Engineering, and Technology Program

In an attempt to increase the ability of State executive and legislative branch organizations to understand and participate in science and technology decisionmaking, the National Science Foundation was instructed to establish a grant program to meet this objective. An examination of the State Science, Engineering, and Technology (SSET) program in the Applied Science and Research Applications Directorate, as well as other intergovernmental programs within NSF, will give an indication of how, and to what extent, the program are meeting the needs of State and local governments.

17.4 Oversight of NSF's Appropriate Technology Program

As the present supply of energy and natural resources becomes more scarce and expensive, increasing attention in the United States is focused on developing alternative means of providing goods and services. Government efforts in support of these endeavors are underway in several agencies. In pursuit of developing technologies which are general labor-intensive, decentralized, and utilize renewable resources, the National Science Foundation was mandated to implement an appropriate technology program.

17.5 Multinational Corporations and the Transfer of Technology

As the principal agency for international technology transfer, what are the contributions and costs of the multinational corporation to U.S. economic growth, innovation, employment opportunity, overseas markets, inflation, and aid to the less-developed countries (LDC's)?

Also see items:

3.6 Use of Existing Technologies for the Handicapped
10.6 Multinational Corporations, Technology Transfer to the LDCs, and Appropriate Technology
12.0 SCIENTIFIC AND TECHNOLOGICAL INFORMATION
14.12 Utilizing Space Technology

18. UNIVERSITY RESEARCH, EDUCATION, AND MANPOWER

18.1 The Future of University Research

There are numerous indications that universities which are presently experiencing constraints from several directions will be even more hard-pressed within a few years. Many problems have been identified; should the Congress take a coordinated look at the situation?

18.2 Implementing Technology in the Educational Environment

Through the years, the potential for substantial improvements in the Nation's educational processes frequently has been raised by the introduction of new technologies, psychological theories, curricula, organizational forms, or educational techniques. Yet, the continued decline in pupil test scores, the inability of some graduating high school seniors to read, write, and compute, and the necessity for colleges and universities to offer courses in the three R's to some students has undermined some of the public enthusiasm for rapid adoption of new educational innovations. "Back to basics" is a familiar plea in many public school districts. Since the profound development and implementation of automatic data processing systems in the past 20 years, the use of computer technology in the educational process -- i.e., teaching, testing, and management -- may continue to foster skepticism of new innovations in education or provide the impetus for an educational revolution.

18.3 Science Resources and Education

Is there evidence for underutilization of U.S. scientific and technical personnel? In particular, has engineering education been subordinated in favor of other areas of emphasis, and what can be done about it? Can improved manpower studies contribute to better education and utilization of engineers?

18.4 Job Opportunities for Trained Scientists

Job opportunities for trained scientists -- young men, women, and those in the minorities -- are reportedly declining in college and university settings. How can the Federal Government help to remedy this situation? Will the creation of National research centers serve as a partial solution?

19. WEATHER, CLIMATE, AND EARTH SCIENCES

19.1 Weather Services and Research

A re-examination of the role of the Federal Government in providing weather services and supporting meteorological research, as well as the organizational responsibilities and authorizing legislation for such meteorological activities, may be desirable.

19.2 National Climate Program

The Federal effort in implementation, performance, and support of the goals and objectives of the National Climate Program Act will be a matter for oversight in the 96th Congress. What will be the relative budget priority and organization of the National Climate Program? Should an immediate objective include the establishment of a national climate information system? Will the Federal interagency and public sector coordination mandated in the act be successfully and constructively undertaken?

19.3 Effects of Increased Carbon Dioxide in the Atmosphere

Are the effects of civilized existence capable of impacting climate on a global scale to a measurably significant extent? One persistent question concerns increasing concentrations of atmospheric carbon dioxide that could result from continuing and expanding use of fossil fuels. What climatic changes might result from increased carbon dioxide concentrations and, attendantly, what would such changes portend for the natural environment, quality of life, and U.S. energy policy? What is the scope of the Department of Energy carbon dioxide program, and how does it interface with the National Climate Program established by P.L. 95-367?

19.4 Weather Modification Policy

There is an apparent need to develop a national weather modification policy, including definition of the role of the Federal Government in research and development, regulation, and possible support of operations.

19.5 Continental Scientific Drilling Program

How can both the mission program results and the scientific information output of a national continental drilling activity already well underway be maximized?

Also see items:

4.1 Earthquake Prediction Technology
7.1 Coal Mining R&D -- For Production and Health and Safety
7.2 Efficient Underground Mining Systems

PART II

DETAILED STATEMENTS OF THE SUBJECTS AND POLICY AREAS

1. SPECIFIC SCIENCE AND TECHNOLOGY POLICY ISSUES

(Not Elsewhere Categorized)

Implementation of the National Science and Technology Policy, Organization and Priorities Act of 1976

To what extent has the intent of Congress been carried out in the implementation of the National Science and Technology Policy, Organization and Priorities Act of 1976?

Background

Many changes have occurred from the passage in May 1976 of the National Science and Technology Policy, Organization and Priorities Act of 1976 to the present. The Executive Office structures mandated by the Act were significantly affected by Reorganization Plan No. 1 of 1977 and the implementing Executive Order 12039. These are reviewed in a two-year status report prepared by the Congressional Research Service for the House Science and Technology Committee. Among the basic questions which may warrant examination are the following: Does the statement of national science policy in Title I require updating? Are the issues addressed by the Office of Science and Technology Policy the priority issues of the Nation? To what extent does the first annual report on science and technology represent a status report of science and technology as seen by OSTP, as the legislation intended? Will the five-year outlook similarly mirror the concerns of OSTP as opposed to those of the contractor or agency which is responsible for its issuance? How are the functions mandated by Title III of the act being discharged? Are the revised coordinating and intergovernmental science arrangements serving their intended purposes?

Importance

February 26, 1979 will mark the first anniversary of the operation of the Office of Science and Technology Policy under its revised guidelines. Enough time would appear to have elapsed for the legislative committees of the Congress to review the status of the Office and to consider the future outlook.

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The Interaction of U.S. Science and Energy Policies

U.S. science and energy policies are closely linked. Yet there has been little visible attention to their interrelation. Science policy has to do with the state of U.S. science and technology, with much of it addressed to research and development. Energy policy has to do with the demand for and the supply and conservation of fuels and energy. It too has a large research and development component. Congressional oversight of science and technology policy and energy policies can deal with the interactions between these policy areas.

Background

By the 1990's it is expected that world demands for fuel and energy will surpass supplies. U.S. policy in preparation for this era of increasingly scarce and expensive fuels and energy seeks to reduce U.S. dependence upon imported fuels and energy through conservation, reductions in use, expansions in supply and development of alternative sources. Each approach depends in part upon technological advances hoped for from Federal research, development and demonstration conducted primarily in the Department of Energy. Each approach presumes a productive and vigorous scientific and technological community. In particular, commercial deployment of new energy technologies presumes an adequate supply of scientists, engineers and technicians not only for laboratory work but for the ultimate commercial manufacture, installation and use. Each will be influenced by conditions that affect the movement of new developments out of government and private laboratories into use. U.S. science policy decisions that adversely affect these presumptions could cause technological solutions for U.S. energy problems to be delayed, reduced, or perhaps even negated.

Importance

Changes in U.S. science policy can affect the condition of U.S. science and technology. Likewise, changes in U.S. energy policy can interact with science policy to strengthen or to weaken it. For example, the stock of future scientists, engineers and technicians will be affected by U.S. science policy as well as conditions affecting the movement of new technologies from the laboratory to the market place. Changes in Federal funding for R&D unrelated to energy could lead to new products or services that would increase demands for fuels and energy. Other changes, however, might cause changes in patterns in demand and so perhaps even cause a decrease in demand for fuels and energy. Still other changes could affect the amount and quality of information about environmental effects of producing and using fuels and energy and so change the nature of current controversies on these matters.

The interaction between energy and science policies merits attention because it could: (1) stimulate productive interaction between officials responsible for these policies; (2) provide opportunity to anticipate and head off undesirable side effects of such changes; and (3) increase the possibilities of finding technological ways to adapt to the future energy situation. On the other hand, such attention could be premature and waste time, because: (1) the relationship between science and energy policies is nebulous and debatable; (2) exploring this relationship implies efforts to coordinate them with attendant undesirable growth in the role of government and movement toward central government planning; and (3) our ability to forecast and anticipate is so limited that efforts to coordinate energy and science policy could result in incorrect decisions and be counterproductive.

Implementation of the Federal Grant and Cooperative Agreement Act

Lack of uniformity in Federal agencies' choice of instruments -- grant or contract -- to use in Federal procurement activities, including research and development, has been an unresolved issue of long standing. Legislation enacted in 1978 which goes into effect in 1979 will mandate agencies to use the same type of legal instrument for the same type of relationship and purpose. The effects of these requirements on the extramural funding of Federal research and development will warrant congressional attention.

Background

On February 3, 1978, the Federal Grant and Cooperative Agreement Act of 1977 (P.L. 95-224) was signed. The legislation implements recommendations made by the Commission on Government Procurement in 1972 and was the culmination of congressional efforts to legislate in this area which extended back into the 93rd and 94th Congresses.

Shortly after the 96th Congress convenes, the Federal Grant and Cooperative Agreement Act will have been in effect for a year and the grace period before implementation of the act's requirements will have expired. After February 3, 1979, executive agencies are mandated to use the same type of legal instrument -- either contract, grant agreement, or cooperative agreement -- for the same type of relationship and purpose with State or local government or other recipient. Since it has been estimated that approximately one-third of the Federal budget is expended for procurement, the consequences of this act are far-reaching. A two-year study of Federal assistance programs which the act directs the Office of Management and Budget to conduct must be submitted to the legislative oversight committees (House Government Operations and Senate Governmental Affairs) within two years from date of enactment. This study is intended to provide guidance to better understanding of alternative means to implement Federal assistance programs and recommendations concerning the feasibility of formulating a comprehensive guidance system for Federal assistance programs. Pending the completion of this study, OMB is authorized to approve exclusions from compliance with the act in individual cases. OMB published final guidance to agencies on implementation of the act on August 18, 1978 (43 F.R. August 18, 1978, pp. 36860-65), and a draft plan of the mandated Federal assistance study is expected to be made final before the end of 1978.

Importance

The 1978 legislation encompasses Federal support of research and development as well as funding of other goods and services. An OTA report of June 1978 entitled, Applications of R&D in the Civil Sector; The Opportunity Provided by the Federal Grant and Cooperative Agreement Act of 1977, examined the implications of the legislation in this important area, and identified a number of questions which have implications for congressional oversight: "(1) Is the distinction clearly drawn between (a) generating new knowledge to expand the range of technological options, and (b) fostering specific technological innovations? (2) Are the Federal and non-Federal roles and responsibilities appropriate to assistance relationships

reflected in the use of alternative legal instruments? (3) Are program strategies for achieving innovation goals systematically developed? (4) Is the potential of a uniform Government-wide framework for systematically learning which program inputs produce the desired program outputs being fully exploited by executive agencies? and (5) Are the limitations, as well as the opportunities of R&D as a policy tool for meeting social and economic needs being fully reflected in Federal assistance of innovation?"

The Office of Science and Technology Policy has been monitoring the implementation of the act as it concerns Federal support of science and technology. Two potential problems it sees are the possibility that there will be a shift toward increasing use of contracts, in some cases "flexible contracts" rather than grants to fund R&D activities, and the danger that because assistance activity will be more visible, it may become a target for budget cutting.

Multiple Year Funding of R&D

Most federally-funded R&D programs are authorized on an annual basis. However, a longer-term approach may be more appropriate for many R&D programs.

Background

Historically, funds for Federal activities and programs, including R&D programs, have been authorized and appropriated by the Congress, and budgeted by the executive branch, on an annual basis. Indeed, although many Federal programs are funded by continuing authorizations, since the end of World War II there has been a trend to require annual authorizations for R&D programs, starting with those of the Department of Defense and continuing with those of NASA, the Department of Energy, and now most other major R&D programs. In the 95th Congress, for example, P.L. 95-322 was passed to require the authorization of appropriations for the National Bureau of Standards for the first time. Moreover, both the House and Senate expressed interest in requiring the authorization process for NBS to be for a two- or three-year period rather than annually. There was also interest in authorizing the appropriations of the National Science Foundation for a two-year period rather than for a one-year period as in the past.

Thus, concurrently with the trend to include most major R&D programs within a periodic authorization process, there is evidence that, in some cases at least, a more than one-year authorization period may be the most appropriate.

Importance

Several things make federally-funded R&D programs different from other Federal programs. In particular the difference is in the long-term commitment of highly educated manpower and extremely complex and expensive equipment and facilities to carry out such programs. Without such a long-term commitment, many, if not most, scientific and technological research, development, and demonstration programs may not be planned, administered, and evaluated as effectively as possible

There is currently interest in the Nation's scientific and technological establishment, including the Congress and executive branch Office of Science and Technology Policy, in multiple-year funding of R&D, the rationale being that such funding would provide the continuity required for scientists, engineers, and administrators to most effectively plan and carry out their long-range R&D programs. While it has not yet been shown conclusively that multiple-year funding would contribute to a more efficient administration of major R&D programs, it may now be timely for a comprehensive congressional examination of the pros and cons of multiple-year funding for major federally-funded R&D programs. This is particularly so now because increased efficiencies in the administration of federally-funded R&D programs would, to some extent, offset the increased Federal budget constraints on R&D and the decreasing value of the R&D dollar due to inflation.

The Allowance of Independent Research and Development Costs for Civilian Purposes

Should the concept of independent research and development funding, which has proven beneficial to defense and aerospace industries, be extended to civilian industry and to universities?

Background

There has been considerable concern that industries in the civilian sector may not be supporting enough R&D and may be factors in the worsening productivity growth rate and international trade competitive position of the U.S. vis-a-vis other industrialized nations. The university community is another major source of research which, with proper support, could also make an increased contribution to the productivity of the Nation.

As defined in a 1975 GAO report entitled "Contractors' Independent Research and Development Program--Issues and Alternatives," the term "IR&D" is used by Government agencies "to distinguish the independent work of the contractor from research and development performed for the agency under contract or grant arrangement." It originated in the Department of Defense and the concept has been extended into contracts funded by NASA and the AEC (later ERDA, now DOE). The rationale behind IR&D is the recognition that firms doing a large amount of business with the Government must perform some independently conceived and directed R&D in order to insure that the contracting Federal agency is provided with the most advanced technology possible.

Importance

In the past several years there have been a number of suggestions that IR&D be extended into the civilian industrial sector. As far back as 1970, consideration was given to the idea that IR&D might be an instrument toward achieving an objective of controlling the direction and rate of growth of science and technology in an entire field of technology or on a broad national level. The Commission on Government Procurement said in 1972 that IR&D expenditures "are in the Nation's best interests to promote competition (both domestically and internationally), to advance technology, and to foster economic growth." At hearings in the spring of 1978 before subcommittees of the Senate Banking, Housing and Urban Affairs and the Senate Commerce, Science and Transportation Committees, a suggestion was made that extension of the Department of Defense IR&D allowance should be considered to help increase the investment in industrial R&D. Also in 1978, a report by the Committee on Governmental Relations of the National Association of College and University Business Officers analyzing responses from educational institutions to proposed revisions to OMB Circular A-21, Cost Principles for Educational Institutions, discussed the subject. Since the OMB circular does not include provision for the allowability of the cost of IR&D as a cost of Government R&D, the suggestion was made that "it would be in the national interest to provide [such] similar support to universities, where incentives already exist, but where funding is inadequate," and supporting recommendations were made that these costs be included in the revised circular. A preliminary CRS analysis "Independent Research and Development as a Mechanism to Stimulate Civilian Research and Development: Selected

Issues" of July 26, 1978, pointed out that Government funding gave rise to the imposition of Government controls and disclosure requirements and questions of ownership of patent and data rights; the report noted further that it was questionable whether the size of the civilian R&D allowance might be large enough to bring about desired results and concluded that for these several reasons it was questionable whether using IR&D funding to stimulate industrial R&D would have a significant impact.

The subject would appear to merit more extended consideration in the 96th Congress.

United States Conversion to the Metric System

Public reaction to the U.S. conversion to the metric system of weights and measures has generally been negative; a General Accounting Office report found that the U.S. international trade position will not suffer significantly whether the nation converts or not; the European Economic Community has declared the Systeme Internationale (SI) as the official system of weights and measures. Will these developments affect the national policy for conversion?

Background

The metric system of weights and measures has been legal in the U.S. since 1866. Intermittent discussions concerning the U.S. converting to the metric system have occurred in Congress for over one hundred years. The U.S. began to make positive moves toward converting when in 1965, the British government announced its intentions to convert the United Kingdom within ten years; in 1969, New Zealand began conversion; and Canada and Australia started conversion programs in 1970. A U.S. study, began in 1968 and completed in 1971, explored the advantages and disadvantages of converting. The study emphasized that if the U.S. does not convert, it will eventually suffer seriously in international trade. In December 1975, the Metric Conversion Act (P.L. 94-168) became law -- declaring a national policy of coordinating a voluntary increase in the use of the metric system through the creation of the U.S. Metric Board.

A recent Gallup poll showed that 74% of Americans have heard of the metric system, but only 24% favor conversion; almost twice as many (45%), are opposed. In 1977, the Federal Highway Administration asked for public comments on its decision to change the nation's highway speed signs to display both metric and customary units, 98% of the public was against it. The National Weather Service decided to re-evaluate its plan to change public weather reporting to metric units after receiving many letters of protest.

Importance

In October 1978, the GAO released a report, "Getting A Better Understanding of the Metric System -- Implications if Adopted by the United States." The report indicated that there has been a widespread misunderstanding of the Metric Conversion Act. GAO surveys showed that 42% of small businesses and 23% of the general public believe conversion is mandatory. The report indicated that actions of Federal agencies, many national firms, educators and others, and a general nationwide feeling of inevitability tend to create a metric policy for the whole nation. No evidence was found, it said, to show that U.S. trade would suffer greatly by converting or not converting to the metric system. Of the nation's largest industrial businesses, 60% responding to a GAO inquiry felt that conversion would promote trade through a mutual measurement language, but over 80% did not expect any important changes through exports or imports as a result of conversion.

In April 1978, the EEC authorized the SI as the official system of weights and measures in all transactions. Basically, this means that the importation of goods for resale within the Common Market is prohibited unless they are clearly defined in metric terms. What impact will the public response, the GAO report, and the EEC directive have on the nation's policy for metric conversion? The implications may warrant the attention of the 96th Congress.

2. AERONAUTICAL R&D

Supersonic Commercial Transportation

Will the United States be capable of providing an economical, quiet and competitive vehicle for the supersonic transportation market now being explored by the Concorde?

Background

In 1971 the United States cancelled its own SST development program primarily out of concern for the environment. The British and French completed their program and introduced supersonic flight service with the Concorde.

Even with premium fares double those of subsonic flights, cost performance of the Concorde is uncertain due to its small size. However its exceptional flying quality and its capability of reducing flight time to less than half that of the subsonics has made it popular with passengers able to pay the high fare. On the negative side, the Concorde's engines are noisier than the subsonic competition and have generated complaints from people who live near the airports serviced by the Corcorde.

Importance

The Concorde is a first generation SST derived from technology of the 1960's. It is an all aluminum aircraft with engines designed prior to the time noise emission became an engineering consideration. Studies by NASA and others show that a second generation SST of greater size than the Concorde would be quiet, would not require premium fares and could cruise at three times the speed of sound, about 30% faster than the Concorde.

An aircraft of this type would be about three times as productive in passenger miles per year than present subsonics. It would reduce the long flights to the West (Hawaii, Japan, Hong Kong) to about a third the time required by subsonics.

It would represent a step in aircraft marketing as well as in passenger service about equal to that achieved by the introduction of jet power to civil aviation.

Aeronautical Research and Development

Is the pace of military and civil aeronautical research and development adequate to preserve the dominant marketing and defense position of the United States in the world arena?

Background

European as well as Russian progress in civil and military aircraft, in both research as well as productivity has gained capability at a faster rate during the past decade than has that of the United States. In civil aircraft, the wide body A-300 transport has made significant inroads into the world market as well as into the United States domestic air carrier market. A number of smaller jet aircraft, commuter air liners, and executive transports are being successfully marketed world wide. In some areas, these transports are competing directly with domestic models and in others they are filling gaps in the market.

In military aircraft, the United States has failed to produce VTOL fighters. As a consequence, this gap is being filled by purchases and by licensed production of the British AV-8 Harrier VTOL fighter. There are gaps in other parts of military performance envelope as well, namely in supersonic strategic bombers and high altitude interceptors.

Importance

Without question, the United States has achieved significant progress in civil as well as military aeronautical technology over the past decade. However, the status of the United States in the world arena of civil and military aeronautics shows that the extent to which it leads has been reduced.

The erosion of the civil and military export market of the United States would diminish a leading export category at a time in which the balance of trade is negative. In addition, a strong R&D base is important in determining military superiority in the aerospace field. Given these considerations, the Congress may wish to address the issue of increasing support for aeronautical R&D.

Collision Avoidance Technologies

The recent midair collision between an airliner and a general aviation aircraft in the San Diego, California area has rekindled debate on collision avoidance systems. The debate centers on the issue of whether or not a reliable technology exists to prevent midair collisions.

Background

In 1959, the Federal Aviation Administration (FAA) set up COPAG (Collision Prevention Advisory Group) to study the development and implementation of a collision avoidance system. Since that time various contracts have been awarded to study the feasibility of several proposed collision avoidance systems. The FAA has continuously postponed the announcement of a national standard for such a device. Critics of the FAA have argued that the technology for an effective collision avoidance system exists, and that the agency has been delaying a decision on the various proposed airborne systems in order to develop their own ground-based collision avoidance system. The FAA responds by asserting that the lack of a standard for collision avoidance technologies is based on the unavailability of a reliable technology, that no system can operate effectively in congested areas without giving false alarms, and that a high rate of false alarms could prove more dangerous than no system. A proposed standard, which was originally promised for 1976, is now scheduled for 1979. A final standard is supposed to be announced in 1980. As in the past, however, these deadlines could be subjected to delay.

Importance

In 1977, midair collisions resulted in 41 fatalities. As of September 26, 1978, midair collisions resulted in 155 fatalities. As the aircraft fleet and passenger capacity continue to grow, and as the airways become more congested, the midair collision threat increases. Given this increasing potential hazard of midair collisions, the Congress may wish to examine the issues to determine if a reliable technological solution to this problem exists, and if a congressional mandate is needed to implement a collision avoidance system at the earliest possible date.

Concurrent with any decision on the implementation of such a system is the consideration of its economic impact on the aviation community. Whatever system is chosen for the national standard is likely to involve significant costs for the user. Thus, legislation to encourage the production of collision avoidance devices and ease the financial burden of their implementation may also be appropriate for congressional consideration.

Microwave Landing System (MLS)

The microwave landing system is an all-weather precision approach and landing guidance system. The manner in which this system is implemented may greatly affect the aviation community.

Background

The first Instrument Landing System (ILS) was demonstrated commercially in 1939. It was adopted for national service in 1941 and as an international standard by the International Civil Aviation Organization (ICAO), an affiliate of the United Nations, in 1949. ILS still provides satisfactory precision landing guidance at airports where it is used.

ILS does, however, have a number of limiting factors. The system is limited to 40 channel frequencies and does not meet military tactical requirements. It is adversely affected by heavy snow, irregularities in the terrain, and structures in close proximity to the runway.

Thus, in 1969 the Department of Transportation's Air Traffic Control Advisory Committee concluded that the projected demand for air traffic control services would surpass the capabilities of the present system and recommeneded that MLS be a part of the future national aviation system. The national MLS development plan, prepared by the Department of Defense, the National Aeronaûtics and Space Administration, and the Department of Transportation/Federal Aviation Administration, was issued in 1971. In April 1972, ICAO developed operational requirements for a precision approach and landing system for international civil aviation. A number of ICAO member states -- including the United States, the United Kingdom, Australia, France, and Germany -- pursued development programs designed to meet the ICAO operational requirements. The various proposed system were evaluated by ICAO, and in April 1978, the All Weather Operational divisional meeting recommended that the U.S./Australian candidate MLS be adopted for international use. This recommendation was later approved by the ICAO council.

MLS is expected to make instrument landings possible in many more locations and provide flexibility in approach paths to enable more efficient use of airspace. The MLS system is supposed to be easier to install and maintain and therefore less expensive to operate. MLS offers a large increase in channel availability (200 channels) and an all-weather capability. And, it is unaffected by irregularities in the terrain or by structures close to the runway.

Importance

As of May 1978, nearly 650 operational ILS ground systems were in service at 498 civil U.S. airports and approximately 50,000 (47,000 general aviation and 3,000 air carrier/commuters) aircraft were equipped with ILS avionics equipment. A large number of military aircraft also have ILS avionics equipment. Thus far, there is no timetable or plan for the implementation of MLS. Given the transition costs and the huge investment in ILS avionics, a major consideration for the Congress may be the development of a plan to implement MLS which will minimize adverse impacts on the aviation community.

Civilian Use of the Navstar Global Positioning System

There have been numerous proposals to establish a consolidated approach to radionavigation planning. Such an approach would be based on shared military/civilian facilities wherever possible to eliminate costly duplicative systems. One of the most significant developments in the area of radionavigation is the Navstar Global Positioning System (GPS) based on a system of navigation satellites designed for military use in the 1990's. Although many civilian uses for Navstar have been suggested, no policy exists to ensure civilian access to the system.

Background

The Navstar Global Positioning System (GPS) is a space-based radio navigation system designed to provide users with continuous world-wide three dimensional position and velocity information. GPS will consist of three segments: (1) a space segment which will comprise satellites broadcasting extremely accurate satellite position coordinates and timing information to users around the globe, (2) the user segment, which will process the time and position information from four satellites to obtain accurate position and velocity components, and (3) the control segment which will monitor the 24 satellites and update their position coordinates and timekeeping mechanisms.

The space segment will ultimately consist of 24 satellites, each in three planes in circular orbits. The satellites will continuously broadcast on two radio frequencies, providing satellite identification and navigation data to be processed by the GPS user's receivers. On being activated, the user's set automatically will select the four satellites most favorably located, lock onto their navigation signals, and compute the approximate range to each. In then will form four simultaneous equations involving the user's position and the time factor. Position determination is expected to be accurate to within ten meters.

The accuracy of this type of position location system depends heavily on the ability to measure radio signal travel time and requires precision clocks. The first two experimental passive ranging navigation satellites, TIMATION I and II, launched in 1967 and 1969, experimented with quartz crystal standards. The need for more accurate clocks was recognized and in 1974 Navigation Technology Satellite One (NTS-1) was launched. It used a rubidium atomic clock. NTS-2, the first of the six satellites in Navstar's validation program, was launched in June 1977, and was used in the first true test of the Navstar GPS concept. In 1978 three Navstar satellites, Navstar 1, 2, and 3, were launched as a continuation of the validation phase. If the Department of Defense decides to proceed with the program, a six satellite Navstar GPS system should be operational by the late 1980's.

Importance

Since World War II, military and civilian navigation systems have proliferated. At present, the Navstar GPS system is a multi-service Department of Defense program. A shared Navstar system may replace other systems and offer substantial cost savings. If so, a comprehensive plan is needed to incorporate its use into the civilian sector, as part of an overall plan to coordinate all radionavigation systems. If the decision is made to make Navstar a combined military/civilian program, any modifications which may be necessary for civilian use of the system should be proposed before such changes would result in a delay of the implementation of the system.

Aircraft Noise Abatement

FAA regulations which went into effect on January 1, 1977, require all commercial jet aircraft to be in compliance with the "FAR 36" noise standards by January 1, 1985. The method for implementing this regulation is still in question. The technology exists for retrofitting or replacing the aircraft not in compliance, but financing this large-scale program remains problematical.

Background

The "FAR 36" aircraft noise regulations, promulgated in 1969, required that subsonic jet aircraft certified after that date meet certain noise restrictions; essentially, noise levels of 108 decibels at each of three specified measuring points. Aircraft that have entered service after that date, such as the Boeing 747 or the L-1011, have met these requirements and therefore have been quieter than the older, noisier jets. However, the pre-FAR 36 aircraft, such as the Boeing 707 and 727, still make up the bulk of the U.S. civil aviation fleet.

In order to provide relief from these noisy aircraft for residents of communities close to airports, the Ford Administration in its last month in office issued new regulations, which mandate that the older, noisier aircraft must also meet the "FAR 36" rules by January 1, 1985. (The Carter Administration on taking office concurred with these new regulations.) The airlines have the option of making their old aircraft quieter, by retrofitting or engine replacement, or retiring them from service. The technology exists for either course of action, since retrofitting kits, quieter engines, and quieter aircraft are all in existence. However, the program would cost an estimated three billion dollars, and financing such a program would be difficult for the nation's airlines.

One proposed solution to the financing problem was the Airport and Aircraft Noise Reduction Act, which passed the House by a wide margin, but was substantially altered by the Senate and then failed to win final Congressional approval in the closing days of the session. The House version of this legislation, H.R. 8729, would have provided that tax revenues be diverted from the Airport and Airways Trust Fund and used by the airlines in their retrofitting and replacement programs. The Senate version, S. 3279, provided for a simple tax cut for airline tickets, instead of the special fund which would have been set up by the House bill.

Importance

With the failure of the aircraft noise legislation in the 95th Congress, and the approach of the 1985 deadline mandated by the regulations, the issue of financing an aircraft noise abatement program will almost certainly recur in the 96th Congress. The approach taken in the 95th Congress legislation was highly controversial, in that it was both praised as a reasonable way to assist the airlines with a difficult financial burden, and condemned as an unnecessary "giveaway" to the airlines which might set a bad precedent for other industries.

This issue has been primarily under the jurisdiction of other committees (particularly House Public Works and Transportation), but the interest of the Science and Technology Committee in research and development of advanced aviation technology might make this problem of interest to the Committee.

3. BIOMEDICAL RESEARCH; THE HANDICAPPED AREA

Administration of Biomedical Research: Cost Effectiveness of Research

How cost effective is the administration of Federal biomedical research? Can it be measured adequately?

Background

From a one-room Laboratory of Hygiene in 1887, the National Institutes of Health has evolved into the world's largest biomedical research establishment. Since fiscal year 1948, which marked the formal establishment of NIH the total Federal budget for biomedical research has increased from $27 million to more than $3 billion in fiscal year 1980. Among the issues of recent and continuing congressional concern is the cost effectiveness of this research.

Importance

Many critics of the NIH research establishment claim that while costs for the establishment have increased sharply, there has not been a commen surate increase in the return of benefits to the public. On the other hand, defenders of NIH's research programs argue that, quite to the contrary, research advances and progress against the killer diseases is proceeding at a rapid rate and that the public is getting its money's worth. A continuing issue of congressional concern will be how to increase the productivity of the biomedical research dollar. Another continuing issue will be how to conduct cost-benefit analyses of biomedical research.

Other related issues include:

1. New emphasis on disease prevention (versus disease cure);
2. Multi-year funding to provide for research continuity;
3. Program emphasis and institutional organization (proposed reorganization of NIH); and
4. Contributions of expensive biomedical technologies to health care costs.
5. The very magnitude of the $3 billion total Federal budget for biomedical research may be an issue during the 96th Congress because of the Government's growing concern with Federal budget deficits.

45-884 O - 79 - 5

Biomedical Technologies and Health Care Costs

There has been some recent speculation that the emerging technologies and methodologies applied to health care, such as computerized axial tomography (CAT scan) and open heart surgery may be contributing substantially to rapidly increasing health care costs. The crux of this issue is whether it can be determined compellingly that, indeed, there is a direct correlation between emerging, expensive health care technologies and health care costs, and if so, what can be done to reverse the trend.

Background

In recent years, spectacular technological and methodological advances have been achieved in medicine. Elaborate and sophisticated medical devices and surgical techniques have been developed both to diagnose and treat many, heretofore intractable, disease states. While many of these new developments are unquestionably effective, their use tends to be limited to relatively few people and unit costs for development and for application tend to be very high. Many economists and public health experts are therefore of the opinion that expensive biomedical technologies may be contributing substantially to sharply rising health care costs.

Importance

The rising costs of health care in the United States has stimulated an examination on many fronts of the underlying reasons for this trend. One facet of the trend which has received attention recently is the issue of the contribution of emerging biomedical technologies to health care costs. Some experts maintain that there must be a direct correlation between rising health care costs and expensive biomedical technologies and methodologies. Others argue, quite to the contrary, that new biomedical technologies, while admittedly expensive to develop, are cost effective and may actually lead to lower per capita health care costs. An issue which might be addressed in the 96th Congress, then, is which of the two viewpoints is closest to correct. A correlary issue might be to examine cost-benefit analytical techniques for ascertaining such a correlation. Finally, should a strong correlation between health care costs and expensive biomedical technologies be established, approaches toward reversing this trend might be examined.

Aging Research

In order to meet the needs of a growing elderly segment of the population, funding for research on aging has grown considerably in recent years. The relatively new National Institute on Aging (NIA) has been charged with lead responsibility for this broad new field. Is the coverage and emphasis of this program adequate and are research results being utilized?

Background

As an unprecedented number of Americans now survive childhood and middle age to grow old, it is becoming increasingly clear that growing old can no longer be considered an isolated or unusual event, but rather the norm. Stemming from this trend are a number of social, economic, and ethical issues. Paramount among these is an astonishing lack of information regarding the physical, social, and behavioral changes associated with aging. Such information will be crucial if we are to deal effectively with the widespread problems which will arise.

In the past one hundred years, the proportion of Americans over 65 has grown from 5% to 10% of the population, and it is estimated that by 2030 that figure will rise to 17%-20%. With the control of childhood and infectious diseases has come a corresponding increase in the average life expectancy of 49 years in 1900 to 73 years today. Although the rate of increase has slowed significantly since 1950, it is likely that breakthroughs in the control and treatment of cancer and heart disease will result in another leap in life expectancy in the next 50 years. In addition research into the biomedical process of aging may lead to the development of technologies to combat aging as one more disease, and thus contribute to greater logevity. Greater numbers of elderly people will mean that currently ignored problems of housing, medical care, loneliness, employment discrimination, etc., will have to be addressed. Knowledge is not available to answer all these questions. For this reason the Congress in 1974 established the National Institute on Aging, an arm of the National Institutes of Health, whose mission includes the study of biomedical, social, and behavioral effects of aging.

Importance

Questions regarding the Institute's appropriate emphasis continue to rise. In the 95th Congress, for example, legislation was introduced to limit the scope of its mission to biomedical research only, eliminating the social and behavioral aspects (S. 2631, H.R. 12075). On the other hand, a subcommittee of the House Select Committee on Aging heard testimony from a number of witnesses that more work should be funded on the social and ethical ramifications of biomedical aging research, as results in this field have the capacity to disrupt social patterns. In addition, it is generally agreed that extending the human life span is of no value if the quality of later life does not improve. The means to improve those years could come from a better understanding of that period of life.

In 1977, the National Institute on Aging published its first research plan, entitled Our Future Selves (DHEW Publication No. 77-1096). Beginning this year, the NIA is committed to more complete implementation of this comprehensive plan. A second White House Conference on Aging is scheduled for 1981. While ideas are still being formulated for this new field, the subcommittee could profitably review the focus of NIA's work as well as its applicability to current problems.

Continuation of Oversight of Research in Genetic Engineering

Regulation of research in genetic engineering, including recombinant DNA technology and other areas of applied genetics, will continue to be a legislative science policy issue in the 96th Congress. Recombinant DNA research is a technique of molecular biology used in the biochemical study of genetic mechanisms in plants and animals. The science policy question to be addressed by the Congress is whether this research and technology, as well as other aspects of applied genetics,should be regulated by the Federal Government. Congress has already addressed the recombinant DNA issue in the form of hearings, reports, and legislation (none of which was enacted during the 95th Congress.) The legal, ethical, and social implications of other aspects of applied genetics will also no doubt be major issues for the Congress in the future.

Background

The House Science and Technology Committee has had oversight responsibility in the area of genetic engineering research since 1971. At that time, during the "International Science Policy Proceedings", Nobel Laureate James Watson focused public attention on the rapid advances being made in the field of molecular biology -- some with potentially far-reaching social impacts. (A potential benefit to medicine, for example, would be the large-scale production of synthetic human insulin, while the possibilities for energy and agriculture include the production of nitrogen-fixing bacteria capable of acting symbiotically with plants to permit increased yields with reduced requirements for energy-intensive commercial fertilizers.) In addition, the Committee has filed several reports on the general issue of advances in genetic engineering (1972 and 1974); a report on the specific issue of recombinant DNA research technology (1976); a summary of 13 days of oversight hearings on the recombinant DNA research issue (1978); and a legislative report to accompany the House 95th Congress bill re: recombinant DNA research, (H.R. 11192, Rept. No. 95-1005, Part III, April 1978), which had been sequentially referred to the Committee for its consideration. The Senate Committee on Commerce, Science, and Transportation also held three days of oversight hearings on the regulation of recombinant DNA research, and issued a report on the applications of that research, during the 95th Congress.

Importance

None of the recombinant DNA-related legislation introduced during the 95th Congress was enacted, but at least one Senator has indicated his intention to re-introduce similar legislation in January 1979 at the start of the 96th Congress (see remarks of Sen. Adlai Stevenson, Congressional Record, vol. 124, no. 168 -- Part V, October 14, 1978: S19351-S19357).

In addition to the probability of renewed legislative interest during the 96th Congress, the Office of Technology Assessment is undertaking a three-year study of the impacts of applied genetics, including, but not limited to, those associated with recombinant DNA molecule research. This could include an assessment of applications to agriculture, industry, human reproductive technology, and disease, to name a few.

In summary, the House Committee on Science and Technology and the Senate Committee on Commerce, Science, and Transporation have established their interest in the science policy issues associated with genetic engineering. The continuing evolution of interest in this area on the part of the Congress is further reason for the Committees' continued oversight responsibility both in terms of research regulation and research applications.

Pharmaceutical Innovation

There has been no major revision of the Food, Drug, and Cosmetic Act since 1962. The FDA approval process for new drugs is considered by many to be too stringent, ponderous, and expensive to promote the development of chemical entities with which to treat new and existing medical pathologies. Prior to 1962 drugs were approved on the basis of safety alone. The 1962 amendments to the FD&C Act further required a drug to be proven effective for its indicated use. Many feel that the additional requirement of demonstrating effectiveness has placed a burden on the drug industry which has resulted in a "drug-lag" in the research and development of new pharmaceutical products in the U.S.

Background

The drug-lag concept is based on the belief that the Food and Drug Administration, since 1962, has failed to allow entrance to the American market of a number of drugs that were therapeutically useful abroad. Proponents of this view argue that the FDA approval process requires too much duplication of data already known for drugs approved in other countries. This results in an inordinate amount of supportive paperwork and time necessary for review, increased costs to the industry and consumers, and a decrease in incentive to develop new chemicals which may prove to be financially rewarding to the industry or medically beneficial to the public.

Aside from accusations that the FDA tends to be unreasonable in what it demands of the pharmaceutical industry, there exists another possible cause for lack of innovation; namely, the difficultly in discovering a new drug. Many feel that the great influx of novel drugs discovered during the 1950's and 1960's has slowed somewhat, and that new chemical structures and breakthroughs are needed before major advances can continue.

Importance

Some believe that FDA regulation of pharmaceuticals serves as a deterrent to innovation and thus inadvertently affects public health. The FDA's promulgation is that their agency only follows mandates directed through legislative action.

Legislation such as the Drug Regulation Reform Act of 1978 was introduced in the 95th Congress and cited as the first major effort since 1962 to amend and overhaul the FD&C Act. In several ways this was an attempt to reach compromises between the regulatory agency and industry in order to facilitate and speed the drug approval process.

Other approaches were directed at repeal of the drug efficacy clauses in the FD&C Act. Under the title "Medical Freedom of Choice," this legislation would allow consumers to determine a drug's efficacy and thus unburden the industry from meeting this requirement under present law. While both forms of legislation died with the 95th Congress, each will likely reappear in the upcoming sessions. If the standard for health care in the U.S. is to continue in an upward trend, the research and development of new chemical entities is a priority which should not be thwarted by unnecessary disincentives produced by either private or public demand.

Use of Existing Technologies for the Handicapped

The adaption or application of existing technologies to the cure or containment of handicapping conditions and for the betterment of handicapped individuals may require Federal policy directions.

Background

Extensive government-sponsored R&D programs addressing major national goals (like space exploration, national defense, and energy) have resulted in a steadily increasing store of technology. Although there is great potential for the application of new technologies to the solution of problems not considered by the originator, no comprehensive program now exists for matching the specialized needs of handicapped people to existing technological solutions. Legislation (for example, P.L. 90-480, The Architectural Act of 1968, and P.L. 93-112, The Rehabilitation Act of 1973) regarding accessibility has increased the integration of handicapped persons into the social and economic mainstream.

Importance

National awareness of handicapped individuals is increasing; technological applications can contribute to their therapeutic, educational, and recreational needs, as well as their ability to operate independently. Advocates point to the vast, largely untapped, manpower resource represented by handicapped individuals and to the goal of full citizenship for these people. Detractors cite the cost of providing individualized technological support for a relatively small portion of the population. A coordinated application of the Nation's present technological capabilities to the problems of handicapped people could be initiated at the national level and it may be an appropriate concern of the 96th Congress. Two major items could be addressed. First, the term "handicapped" is an umbrella term covering many different conditions; it could be more adequately defined to differentiate between different types of handicaps, different degrees and characteristics of handicapping conditions, relative prevalences within the population, and desired objectives for each. Second, the creation of a nationwide network of multidisciplianry professionals located at the sources of technological development, and charged with reviewing emerging technologies for application to the needs of handicapped people, could be considered.

Effects of the Medical Device Amendments of 1976 on Developing Technologies Related to the Handicapped

There is some apprehension that recently enacted medical device regulations will have an adverse effect on the emerging biomedical technologies.

Background

P.L. 94-295, The Medical Device Amendments of 1976, was signed into law in May of that year. Since that time, the Bureau of Medical Devices of the Food and Drug Administration has been in the process of promulgating regulations for the medical device industries. These regulations will provide for the categorical regulation of the design, manufacture, and dissemination of any device used for medical purposes, including those devices used by the handicapped.

Importance

Proponents of the Medical Device Amendments cite a lack of a clear-cut regulatory mandate in the FDA coupled with an alarmingly high incidence of life-threatening medical device malfunctions as the major driving forces supporting such legislation. Opponents of the legislation, chiefly the medical device industries, are apprehensive that the legislation would (1) impose excessive costs on small industries unable to incur such costs, (2) inhibit technological innovation (citing the deleterious effects of drug regulations on innovations in the drug industry), and (3) impose an unacceptable burden on the health and welfare of the public by slowing down seriously the process of technology development and dissemination.

It is probably too early to assess what effects medical device regulations have had on developing technologies related to the handicapped. Nonetheless, an issue of continuing concern in the 96th Congress might be oversight over Federal agencies, like the FDA, and the medical device industries in order to determine whether the three points cited above in opposition to the amendments are occurring.

Federal Priorities in R&D Related to Handicapped Individuals

Federal priorities in R&D related to the handicapped may need to be reviewed and focused.

Background

The Report of the Panel on Research Programs to Aid the Handicapped to the House Committee on Science and Technology (95th Congress, April 1977) addressed the general question: "How can a research program using the best of science and technology be put to work for the handicapped?" Legislation, such as the Rehabilitation, Comprehensive Services, and Developmental Disabilities Amendments of 1978 (P.L. 95-602), demonstrates the intent of Congress to be responsive to individuals who have substantial limitations in one or more major life activities. In the specific area of reading programs for blind and physically handicapped persons, for example, focus is needed on a program concept of applied technology that is modified to meet the individual reading needs of severely disabled adults. Present experimental efforts include transmission of talking book program materials over cable television lines, magnetic coding and storage of braille characters on cassettes with their display on special equipment, and modification of an existing reading machine to permit translation to an output in braille as well as in synthetic speech.

Importance

Emphasis should be placed on achieving the goal of increased independence for handicapped individuals; i.e. technology applied to modify their total environment including functions for daily living, mobility, information and communication, and employment. Reading programs could benefit from technological research in the following ways: (1) information and reading materials could be transmitted almost instantaneously, anywhere in the country, thereby minimizing delays and expense currently encountered in the mailing of often bulky materials from cooperating libraries to the reader, and (2) lower costs of producing and circulating braille and recorded materials could result nationwide from the need for fewer copies, less storage space, and fewer personnel for multiple handlings. With ever-tightening budgets, it is imperative that the best use be made of existing funds and that duplicative efforts be avoided. This would require coordination and sharing of information by people knowledgeable about the many resources and services available to handicapped people. Relevant input should be invited from all disciplines that seek to help disabled persons reach their maximum potential. A concern of the 96th Congress could be that the National Institute of Handicapped Research, established under (P.L. 95-602), interpret "rehabilitation" in the broadest sense.

4. DISASTER/FIRE R&D

See also item:

19.5 Continental Scientific Drilling Program

Earthquake Prediction Technology

The extrapolation of work on technology to predict earthquakes in the Western States, to the Eastern and Central U.S., will require innovations.

Background

The development of earthquake prediction technology is well underway for the Western United states, where two crustal plates of the earth are colliding slowly. As the technology to predict earthquakes is refined, it will be necessary to adapt this technology to earthquake predictions in the Central and Eastern United States, where geologic conditions differ because no crustal plates are colliding and evidence of potential earthquakes may be much more subtle, and the mechanisms for triggering the earthquakes are not as well understood.

Importance

The Earthquake Hazards Reduction Act (P.L. 95-124) directs the President to establish a coordinated multi-agency earthquake hazards-reduction program, including the goal of developing earthquake-prediction technology. Such earthquake-prediction technology should be aimed not only at the Western United States, but also the Central and Eastern States where earthquakes are not as common, but nevertheless pose a significant potential hazard.

Fire Prevention and Control

Ever increasing applications of polymeric materials have created demands for developing a standardized screening test to evaluate the relative toxicities of these materials.

Background

Polymeric materials are used in numerous applications, but not much is known about their properties. A recent National Academy of Sciences report points out that "in the built environment, all fire situations yield (1) heat, (2) decreased atmospheric oxygen concentration, and (3) carbon monoxide. Polymers that undergo pyrolysis or combustion may yield varying amounts of heat or smoke, and/or additional specific toxicologic agents, such as hydrogen chloride, sulfur dioxide, hydrogen cyanide, and nitrogen oxides. The occurrence and quantity of these toxicants vary between various polymers and under changing fire conditions." (NAS, v. 3, Smoke and Toxicity, 1978, p. 7-8.)

With this increased usage, a standardized screening test is proposed to evaluate the relative toxicities of these materials. This raises the question of what Federal program priorities, timing, and level of effort are necessary to develop a meaningful small-scale screening test that will identify combustible materials capable of yielding large amounts of toxic agents?

Importance

To protect the public, the safe use of these materials in our built environment may require a small-scale screening test to identify those combustible materials having the great potential to yield large amounts of toxic agents. Because the use of these materials continues to increase, a major effort might be undertaken as soon as possible to develop an appropriate test.

Monitoring the Federal Emergency Management Agency, Particularly as It Relates to the Fire Problem

Monitoring implementation of Reorganization Plan No. 3 of 1978, with particular reference to how the transfer of the National Fire Prevention and Control Administration (NFPCA) to the Federal Emergency Management Agency (FEMA), under the Reorganization Plan will affect the focus on the fire problem.

Background

Fire is one of this Nation's major problems, and continued Federal focus on the problem is still necessary. Under the recently approved Reorganization Plan No. 3, NFPCA was transferred along with four other agencies and several disaster-related programs to form the new FEMA, an agency that will be concerned with potential natural and man-made disasters.

It is important that the new agency be monitored to ensure that the fire problem is not lost among the other disasters. It should be pointed out that fires present distinctly different problems from those of floods, earthquakes, and other disasters in which numbers of persons and the property losses can be quite large for a single incident. For fires, the numbers involved are not as large for a single incident which are usually residential fires. However, 7,500 people die annually in fires, there are 310,000 injured, and property losses exceed $13.6 billion.

Importance

This area is an important new area -- the consolidation of emergency preparedness, mitigation, and response activities. The combination of the agencies and programs, all concerned with disasters, into a single structure "will make government more accountable and will provide increased cooperation among governments." In addition, it is estimated that the reorganization will save between $10 and $15 million a year. It is urgent that under the Reorganization Plan that the fire problem is not subsumed by other disaster problems, but that its importance remains as indicated by the Federal Fire Prevention and Control Act of 1974.

The Reorganization Plan No. 3 becomes effective on or before April 1, 1979. A new director, deputy director, and various associate directors will be appointed to the new agency. This may be the time to make certain that the agency gets off to a good beginning.

5. ENVIRONMENTAL R&D

See also item:

8.5 Nuclear Waste Management

Environmental Regulations, R&D, and Technological Innovation

Federal pollution regulations and R&D attempt to stimulate the development and application of less-polluting technology. There is some question whether the programs actually stimulate or discourage innovation and how the impacts on technology compare to the benefits of these programs.

Background

Declining levels of productivity growth in the United States have been partly attributed to declining industrial innovation, which in turn has been partly attributed to the increase in environmental regulations. Most do not quarrel with the objectives of regulations (e.g., clean air and water and better health) but there is concern that the regulations have sustained very high costs, including slowing and distorting the rate and direction of industrial innovation. Moreover, some evidence indicates that regulation, unless properly backed up with R&D, may encourage only incremental changes as opposed to fundamental process changes.

Importance

There exists no consensus on whether environmental regulation and R&D have a net beneficial or detrimental effect on technological change. One the one hand, regulation may stimulate innovation by requiring use of "best available technology" to reduce pollution. Whole new industries have sprung up to supply effluent control equipment. On the other hand, regulation in some cases may act to retard or distort industrial innovation by increasing the cost and time necessary to bring new products to market and by diverting R&D resources to short-term projects such as end-of-pipe cleanup. The controversy is indicative of the lack of a satisfactory framework for assessing socio-economic benefits and costs of Federal environmental programs.

Other regulatory issues include the effects of regulatory uncertainty on R&D and innovation and the alleged disproportionate burdens on small firms.

The current presidential policy review on industrial innovation is studying the effects of environmental, health, and safety regulations on innovation and may suggest policy options to the President.

Some of the issues for Congress include:

(1) Are current Federal environmental regulations and R&D programs effective in stimulating the development and application of new technology that is less polluting and safer?
(2) Does regulation have a negative impact on industrial innovation and, if so, under what conditions?
(3) Should the socio-economic assessment capabilities of regulatory agencies be improved? Should they be required to study impacts on technology and productivity among other impacts?
(4) Would partial deregulation or alternatives such as taxes or fees be less of a disincentive to innovation?
(5) Are health-based or technology-based regulations more effective in terms of achieving regulatory objectives and stimulating technological change?

Hazardous Wastes

Pollution episodes in the last two years have identified a number of problem areas. Hearings and legislation may be appropriate to address issues of siting of waste management and disposal facilities, compensation of victims, and assessing the cost of cleaning up abandoned polluting waste disposal sites.

Background

Several incidents have occurred in recent years in which old waste disposal sites, hazardous and otherwise, have endangered the life and health of nearby residents, and polluted ground and surface waters. Recent episodes which have drawn national attention include those at the Love Canal, Niagra Falls, N.Y.; Lowell, Mass.; Toone, Tenn.; and Gray, Me. The hazardous waste management program created under Subtitle C of the Resource Conservation and Recovery Act of 1976 is not of assistance since it is directed at the future disposal of wastes, not rectifying problems created in the past.

Importance

The recent rash of incidents has created resistance to the siting of any kind of waste disposal plant near where people live. The residents of Wilsonville, Ill. (population 700), persuaded a court to close a site near them which industry and State and environmental authorities considered a "model facility." Many fear that such action will simply result in the same wastes being disposed illegally with far more potential environmental damage in the long run. Also at issue is the compensation of victims such as those in Niagra Falls. Leakage of chemicals occurred two decades after the site's closing; the company involved claims it complied with all applicable regulations at the time. Who can the victims turn to for redress, and who will bear the cleanup costs?

Underground Stockpiling or Waste Storage

The use of wells, salt domes, and underground caverns for waste disposal or stockpiling of strategic materials.

Background

The increasing need for adequate and safe storage of strategic materials (such as oil) and the disposal of waste materials (such as toxic or radioactive materials) has led to the utilization of underground facilities. However, the various options for underground storage need to be carefully analyzed so that the advantages and risks associated with each are fully known.

Importance

With increased emphasis on environmental problems associated with the generation of waste materials, many of which are toxic or radioactive, the need for adequate and safe storage sites for these wastes is imperative. Certain States have already declared a moratorium on the construction of nuclear power plants until adequate storage facilities for the waste fuel are developed. In addition, the stockpiling for strategic purposes of large quantities of oil in underground reservoirs should be fully evaluated for potential risks -- such as oil mobility, temperature increase from oil injection, earthquake generation from increased pressures, and stability of the reservoir rock.

Environmental R&D

At issue is whether EPA's research and development is adequate to provide information on which to base regulations and to assess their benefits.

Background

EPA's R&D is now authorized annually, providing an opportunity for regular oversight. Questions of concern include: (1) coordination: how well coordinated is environmental R&D, which is conducted under various statutes? (2) basic vs. applied R&D: is EPA's R&D program balanced between basic and applied research, and is EPA's R&D organized to provide long-term stability for basic research projects? What is the status of EPA's 5-year R&D plan, and what use is made of it? (3) Monitoring: What concrete steps are being taken to improve the nation's environmental monitoring, which has been sharply criticized in numerous studies?

Importance

Considerations of energy development needs and economic pressures are increasingly focusing attention on the bases for environmental regulations. Assessments of regulations depend on a good information base. Furthermore, basic research on the environment provides the capability to anticipate problems and deal with potential problems with less difficulty.

45-884 O - 79 - 6

Bottle Bill

In early 1979 the interagency Cabinet-level Resource Conservation Committee will be making a recommendation to the President and Congress on the desirability of nationwide mandatory deposits on beverage containers. Do the benefits of a bottle bill outweigh the disadvantages?

Background

Three States now have experience with mandatory deposit legislation: Oregon since 1972, Vermont since 1973, and Maine since January 1978. Three others have recently enacted such legislation: Michigan's law went into effect December 3, 1978, and Iowa and Connecticut have statutes that will be implemented in July 1979 and January 1980, respectively. Federal facilities were required to implement returnable beverage systems under EPA guidelines of September 21, 1977. The National Park System instituted mandatory deposits earlier in 1977 with salubrious effect. A one-year test by the Department of Defense at ten military installations is due out in December 1978. Proposals for a national bottle bill have appeared in every Congress since 1970.

Importance

The bottle bill has occasioned one of the most strident environmental debates. Proponents argue that it would result in conservation of energy and materials and a reduction in litter and solid waste generation, accompanied by net gains in employment and labor income. Opponents cite job losses in the affected industries, with newly created jobs being low-paying and uninteresting; additional capital investment would be required for warehouse space, delivery truck fleets, and other equipment; and the benefits are challenged. EPA endorsed the concept in 1974 and an interim report of the Resource Conservation Committee was generally favorable to a nationwide bottle bill. If the final report recommends action, proponents in both Houses will surely call for prompt attention to the issue by Congress.

Resource Conservation

"Causes of high waste and low recycling have deep historical roots in the economy and public institutions. Major progress in waste reduction and resource recovery will require a broadly based, long-term strategy that considers ways of improving the market incentive system as well as more direct efforts at technological and institutional development." (EPA Fourth Report to Congress: Resource Recovery and Waste Reduction, p. xi).

Background

The Resource Conservation and Resource Recovery Act of 1976 set national goals of reducing the amounts of solid waste generated, reducing overall resource consumption, and utilizing recovery resources, among others. Accomplishing more with less, and seeking to moderate demand instead of searching for means of increasing supply are two of the unfamiliar paths available.

The Brookings Institution, under contract to the Environmental Protection Agency, held a three-day seminar on January 15-17, 1979 to explore policies in this area.

Importance

The policies needed to implement these goals sometimes go against traditional American ways of doing things. As EPA's Fourth Report observed, "Conventional disposal and fossil fuels and virgin raw materials appear to have been subsidized and favored by market failures and government practices." Society at large has paid the costs as a result. Modifying government-induced distortions and removing disincentives is not only difficult but should be brought about with maximum reliance placed on market forces.

Resource Recovery

Should EPA's resource (materials and energy) recovery activities be transferred to another agency? Both in absolute and percentage terms, is the United States recovering any more values from waste than it did, say, a decade ago?

Background

The resource recovery program was originally located in EPA (and its predecessor, HEW) because the raw material, waste, was a subject of environmental concern. The original Solid Waste Disposal Act of 1965 was an amendment to the Clean Air Act, aimed at reducing pollution from incinerators and smoldering open dumps. Further study showed a threat to ground and surface waters from leachate and runoff, respectively. Resource recovery was made a topic of Federal interest in the 1970 and 1976 laws without much thought being given to any possible change in its bureaucratic home.

Importance

Critics have called this activity a stepchild of EPA whose R&D and technology transfer functions never smoothly fit in with the agency's mission of environmental regulation. The Resource Conservation and Recovery Act of 1976 gave EPA regulatory powers in the area of hazardous waste management, and a leadership and tutorial function in assisting the States to set up their own waste management programs. Current reorganization within EPA's Office of Solid Waste downplays resource recovery (according to news reports) at a time when the Department of Energy's energy recovery program and the Department of Commerce's resource recovery program are growing. The Bureau of Mines also maintains an R&D program. Bureaucratically speaking, the Federal resource recovery program is in a state of flux; this appears an appropriate time to reassess the leadership function, and order our forces accordingly.

Sludge

What are the long-term strategies for dealing with the disposal of sewage sludge?

Background

Sewage sludge, the mud-like residue of the municipal sewage treatment process, is generated at a rate of approximately 7.3 million dry tons per year. Another estimate puts it at 300 million wet tons per year. Furthermore, it is estimated that by 1990 the amount of sewage sludge requiring disposal could triple as a result of secondary treatment requirements under the Federal Water Pollution Control Act.

In recent years municipalities have disposed of their sludge through ocean dumping (15 percent), incineration (35 percent), landfill (25 percent), and land application (25 percent). However, environmental legislation has called for ocean dumping to end by 1981, and incineration has been made much more expensive by pollution control requirements. Research into energy recovery is underway, and practices such as composting are gaining more attention. Increasing amounts appear destined for the land, but even here stricter controls are being applied to guard against threats to ground and surface water. There is also debate in the scientific community over the threat posed by heavy metals and pathogens. As progress is made in the fight against water pollution, the sludge problem increases, and financially strapped communities are calling for more Federal assistance.

Importance

From being treated as a secondary aspect of water pollution control and solid waste management, sludge disposal and use has emerged as an issue in its own right. The General Accounting Office recently said that effective Federal leadership is required to promote a comprehensive national sludge management policy. 1/ In response to legislative mandates in the FWPCA, as amended, and the Resource Conservation and Recovery Act, EPA is developing documents effecting such a national policy. To accelerate the beneficial use of sludge, the Congress may wish to consider whether additional research and development funding is required to develop new ways of treating wastewater and sludge to resolve the heavy metals and pathogens problem which is a major obstacle to increased land application. Also, energy recovery through pyrolysis and copyrolysis with municipal wastes has been demonstrated in pilot projects but has yet to be proven in full-scale operation, partly because the costs and risks are too large for municipalities to bear alone. Additional Federal research funds may be appropriate here, as well.

1/ U.S. General Accounting Office. Sewage Sludge -- How Do We Cope With It? (CED 78-152) Washington, U.S. G.A.O. September 1978: 28.

6. ENERGY: ADVANCED AND OTHER ENERGY R&D ISSUES

See also item:

14.10 Space Program Contributions to Solving the Energy Crisis

Department of Energy Programs in Alternative Energy Technologies and Energy Conservation

The Department of Energy appears to be limiting, or reducing, its programs to develop new energy technologies in favor of promoting the early commercialization of existing technologies which may not be able to be made commercially competitive. In addition, the Department of Energy has yet to mount a coherent and effective energy conservation program, even though existing knowledge and technologies could produce considerable energy savings, particularly in city operations. It may be appropriate to review DOE's priorities and objectives in each of these areas.

Background

In the Federal Non-Nuclear Energy Research and Development Act of 1974 (P.L. 95-577), Congress mandated that the Energy Research and Development Administration (ERDA) undertake a vigorous effort to (1) develop and commercialize non-nuclear energy technologies and (2) develop and implement energy conservation technologies. This act also required the Administrator of ERDA to submit to Congress an annual report detailing ERDA's plans and activities in research, development, and demonstration aimed at perfecting and discovering alternative and energy conservation technologies. This report was to contain a plan for future activities including specific discussions of: anticipated objectives to be achieved; the economic, environmental, and societal significance of the various programs; and the total estimated costs of such programs, including a statement of both the Government's and industry's share of the financing.

These responsibilities were transferred to the Department of Energy upon its creation. However, unlike ERDA, DOE has broad economic activities which appear at times to conflict with the research, development, and demonstration activities mandated to ERDA. DOE is now placing great emphasis on the commercialization of existing technologies, possibly at the expense of the underdevelopment of new technologies. It may be significant that the latest mandated annual report to Congress was significantly smaller and far less detailed than the reports submitted by ERDA, and did not contain much of the information stipulated in P.L. 95-577.

Importance

An over-emphasis on the commercialization of alternative energy technologies by DOE may produce serious consequences. There is no certainty that the existing technologies are now, or will ever be, reasonably efficient and able to compete with the best technologies that might eventually be developed. In some cases, totally new technologies may have to be developed. In other cases, fairly major revisions in technology will prove to be needed before energy, or energy fuel, can be obtained at lowest cost. By focusing on the earliest possible commercialization of the technological approaches that are now under development, DOE may be

curtailing, weakening, or discouraging the establishment of research programs -- either in its own laboratories or in industry -- which might ultimately produce technologies that are much better than what is now available or under develooment. While it may be reasonable to seek early improvements in such areas as lighting and electric motor design, the energy technologies for the production of synthetic liquid fuels, for producing photovoltaic electricity, for producing electricity by MHD, and so forth, would appear to need considerable refinement to be economically competitive, and some of the existing technological approaches may not even be capable of further significant improvement. Thus, there is good reason to inquire whether DOE's general emphasis on commercialization, and its organizational restructuring to promote early commercialization of all possible technologies, is an appropriate course of action when the world's commercially available petroleum resources seem to be increasing and when there appears to be a decreasing likelihood of shortages in the foreseeable future. It might be wiser to use the time available to pursue vigorous research efforts aimed at understanding and "stockpiling" technologies against the day when they will be needed. It might be particularly wise not to promote the commercialization of any process whose product has no short-term prospect of being economically competitive in the marketplace. By prematurely capitalizing plant and facilities for processes that can only compete under Federal subsidies, we may be "locking ourselves into" production facilities that can never be made competitive, but which will be too expensive to be "junked" in favor of other technologies.

In addition, DOE seems to be making little effort to mount a vigorous and coherently managed energy conservation effort. The several relevant aspects of energy conservation which lie within DOE's responsibility are administered through several offices in the agency, with no single senior person responsible for producing a successful energy conservation program. Though a great deal could be done without invoking new technologies to make sizable energy consumption reductions in the operation of city governments, DOE has no programs dealing directly with cities in general and no effort to help cities to retain their personnel to improve efficiency. Nor does there appear to be a set of firm objectives, with timetable, in DOE's conservation program.

Finally, DOE's R,D, and D programs cannot be assessed in detail without the annual reports to Congress mandated under P.L. 95-577, nor can its general strategies and timetables be determined without such a document.

Energy Technology Commercialization

The Department of Energy is making a concerted effort to effect the early commercializations of the technologies which it has been developing for (1) the production of energy, (2) the production of energy fuels, and (3) the conservation of energy. This raises questions about whether an emphasis on commercialization will weaken DOE's effort to discover totally new technologies and to make major improvements to known technologies, and about whether the possible economic problems and impacts of large scale commercialization are able to be handled.

Background

The Department of Energy has reviewed the energy technologies which it has been seeking to develop. Several have been selected for immediate commercialization efforts by DOE, which will make a vigorous effort to overcome institutional and economic barriers to their use. This effort may require the creation of new markets and new products and production facilities. It may alter the demands on the Nation's energy distribution system. In some cases it would seem to require the use of price supports, subsidies, and/or tax write-offs. These measures might create a substantial and unbounded liability on the Treasury, unless appropriate limitations are applied. In addition, there may not be sufficient capital to create the new plant and distribution facilities needed, and in some cases the adoption of a new technology may create materials shortages.

In a more general sense, the commercialization effort raises a significant question about DOE's priorities and objectives. There would seem to be the possibility that DOE's emphasis may be shifting from research and development to produce new, and optimal, energy technologies toward the commercialization of those technologies that now exist or are known. If this shift is in fact occurring, then it could have a large effect on DOE's research programs, which would seem to need further strengthening in some areas -- particularly in fossil fuels research according to recent statements by some senior DOE officials. Whether intentionally or not, it may be that DOE will no longer seek to develop and stockpile energy technologies for use when commercial conditions warrant, but will now seek to raise commercial interest in those technologies that now exist and to circumvent, where necessary, the economic factors which inhibit their commercial viability. Thus, the commercialization effort may have a significant effect on DOE's R&D policies and activities.

Importance

DOE's commercialization effort raises a number of questions that merit an early examination. One of these is whether DOE will, consciously or not, diminish its effort to discover and develop reliable, workable, and economically competitive energy technologies in favor of promoting the use of those technologies which are now under development. Another question is whether, with the current abundance of petroleum supplies, it is wise to promote the adoption of technologies (particularly

for the production of potentially large quantities of fuel) which may be less than optimal in efficiency and cost. Once production processes are underway, industry may be reluctant to junk a technology, particularly if a reasonable profit is assured under some sort of Federal assistance program. Another question is whether reasonable incentives can be found to interest industry in alternative energy sources given the amounts of capital available and the market risks involved, as well as the possible dislocations that may be produced in production facilities and in the marketplace. The costs of implementing a major commercialization effort could prove to be unattractive.

Alternatively, the costs of maintaining a dependence on foreign sources of oil at current growth rates, or at current levels, might legitimatize a national sacrifice in favor of early commercialization. Inflation, and the value of the dollar, are certainly matters for concern, although there is debate about their immediate connection to the price of petroleum and the balance of payments. It can also be argued that domestic security requires domestic fuel supplies for military operations. Thus national imperatives may require a vigorous commercialization effort. In addition, it can be argued that AEC and ERDA did not make a sufficient effort to "get technologies off the shelf and into use"; and that because there was little sense of urgency for commercialization, the pace of energy R&D was less than it should have been. In this regard, the commercialization effort may be of significant benefit to DOE's R&D effort, and could bring daily decisions into a focus that had heretofore been missing. Finally, it can be argued that actual production experience is the only way to overcome a great many technical problems, and that production experience reduces the chance of unexpected problems in the future. The question then might be that of how much production experience is necessary to iron out problems and to accurately project prices of the products involved.

Federal Energy Conservation Programs

Efforts to promote energy conservation involve the operations of cities, of industry, and a great many areas of personal decision and lifestyle. As a result, the various Federal offices which need to address facets of the energy conservation program are spread through a number of agencies. Their efforts could well be better coordinated under effective leadership if greater energy efficiency is to be achieved.

Background

There is a consensus that energy conservation is an important national objective, yet progress is conserving energy seems slow. This is not to say that there are not impressive examples of energy conservation to be found. Large industrial users of electrical power are installing more efficient motors, other industries are installing more efficient boilers, and large office buildings are opting for cogeneration of electricity and heat. In addition, the fleet mileage standards for automobiles will increase according to standards established by law. On the other hand, progress in conserving energy in other areas has been slow, even though a good deal could be done on the basis of existing technology and even more impressive gains might be able to be made if there were better understanding of the economic, social, and behavioral sciences involved.

In any case, there is limited promise of success for any conservation effort that does not offer a comprehensive approach to the problems at hand. For instance, cities offer an attractive opportunity for energy conservation. Even though much can be accomplished, such beginning measures as changing to high efficiency street lighting, operating a city's buildings in a more energy efficient manner, or making more efficient use of a city's motor vehicles, are often hard to achieve. Cities complain that they are ignorant of what measures have proved helpful and that they do not know how to acquire the relatively few trained people they would need to mount an energy conservation program on that modest level. More substantial energy savings might be obtained by creating economic and other incentives for conservation by including energy as a prime consideration in land-use planning and zoning, and in property assessment. Current planning, zoning, and assessment methods favor the profligate use of private transportation and maintain current patterns of energy use.

Architectural and community design are other areas which offer opportunities for significant energy savings. Though the energy standards being, or about to be, required by FmHA and FHA may have a considerable impact on the single family housing market, community and building design is ripe for improvement. Yet there is no Federal program that seems to be addressing this area effectively.

Finally, individual habit patterns of energy use will ultimately have to be changed if energy conservation is to become a true reality. Economics (i.e., higher prices) is not necessarily the only means, or the best means, for effecting such change. For instance, higher

fleet miles for autos may simply permit people to drive even further than they might with low mileage autos, with the result that gasoline consumption is not greatly affected and the dependence on autos is increased. In addition, a major swing to cogeneration in industry and large buildings may increase the expense of maintaining electrical and gas distribution systems to smaller users. Thus, the problem of energy conservation must be handled on a comprehensive basis which includes all sectors of the community, all types of uses, and factors other than the economics of fuel and energy.

Importance

Energy conservation is a worthwhile goal that arguably requires a coordinated national program. At present, agencies such as the Departments of Transportation, Agriculture, and Housing and Urban Development, and the Environmental Protection Agency are individually responsible for important elements of the energy conservation program in addition to the Department of Energy, yet all their efforts need to be coordinated into a single effort that can be effective. This would seem to be a matter where appropriate legislation might produce worthwhile results.

In addition, at present there is little understanding of how to incorporate energy considerations in city planning. zoning, and assessing. This in turn is related to the problem of how people might be induced to change their uses of energy by non-coercive measures and by measures that are not likely to work an economic hardship on certain groups in society. These are areas in which imaginative research needs to be done. Other areas include architectural and community design.

Finally, Federal energy programs need to begin to deal directly with levels of government other than the State level. Cities and communities need direct technical help in mounting comprehensive energy conservation programs, both in dealing with city operations and in dealing with the various private users of energy. The research and development needs in this case may be only partly technical in nature; the major problems may lie in the economic, social, and behavioral sciences.

Solar Commercialization: The Need for Comprehensive Federal Policy

There is some evidence that solar technologies will have difficulty penetrating commercial energy markets even after their technical and economic feasibility has been demonstrated. Federal action may be required to help move technologies into commercial use after the R&D phase is completed. It is yet unclear, however, exactly when, how, and to what extent the Federal Government needs to become involved in the solar commercialization process.

Background

A cohesive Federal program in solar energy research and development was set forth in 1974 following the Arab oil embargo (P.L. 93-473, the Solar Energy Research, Development and Demonstration Act of 1974). Since that time the Federal program has focused on establishing the technical and economic feasibility of the various technologies included under the "solar" rubic, and bringing those technologies to the point where they can compete in conventional energy markets. Important technical progress has been made, but solar technologies still lack the commercial appeal necessary to attract a major market. It appears that if left to normal market forces, solar technologies will not penetrate the conventional fuels market fast enough to make a meaningful impact on the U.S. energy supply at least in this century. Federal intervention in the solar market may be necessary to speed the commercialization process, but existing policy does not adequately address the Federal role in solar commercialization.

Importance

Federal policy in solar commercialization is arguably needed, first, to expedite the mass installation of solar energy systems (if that course of action is found to be in the national interest), and second, to avoid problems which could result from policy being set piecemeal instead of in the framework of a long-range national plan.

Expedite installations. Solar technologies rely on a diffuse, intermittent energy resource, which means that regardless of the technology employed (wind electric generators, water heaters, biogas generators, wood-burning stoves, etc.), thousands, even millions, of solar units must be in use to make a meaningful impact on the U.S. energy supply. For example, as many as 35 million homes must be equipped with combined solar space and water heaters in order to save the energy equivalence of one million barrels of oil per day (500 square feet of solar collector per home, averaged over the entire year). The very large number of units required for a meaningful impact helps create a sense of urgency to begin mass installations as soon as possible.

Avoid piecemeal policy. There is general agreement in Government and industry that to accelerate market penetration, some degree of Federal involvement in the solar market may be called for. Indeed, Congress has already exercised solar commercialization policy options; i.e., tax credits and below-the-market rate loans for certain residential and business uses of solar were included in the National Energy Act. However, policy actions taken thus far have not been in the context of overall national policy and

may prove inadequate or even harmful to the industry in the long-run. It is also possible that pressure will develop for similar action to be taken on other solar technologies as they approach commercial feasibility. These possibilities, coupled with a sense of urgency to begin mass installations, suggest that the need to establish comprehensive Federal policy in solar energy commercialization for the near-, mid-, and long-terms.

Formulation of a national plan for solar commecialization will be a complex task requiring policy judgments on an array of technical, economic and social issues in solar energy, made within the context of our long-range plans for other energy supply options. Some of the issues which might be considered in formulating a national plan for solar commercialization include:

- What is the need for, and what do we know about, the role of solar technologies in meeting future U.S. energy requirements?
- What is the role of the private sector in the implementation of solar technologies?
- Should today's energy technology development direct or follow society's future course in energy?

Oversight of the Department of Energy Geothermal Energy Program

After a period of very little growth, the geothermal industry is showing signs of increased activity. With institutional constraints to geothermal commercialization being studied, and in some cases removed, the technical aspects of the resource (an area of DOE responsibility) will become more important to future geothermal development success. Committee oversight may be warranted in this area.

Background

The purpose of the Federal Geothermal Energy Research, Development, and Demonstration program is to accelerate the utilization of the domestic geothermal resource by stimulating private industry and local power authorities to commercialize these resources for the production of electric power or for direct heat applications. DOE plans for accomplishing this objective are concerned principally with developing economically viable and environmentally acceptable technology. The technical objectives are to reduce both the costs and uncertainties of geothermal reservoir exploration, assessment, development, and utilization; to develop and demonstrate the most cost-effective heat exchange and energy conservation technologies for use over the widest possible range of geothermal fluid temperatures and salinities; and to develop and demonstrate technology for acceptable control of enviornmental impacts. As a part of the demonstration program, the selection of a proposal for a cooperative agreement for the design, construction, and operation of geothermal electric power demonstration plant utilizing a liquid dominated hydrothermal resource was made on March 31, 1978. Other technological efforts by DOE include: the development of a diamond chain-bit drill, a direct-contact binary cycle heat exchanger, a helical-screw expander wellhead generator, and a descaling water jet.

Importance

The selection of a demonstration plant utilizing an existing technology (single flashed steam system) rather than a more advanced technology (binary system) made on the basis of business and management factors may be appropriate for oversight interest. Also of interest to the committee may be the progress in DOE research on geothermal technologies, including the prospects for the commercialization of some of these developments.

Development and Use of Geothermal and Ocean Energy Resources

In view of the present energy situation, it is prudent to explore all possible avenues to clean and adequate energy supplies. Renewable energy resources, like geothermal and ocean energy resources, are of particular interest and importance, as part of a future mix of energy sources, in fulfilling the Nation's energy needs.

Background

To respond to the prospect of energy shortges, researchers on campuses, industry and Government, Members of Congress, and Federal energy officals are looking with a sense of urgency at alternative sources of energy. The great global effort to find and develop new sources of energy encompasses not only the 30% of the Earth's surface covered by land but extends to the greater part covered by water. In this regard, attention has focused on the renewable energy source potential of (1) geothermal resources, and (2) the world ocean.

Geothermal deposits are thought to contain an enormous amount of heat and, thus, enormous energy potential. But most of this energy is so diffuse that recovery of potential economic significance is indicated only in areas where the Earth's heat has been concentrated into restricted volumes. Even the best of these geothermal deposits is comparatively low-grade in energy quality when used to generate electricity. The direct use of geothermal waters, however, is achieving practical and widespread use on a regional basis for space heating, process heat, and agricultural purposes.

In the world ocean, several possible sources of energy have been recognized that are unique to the ocean environment. The disadvantage common to these oceanic energy sources is their dispersion over wide areas of the Earth's surface, a characteristic resulting in energy of low quality or density. This circumstance may preclude their efficient use for power generation, except at locations where the energy resource potential is substantial in magnitude and concentrated or where conventional energy systems are neither available nor feasible. In addition to the possibility of transmitting electricity to mainland distribution grids and process industries ashore, it has been proposed that the power be used on-site for energy intensive refining and manufacturing processes at ocean energy industrial complexes (OEICs).

It may be appropriate for the committee to, on a continuing basis, assess the changing character of the status and technological prospects for geothermal and ocean energy, to probe the potential significance of the role they could pay in easing the strain on U.S. energy resources, and to investigate the adequacy of the Federal efforts in geothermal and ocean energy systems R&D and their relative priority in Government programs for development of new energy sources. Particularly important are investigations of barriers and constraints to the development of new energy sources. The domestic geothermal industry has been impeded by institutional barriers such as leasing arrangements which just now, after several years, appears to be working properly; an uncetain tax situation; and long delays in obtaining permits for development and construction at all levels of Government.

Renewable ocean energy systems will be operated in oceanic areas which in some instances may lie beyond the limits of any national jurisdiction, and, at a time when the law governing use of the world ocean is in flux, their eventual deployment could pose a new dimension of legal and institutional problems, including international jurisdictional issues; spatial and emerging oceanic use conflicts; regulatory and liability aspects; domestic and international environmental aspects; and financing and investment uncertainty.

Importance

The energy produced by these alternative energy sources will by no means eliminate the need for other power generation sources. But even if geothermal energy and ocean-generated energy are not by themselves solutions to the energy problem, they have a contribution to make, however small, as part of a mix of alternative energy sources and to the overall energy needs of the Nation. Continuing identification, consideration, and resolution of the legal, political, institutional, and environmental constraints are viewed as fundamental to full and productive utilization of these energy resource bases.

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Stimulating Industry Participation in Fuel Cell R&D

One industrial company has dominated the field of first generation (phosphoric acid) fuel cell technology. Many people believe that development of second generation (molten carbonate) technology and fuel cell commercialization could be hastened if there were greater industrial participation and competition in fuel cell R&D.

Background

United Technologies, Inc. has been involved in fuel cell R&D for many years and has devoted significant funds of its own to this work, as well as being supported by utility and Federal funds. The company is developing the 4.8 megawatt (MW) demonstration fuel cell power plant for the Department of Energy based on its first generation phosphoric acid technology. It now appears that the best candidate technology for commercialization is not the phosphoric acid fuel cell, but rather the molten carbonate, second-generation fuel cell. This latter technology lags about five years behind the phosphoric acid technology because neither the private nor the public sector has devoted extensive funds to it.

There are a number of significant research and development problems which need to be studied prior to commercialization of fuel cells. Though Federal funds for fuel cell development have increased rapidly in the past few years, fuel cell research is very expensive. Due to budget constraints, only one advanced fuel cell technology, molten carbonate fuel cell, can be supported at the level required for successful implementation. This single advance technology approach offers substantial risk. If there were greater industrial participation, other alternatives could be explored in depth. The General Electric Company, under grants from DOE and the Electric Power Research Institute (EPRI), is now studying the molten carbonate technology. However, GE is not putting significant funds of its own into fuel cell studies. Until the industrial research base is broadened, input to advanced fuel cell technology development will not be competitive and there will be higher risk in developing only one technology which, though it appears promising, may not eventually be viable economically or technologically.

Importance

Fuel cell powerplants have been recently chosen by DOE as one of two energy conversion technologies to serve as the test cases for intensive commercialization efforts. However, extensive research and development is essential for fuel cells to realize their near-term potential for commercialization. If industrial participation and competition could be stimulated, it might lead to earlier resolution of the major problems inhibiting fuel cell commercialization. In reviewing DOE's commercialization plan for fuel cells, and DOE's request for funds for the fuel cell program, the 96th Congresss will be assessing suggested ways to stimulate greater industrial involvement, thus ensuring greater effectiveness of Federal funds for fuel cell development.

The Role of National Laboratories in Energy R&D

The Department of Energy, as successor to the R&D facilities and capabilities of the Atomic Energy Commission and the Energy Research and Development Administration, possesses an R&D resource of international stature. The issue is whether DOE is managing this resource effectively enough to satisfy both national energy and national energy R&D goals.

Background

The DOE laboratories include eight major multiprogram energy R&D laboratories, like Argonne National Laboratory, Brookhaven National Laboratory, Lawrence Berkeley Laboratory, Lawrence Livermore Laboratory, Oak Ridge National Laboratory, and Los Alamos Scientific Laboratory; four specialized laboratories, like Ames Laboratory; five Energy Research Centers (ERCs) specializing in fossil energy R&D; 23 "program dedicated" laboratories, like Fermilab; and a number of additional production plants and other operations. Most recently, the Solar Energy Research Institute (SERI) was established at Golden, Colorado. Also, a number of new regional solar energy centers will manage contracts for the conduct of solar energy R&D.

When the first R&D facilities were established under the AEC following World War II, the research effort was concentrated almost exclusively on nuclear energy, particularly military. After 1960, however, the AEC's mandate was enlarged to include nonnuclear R&D also. This mandate has continued to be expanded throughout the brief existence of ERDA and, now, under DOE. Currently, DOE has major program activities in fossil energy R&D, solar and geothermal energy R&D, the environmental and biomedical aspects of energy use, energy conservation, and commercialization as well as its traditional areas of military and nonmilitary nuclear energy R&D.

Importance

The proper or most effective role of these national energy laboratories in DOE operations and national R&D goals has not yet been determined by the Congress. Organizationally and administratively, the DOE's use of the energy laboratories is more a result of historical development and patchwork than it is of a rationalized approach to the use of this important national resource in an overall national energy policy.

The House Committee on Science and Technology has begun to examine the complex R&D structure of DOE. The interrelations between the Department's major program structure, the field organization, the contractor-operators of the laboratories, and the laboratories themselves; the level of basic research; and the relationships of the laboratories with academia and industry, are areas all susceptible to in-depth analysis in the 96th Congress. The issue of perhaps basic importance now is how a proper balance can be achieved between energy policy formulation and program management at the headquarters level, and R&D creativity and professional development and morale at the laboratory level in the complex organization that is DOE.

Timing the Deployment of Alternate Energy Technologies

Developments of recent years suggest that historical patterns of transition from older to newer technologies may be changing. For example, it has been noted that the transitions from wood-burning to coal-burning, and from coal-burning to oil-burning required about 60 years. Some persons now think that looming constraints, such as exhaustion of some resources, or the possible discovery of deleterious effects of some technologies arising from greater attention to environmental research, may require more rapid transitions, and fewer gradual transitions, than in the past. Consequently, some persons believe that shorter transition periods would have to be more explicitly and more centrally planned.

Background

If it can be known what technologies and resources will be available, and when and at what cost they will be available, what kinds of further knowledge can or must be obtained, by deduction from the above and other resources, to choose a national course through a transition period of specified duration? Are there known methods of management science or economical development analysis for sequencing technological transitions? What general kinds of knowledge may be needed for decentralized (individual) decisions? What general kinds of knowledge may be needed by the legislative and executive branches of government?

If a sudden and large change would occur in the conditions which are considered to be fixed and known -- for example, if conclusive new scientific evidence, or irresistable and seemingly permanent political developments, would require that at least one technology be abandoned with maximum urgency in favor of an alternate arrangement -- what steps would a rational government take now, assuming that such a future necessity might occur? What steps would a rational government take to identify areas of relatively vague scientific definition, or relatively unpredictable political future, from which an unexpected condition might arise? What steps might a government take in the present to speed or to slow the clarification of scientific or political ambiguity, perhaps increasing or decreasing thereby the interval in which adaptive measures could be taken?

What are the factors which limit the rate at which a given technology can be phased in or out of general use, and how are these factors different among distinct technological areas? For example, how do the factors differ which might limit the rates of growth in utilization of nuclear fission, coal conversion, a new genetic strain for agricultural application, a vaccine for a newly virulent disease, and the retrofitting of solar water heating to residential structures? How are the feasible rates of phase-out of an old technology and the feasible rate of phase-in of a new technology related? Is this relationship the same for physical systems and for biological systems?

Importance

For energy technologies, are there any energy technologies for which the relationship between energy payback and the maximum likely phase-in rate is such that the technology, taken as a system, will be a net energy sink for a period or years or decades? For any such technologies, does this condition argue best for pushing their expansion hard and early so they will be in place before fossil energy stores are exhausted in less provident investments, or does it argue best for limiting the phase-in rate of each technology or group of technologies to that which permits its social contribution from an earlier date?

The Congress wrote a requirement into P.L. 93-577 that the net energy or energy accounting considerations suggested in the above paragraph be addressed, and some studies have been done. The Congress also approved a "swine-flu" immunization program which required production of vaccine on a large scale and on short notice, with some consequent legal problems. These are among the precedents for a more careful study of general problem areas in government-sponsored technology deployment.

Optimizing Within and Across Energy-Saving Technologies
(Are We Planning for Use of Energy and Other Technologies Suboptimally?)

This issue concerns the difference between designing more efficient physical objects and devices to do substantially the same job that previous objects and devices did -- and the creation of new conceptual complexes of objects and devices which could accomplish similar social and personal purposes, but eliminate or radically alter some of the intermediate means to these purposes.

Background

Residential and Commercial Structures. The Nation has programs to improve the architectural design of both residential and commercial structures, individually, for energy efficiency. However, the deep dichotomies between residential and commercial structures, and residential and commercial zoning patterns, mean that people work far from their homes, expending time and energy in daily transportation back and forth. Also, maintenance of separate agglomerations of structures, each of which is populated for certain times of the day or week, and largely empty and unused at other times, means that heating and cooling systems must be cycled up and down with ambiguous consequences to overall efficiency, or that redundant heating and cooling systems must be maintained in the sense that many buildings must be kept near habitable temperature even while unused, in the expectation that they will, within hours, be required again to be habitable.

Transportation. There are movements underway to improve the individual energy efficiencies of both personal and public systems; for example, cars, railroad locomotives, airplanes, telephones, and broadcasting and other communications systems. However, the Nation may not be considering fully the opportunities to conduct business and personal affairs through altered commercial and personal patterns which would require less transportation of persons for meetings and appointments, and more use of sophisticated and energy-efficient electronic communications, such as video conferencing, electronic mail, and so on.

Importance

The President was elected in a campaign devoted in part to a discussion of efficiency in government. The recent congressional election year produced much discussion of a presumed public demand to get "more for less" from government. The Federal Government is undertaking moves to increase efficiency in transportation industries by relaxing regulatory barriers which retard efficiency. A broader examination of the institutional barriers to a less time-consuming and less energy-consuming society generally, going beyond examination of those barriers erected by government to regulate the private sector, could be a natural extension of these efforts.

Recent Research on Energy Conservation: Substitutability and/or Complementarity Among Energy, Capital, Labor, and Materials

There is much disagreement among members of Congress on the role of energy in our economy. This disagreement may reflect in part conflicting viewpoints of the "experts" who advise members of Congress: specifically, those whose professional background leans more toward engineering and physical science or more toward economics. Research to resolve such conflict is proceeding and recent results, or results soon to come, may gain the attention of the 96th Congress.

Background

The extent to which energy can be "conserved," while maintaining or increasing the level or rate of growth of economic production or employment, has been an issue in the 94th and 95th Congresses. A part of the controversy results from lack of "expert" agreement on a definition of energy conservation. To reach a consensus definition of energy conservation, and to determine all of the economic effects of conservation however defined, appear to require consideration of whether energy is a substitute for, or a complement with, other factors of final production such as labor, capital and (depending on how the problem is formulated) intermediate manufactures. Academic literature published during the 95th Congress indicates however that there are not solitary and universal definitions of "substitute" and "complement," and that unambiguous definitions of these require some subtlety and mathematical sophistication. This literature appears to show that substitution of energy and capital for each other (usually considered very plausible on the basis of engineering intuition) and complementarity of energy and capital in the aggregate economy, are not contradictory, but are completely consistent. Thus, a basis appears within reach for resolution of a chronic debate which at times seemed to pit the professions of engineering and economics against each other.

Importance

A conclusive resolution of the research results suggested in the Background above could have implications for a substantial number of interrelated policy questions, and the way the Congress handles them. These policies may include those relating to oil imports and international financial relationships; availability or shortage of financial capital at home; unemployment at home; inflation at home; tax policy; and perhaps other policies. Factors for consideration of the status of this research are (1) the interest the Congress has previously paid to the health and development of science of all kinds through establishment, and annual authorizations for, the National Science Foundation and (2) the possibility that the results of this particular line of research may be particularly applicable to the set of energy and general economic policy questions given above. A factor against consideration of the status of this research is that many will find it conceptually quite difficult.

7. ENERGY: FOSSIL ENERGY R&D

See also item:

19.5 Continental Scientific Drilling Program

Coal Mining R&D--For Production and Health and Safety

Coal-mining productivity has dropped continuously in the past 10 years, partly due to the health and safety requirements of the law enacted in 1969.

Background

Coal-mine productivity in underground mines has plummeted since 1969, from 15.6 tons per man-day to only 8.5 tons in 1976 -- a drop of 45 percent in seven years. A similar decline, though not quite so large, has taken place in surface mining, from 35-36 tons per man-hour during the years 1968-1973, to only 26 tons in 1976 -- a drop of 23-26 percent. Although there are several reasons, certainly the requirements of the Coal Mine Health and Safety Act of 1969 have contributed to a major share of this decline.

Importance

President Carter's energy program, and that of the Congress, both envision a substantially increased role for coal in the U.S. energy-supply picture in future years. However, the President's program was predicated on a substantially increased proportion of domestic coal production coming from surface mining, especially in the West. Constraints caused by the new surface mining reclamation law are forcing reconsideration of these proportions, and environmental considerations (principally air pollution) are causing mining companies to search for and to mine low-sulfur coal, underground. Much more of this mining will be underground than anticipated heretofore, and will be performed under more difficult geologic conditions.

The increased productivity of the 1950's and 1960's (when it more than doubled from 4.8 tons per man-day in 1950 to 15.6 in 1969) was due largely to machanization. Thus, we must now turn to R&D and technology transfer of new ideas, to reverse the productivity downtrend.

Efficient Underground Mining Systems

The development of safer and more efficient underground mining systems is necessary to increase both the safety of the miners and their productivity.

Background

Although domestic coal production has increased in the past few years, a smaller proportion is being produced from underground mines -- for economic as well as health and safety reasons. Underground coal-mine productivity (tons per man day) has dropped substantially in the past several years, in part because of requirements of the Coal Mine Health and Safety Act of 1969. Underground production of metals and some non-metals likewise faces these problems.

Importance

President Carter's energy program, and that of the Congress, both envision a substantially increased role for coal in the U.S. energy-supply picture in future years. In order to meet these increased production goals, substantially larger tonnages of coal must be produced by underground mining. However, underground coal mining is more hazardous, and is more expensive in other ways, than surface mining. The same is true for underground metal mining in certain geologic situations.

New research, development and demonstration of mining systems in order to upgrade existing technology could bring significant increases in production, in a number of areas, including:

- Decreasing the time needed to bring a mine into production;
- Improve productivity by automation of longwall and continuous miners in coal mining;
- Improve mine-transportation systems;
- Make feasible the mining of presently marginal metalliferous deposits;
- Maximize recovery of metal from ores being mined;
- Improve control of subsidence;
- Improve waste utilization and disposal; and
- Minimize pollution and other environmental damage.

Coal Liquefaction Program Goals

Over the next few years, DOE's coal liquefaction program is expected to require the expenditure of vastly increased sums of public monies. A careful evaluation of ongoing programs, future plans, expected results, and objectives might be conducted during the 96th Congress. Specification and clarification of program goals for the near, middle, and long-term time frames seem beneficial.

Background

The current objectives of DOE's liquefaction program are: to develop as candidates for commercialization second generation technology that will convert domestic coal into clean boiler fuel, distillate heating oil, gasoline and chemical feedstocks; to assure technology transfer and improved unit operations to support commercial operations; to perform laboratory studies and process development of third generation liquefaction processes; and to support commercial-scale implementation of second-generation liquefaction technology at the earliest feasible date.

Some coal liquefaction processes have not been developed beyond the laboratory scale or beyond a process development unit (PDU). DOE is supporting pilot plant testing of some advanced processes, and is beginning to support the design and eventual construction of demonstration-scale facilities.

Recent operating expenses for DOE's coal liquefaction program have been running somewhat over $100 million per year. Plant and capital equipment (construction) expenses for planned demonstration facilities for advanced Solvent Refined Coal (SRC) I and II processes may require expenditures of more than $1.0 billion over the next five years.

Importance

As part of the continuing reauthorization and oversight process, it appears timely to review progress made to date on major pilot plant programs, PDU projects, and design for demonstration facilities. A review of the coordination and management of this program seems timely. The future of DOE's effort might be reassessed in terms of stated goals and objectives of this program and if necessary a restructuring of program strategy, goals, and objectives may be desirable.

Coal Liquefaction--Government/Industry Involvement

Continued advancement of coal liquefaction technology will require increased financial support from public and private sectors. In order to maintain an aggressive liquefaction research, development, and demonstration program, government/industry relationships must be maximized and problems impeding progress need to be resolved or reduced. New arrangements for government/industry involvement in DOE's liquefaction efforts may be necessary.

Background

Both industry and the Federal Government, jointly and independently, seek to advance coal liquefaction technology and to promote its commercialization. DOE conducts its coal liquefaction program with heavy reliance on private industry contracts; specifically, it accomplishes its mission partly through the management of programs and projects contracted with coal companies, oil companies or their subsidiaries, and utilities. Many liquefaction technologies are either coming to, or are already at, the stage at which increased financial support from industry appears neccessary. Greater industrial participation may be necessary over the next few years because of limitations placed on the Federal budget.

Importance

As part of the reauthorization and oversight process, it is important and timely to reevaluate government/industry involvement in DOE's coal liquids program and in the innovation of this technology, in general. It must be recognized that commercialization of coal liquid technologies is, for the most part, the responsibility and function of industry. Therefore, the views and perspectives of industry are of major importance.

New and innovative ways to demonstrate liquefaction technology may be necessary. Possible options include government-owned industry-operated facilities, equal cost-shared test facilities, and procurement programs. It is important to consider: Under what conditions would industry be more willing to increase its funding of, and participation in, cooperative programs to expedite the demonstration of coal liquids technology? Are DOE practices or policies decreasing industry's willingness to advance or commercialize liquefaction processes? Are Federal patent practices/policies adversely affecting industry involvement in DOE's coal liquids program? How can and should stimulation of the chemical industry involvement in this DOE program be achieved? How can and should a broad industrial base of support be incorporated into this DOE effort?

Coal Gasification Program Goals

DOE's program seeks to advance low-, medium-, and high-Btu coal gasification processes that can be used in a variety of markets. Specification of program goals, priorities, management of current efforts, and planning for the future might be evaluated as part of the authorization process providing funds for these diverse efforts.

Background

The overall objective of DOE's coal gasification program is to develop and demonstrate advanced technologies to economically manufacture fuel gases from coal in an environmentally sound manner. DOE is currently supporting a wide range of coal gas programs including: fixed-bed and fluidized-bed gasification, design of a low-Btu fuel gas demonstration plant, design of a plant to produce ammonia from coal, high-Btu coal gasification pilot and demonstration projects, in situ coal gasification, peat gasification, and advanced power systems using coal-derived gases. For some DOE projects, development is expected to continue to a point where industry can construct, with an acceptable degree of risk, a commercial plant based on one or more technological concepts.

Importance

As part of the continuing reauthorization and oversight process, it appears timely to review progress made to date on major pilot plant programs, process demonstration unit (PDU) projects, and design for demonstration facilities. A review of the coordination and management of on-going DOE coal gas programs seems timely. The future of DOE's program might be reassessed in terms of stated goals and objectives of this program, and if necessary a restructuring of program strategy, goals, and objectives may be desirable.

Coal Gasification--Government/Industry Involvement

Continued advancement of coal gasification technology will require increased financial support from the public and private sectors. In order to maintain an aggressive gasification research, development, and demonstration program, government/industry relationships can be maximized and problems impeding progress need to be resolved or reduced. New arrangements for government/industry involvement in DOE's gasification program may be necessary.

Background

Both industry and the Federal Government, jointly and independently, seek to advance coal gasification technology and to promote its commercialization. DOE conducts its coal gasification program with heavy reliance on private industry contracts. Specifically, it accomplishes its mission partly through the management of programs and projects contracted with such groups as industry associations or research institutes and companies, and engineering or oil companies. Many coal gasification technologies are either coming to, or are already at, the stage at which increased financial support from industry appears necessary. Greater industrial participation may be necessary over the next few years because of limitations placed on the Federal budget.

Importance

As part of the reauthorization and oversight process, it is important and timely to reevaluate government/industry involvement in DOE's coal gasification program and in the innovation of this technology, in general. It must be recognized that commercialization of coal gas technologies is, for the most part, the responsibility and function of industry. Therefore, the views and perspectives of industry are of major importance.

New ways to advance the innovation of gasification technology may be necessary. Possible options include government-owned industry-operated facilities, equal cost-shared test facilities, and positive financial or regulatory incentives. Questions for possible consideration include: Under what conditions would industry be more willing to increase its funding of, and participation in, cooperative programs to expedite the demonstration of coal gasification technology? Are DOE practices or policies decreasing the willingness of industry to advance or commercialize gasification processes? Are DOE's patent practices/policies adversely affecting industry involvement in DOE's coal gas program? Should and how can stimulation of the natural gas or chemical industry's involvement in DOE's coal gas program be achieved? How can a broader industrial base of support be incorporated into this DOE's program?

Coal R&D Goals for Electric Power Production

Coal and coal-derived gases are projected to be the predominant fossil energy resource for electric utilities in the future. DOE is conducting a variety of programs with the objective of advancing technology to allow increased utilization of coal to offset the use of oil and gas in the utility market. A review of these diverse efforts with attention focused on coordination, program goals, and the utilities view of DOE programs, might be conducted.

Background

Decreased reliance of oil and gas and increased use of coal for electrical generation is an important part of the President's National Energy Plan. In support of this plan, DOE conducts a variety of programs to achieve this objective. DOE's programs include: efforts to increase the direct utilization of coal in the utilities by developing advanced, highly efficient, integrated coal conversion/utilization systems, work on magneto-hydrodynamics, -fluidized bed systems for electrical generation, underground coal gasification projects that produce low-Btu gas for local use in electric power generation, and other advanced power systems that address baseload electrical generation by central station utilities.

Importance

Considerable research, development, and demonstration work remains to be done on some advanced technologies that can utilize coal in electrical power production. DOE supports the advancement of these systems in several of its programs. As part of the authorization process, it might be useful to consider the overall coordination of these efforts and the goals of these diverse programs. In addition, DOE's coal R&D goals for electric power production might be reassessed in terms of the recent DOE supply iniative studies.

Assessment of Alternatives for the Demonstration of Oil Shale Technology

Oil shale remains a relatively undeveloped energy resource. Although the Department of Energy is funding an intensive research, development, and demonstration program (estimated budget authority for FY 79 is about $29 million), shale oil is unlikely to contribute substantially to U.S. energy supply before 1990. Two specific questions bear consideration: 1) What alternative means are available to expedite the demonstration of oil shale technology? 2) Is the DOE program focused on the demonstration of the most promising oil shale processing technologies?

Background

Known U.S. resources of high quality Western oil shales are estimated to contain the equivalent of 600 billion barrels of oil. DOE primarily supports the advancement of in situ (underground) processing. This technology, if proven to be economically feasible and technologically reliable, would reduce water requirements for processing, and reduce some impacts normally associated with mining and surface processing. In situ technology has not been reliably tested at the commercial scale as yet. No technology development or pilot scale plant has yet been commercially competitive. Production and capital costs are uncertain and will remain so until commercial size units or modules are operated.

Under current economic and policy conditions, it is estimated that a maximum of 50,000 barrels of shale oil per day may enter the marketplace by 1987. Modified in situ processing may be the only technology that is proven to be commercially viable by this time.

Importance

To expedite the demonstration of oil shale technologies, DOE is funding an intensive research, development, and demonstration program. As part of the FY 80 authorization process, it appears timely to review the management of and progress made on major DOE contracts for the advancement of shale processing technology with Occidental Petroleum, Equity Oil Company, Geokinetics, and Talley Frac. An examination of future DOE program plans for expediting the demonstration of shale technology might also be considered.

DOE has recently formulated draft initiatives to expedite commercialization of shale oil production. While reviewing this work (in relationship to the ongoing DOE research, development, and demonstration program), it may be timely to consider alternative means to promote demonstration, such as:

1. Federal Oil Shale Commercialization Test Act (S.419, 95th Congress, passed by the Senate);
2. Refocusing of DOE research, development, and demonstation program to increase participation by major oil companies who own substantial shale deposits, and to widen the base of industrial support for this program;
3. Continued support of the Paraho project (and its environmental monitoring studies) which may eventually collapse without continued Federal support; and
4. Reactivation of the Colony Project to demonstrate a commercial module (10,000 b/d).

8. ENERGY: NUCLEAR ENERGY R&D

LMFBR Program Review with Emphasis on Program Direction without CRBR

The future of the liquid metal fast breeder reactor (LMFBR) demonstration project at Clinch River, Tennessee was not decided during the 95th Congress although proposals were heard to either suspend or cancel the Clinch River project (CRBR). In the event that the Clinch River project is canceled, the question arises as to what will happen to the rest of the LMFBR program.

Background

The United States has been investigating the possibility of using breeder reactors, which produce more fuel than they consume during operation, for electric power generation since the 1940's. In the 1960's, the liquid metal fast breeder reactor (LMFBR) was chosen as the best of the several breeder types. After operating several experimental LMFBRs, the Atomic Energy Commission won congressional approval for constructing a demonstration plant at Clinch River, Tennessee, referred to as the Clinch River Breeder Reactor (CRBR) project.

Funding for CRBR began to encounter opposition in the mid-1970's as cost for the project escalated sharply. In April 1977, President Carter called for cancelling the project because of the proliferation potential of the plutonium produced by plutonium breeders. Since that time, Congress and the Administration have been debating the future of CRBR, an issue which was not resolved in the 95th Congress since the authorization bill for Department of Energy (DOE) programs which contained funding for CRBR never passed the Senate.

One compromise offered was for Congress to allow cancellation of CRBR in return for design studies for a larger LMFBR demonstration plant incorporating new proliferation-resistant guidelines, although the Administration would not commit itself to ever building such a plant. Another compromise called for suspending CRBR for three years while other alternatives were studied, but with the agreement that CRBR would be either cancelled in lieu of another LMFBR program or continued at the end of that period.

If one of these compromises is accepted by the 96th Congress, the question arises as to what will happen to the rest of the LMFBR program. CRBR is only one aspect of the program. Other aspects include the continued operation of Experimental Breeder Reactor II, completion and operation of the Fast Flux Test Facility, and other LMFBR related research projects in various stages of construction. For FY79, the Administration request for CRBR was $13.4 million, while the request for the base LMFBR program was $251.3 million.

Importance

Breeder reactors are considered by some experts to be a vital necessity for assuring energy supplies in the long term future (post-2000). Since long start-up times are required for research and development programs, as well as long lead times for constructing nuclear power plants (and in the case of breeders, associated reprocessing facilities), decisions need to be made now as to exactly what program the country wants to follow. Should breeders be dropped as an energy alternative because they are too dangerous in terms of nuclear proliferation, or are the risks acceptable because of the necessity of breeders for electrical power production? If CRBR is cancelled, the LMFBR program will need a new direction to which other LMFBR research can relate or the entire LMFBR program could be dropped. These issues will almost assuredly arise in the 96th Congress.

Breeder Reactor Alternatives to the LMFBR

In the 1960's, the Atomic Energy Commission chose the liquid metal fast breeder reactor (LMBBR) as the breeder reactor concept on which to focus research and development attention. In making that decision, the AEC passed over other breeder reactor concepts which are now being revived as possible alternatives to the LMFBR.

Background

Breeder reactors, which produce more fuel than they consume, are of two basic types: thermal breeders, which generally have low breeding ratios (the amount of new fuel material produced per amount of fuel consumed) and use a thorium/uranium combination for fuel; and fast breeders, which have higher breeding ratios and use a uranium/plutonium fuel cycle.

Two thermal breeders have received some attention in the U.S. breeder R&D program: light water breeder and molten salt breeder. In addition to the LMFBR, there is another fast breeder concept, the gas cooled fast breeder. These programs are in various stages of development. An experimental light water breeder began operation at Shippingport, Pennsylvania in the fall of 1977. Preliminary results are expected in about three years. A Molten Salt Reactor Experiment was conducted by the Atomic Energy Commission in the 1960's, but no other work has been performed since. Non-breeding gas-cooled reactors have been built in the United States and abroad, although no gas-cooled breeder has been operated.

Following President Carter's April 1977 decision to terminate the LMFBR demonstration project at Clinch River, Tennessee because of proliferation dangers from the plutonium it would produce, Congress began to look at alternatives to the LMFBR. One proposal calls for operating breeder reactors on the thorium cycle since no plutonium would be produced (although another material which can be used in nuclear weapons is produced). If a thorium cycle is declared preferable to plutonium, then one of the thermal breeders may be better. Fast breeders can operate using the thorium cycle instead of plutonium, although with sharply decreased breeding ratios. Nevertheless, the best breeding ratio for all the breeder types on the thorium cycle is the gas-cooled breeder, not the LMFBR.

Importance

If breeder reactors are considered an essential component of the Nation's energy future, decisions on whether to continue pursuing the LMFBR or switch to one of the other breeder concepts should be made as soon as possible to allow for introduction of breeders when required, possibly by the turn of the century. The question of what breeder reactor concept to pursue is likely to arise during deliberations on DOE's annual budget request.

Thorium versus Plutonium Fuel Cycles

Breeder reactors can operate on either the plutonium or thorium fuel cycles. Since better performance is obtained using plutonium, the thorium option has not received much attention in the past. President Carter's concern over the possible proliferation of nuclear weapons because of the increased availability of plutonium in an era of breeder reactors, however, has revived interest in the thorium option.

Background

Nuclear reactors operate by the fission process which generates energy in the form of heat. The material which fissions is called "fissile" material, as opposed to "fertile" material which becomes fissile if it captures a neutron. In breeder reactors, the fissile material generates heat for the production of electricity and neutrons for converting fertile material into additional fissile material which can be recycled for use as nuclear fuel. As originally proposed, the liquid metal fast breeder reactor (LMFBR) fuel rods would contain either uranium-235 (U-235) or plutonium as the fissile material and fertile uranium-238 (U-238) for conversion into more plutonium. In addition to being used as reactor fuel, plutonium can be used in nuclear weapons. This latter characteristic led to President Carter's April 1977 decision to terminate the LMFBR demonstration project at Clinch River, Tennessee since he was concerned that terrorist groups might obtain some of the plutonium generated in plutonium breeders, and use it to build bombs.

Just as the fissile plutonium is created by bombarding U-238 with neutrons, the fissile element uranium-233 (U-233) can be created by adding neutrons to the fertile element thorium. Therefore it is possible to operate a nuclear reactor on the thorium cycle, too. Since the uranium/plutonium cycle has superior breeding characteristics over the thorium/uranium cycle, the U.S. breeder program has proceeded under the assumption of using the plutonium fuel cycle. Following President Carter's decision to avoid using plutonium if at all possible, the thorium cycle option is receiving new attention. Uranium-233 can be used for nuclear weapons just as plutonium can, but some experts are convinced that the U-233 created in thorium cycle breeders would be less prone to proliferation than plutonium. This reasoning is based on the assumption that the U-233 would be mixed with U-238 in the reactor. Such a mixture would require both isotope separation and chemical reprocessing, rather than just the chemical reprocessing needed to separate Pu from U-238.

The central questions regarding use of thorium instead of plutonium in reactors are whether the U-233 is really less prone to proliferation than plutonium, and if so, whether the proliferation considerations outweigh other factors, such as maximizing the breeding capability.

Importance

A decision to use thorium cycle reactors instead of plutonium could completely change the nature of the U.S. breeder reactor program. An LMFBR operating on a thorium, rather than plutonium, fuel cycle does not provide outstanding performance, so a different breeder reactor concept may be preferable. The International Nuclear Fuel Cycle Evaluation (INFCE) study organized by President Carter is studying the advantages and disadvantages of thorium versus plutonium fuel cycles. This two-year study will conclude during the term of the 96th Congress, and the issues will undoubtedly be raised during budget deliberations for the Department of Energy.

Non-Proliferation Alternative Systems Assessment Program and International Nuclear Fuel Cycle Evaluation

In 1977, President Carter invited other nations to join with the United States in an International Nuclear Fuel Cycle Evaluation (INFCE). Subsequently, INFCE was given statutory standing in the Nuclear Non-Proliferation Act of 1978. U.S. participation in INFCE is supported by analysis and research funded by DOE's Non-Proliferation Alternative Systems Assessment Program (NASAP). How effective the United States will be in persuading other nations to accept its non-proliferation ideas will depend in part upon the quality and effectiveness of NASAP work.

Background

President Carter's non-proliferation policy statements of April 1977, with their purpose of seeking to limit the spread of sensitive nuclear technologies and facilities, led to NASAP. The goal of this DOE program is to provide recommendation by the fall of 1978 on the development of systems which have potential for reducing the risks of diversion of nuclear materials to make weapons. NASAP analyses and reports are being used by U.S. participants in INFCE. Moreover, many U.S. advisers and consultants for the U.S. participation in INFCE are funded through NASAP. The NASAP budget request for FY 1979 was $6.3 million.

The statutory purpose of INFCE, as specified in Sec. 105 of the Nuclear Non-Proliferation Act of 1978, P.L. 95-242, is to reevaluate all aspects of the nuclear fuel cycle, with emphasis on alternatives to an economy based on the separation of pure plutonium or the presence of highly enriched uranium, methods to deal with spent fuel storage, and methods to improve the safeguards for existing nuclear technology. The President, in his first report on non-proliferation progress, in January 1979, is to include in detail the progress of this international reevaluation.

Importance

President Carter, in opening the organizing session for INFCE at the United Nations, on October 19, 1977, said in part:

> It's important that we know what potential nuclear fuel cycles are available to use, the quantity and the location of uranium and thorium and other nuclear fuels, the methods used for extraction, the methods used and the costs for enrichment, possible distribution systems, the proper design and use, standardization of power plants, safety of people who live near them, proper siting considerations, the political objections to atomic power plants themselves, the possible need for breeder reactors, the handling of spent fuel, and international safeguards that will prevent the development of nuclear explosives.

The reports anticipated at the conclusion of INFCE in 1979 are expected to become a foundation for further U.S. non-proliferation efforts. The INFCE exercise itself, if it meets the President's hopes, will help to convince other countries that plutonium is not needed now as a nuclear fuel and that

reprocessing can and should be deferred until more effective safeguards can be devised and installed, and alternatives to the use of plutonium have been found inadequate.

Analyses funded by NASAP are fundamental inputs for the U.S. participation in the eight INFCE groups. Among these, the U.S. cochairs the group on advanced fuel cycles and reactor concepts. NASAP funding is short-ranged, since INFCE itself is a two-year undertaking. Much of the NASAP work is not yet available because these analyses and reports are considered as INFCE working papers which, under INFCE ground rules, are not available to the public. It is not clear whether, when and in what form the results of this DOE-funded work will become generally available.

Of possible interest to the 96th Congresss is how well NASAP analyses and research have supported INFCE, how this work and information have been received, and what influence it has had. As for INFCE, its report can be expected to increase congressional interest in nuclear power issues in the second year of the 96th Congress, which will also be the year of a presidential election and the year for the second international review conference for the Nuclear Non-Proliferation Treaty (NPT).

Nuclear Waste Management

The disposal of radioactive wastes is one of the major issues involved in the debate over the future of nuclear power generation. Growing dissatisfaction with past and present nuclear waste policy has been reflected in numerous hearings and legislative proposals in the past two years.

Background

The major question involved in radioactive waste management is the disposal of highly radioactive fission products resulting from the operation of nuclear power plants. These fission products are present in the spent fuel removed from reactors. Formerly it was assumed that spent fuel would be reprocessed to remove remaining uranium and the plutonium that was produced in the reactor, leaving the fission products to be disposed of permanently. The current Administration policy is to defer reprocessing indefinitely, creating the possibility that spent fuel will be disposed of permanently without reprocessing. The deferral of reprocessing has created a problem for utilities whose facilities for on-site storage of spent fuel are expected to be filled, in many cases, in the next few years. In response, the Administration has offered to take ownership of spent fuel and store it in Away-From-Reactor (AFR) storage facilities.

Importance

The formation of a comprehensive policy to deal with the problem of radioactive wastes will reach a climax during 1979, and the Congress will have a major role to play. The President's Interagency Review Group (IRG) issued its draft report in October 1978, and a formal policy and package of legislation is expected early in 1979. In addition, crucial policy questions will be involved in the program authorization requests for nuclear waste management.

Among the issues involved in the waste management program are:

1. The adequacy and timeliness of the proposed Administration program to deal with high-level radioactive wastes from commercial nuclear power facilities in light of public concern over the problem posed by rapid growth of nuclear power.
2. The significance of Administration policy deferring spent fuel reprocessing and the concomitant difficulties in disposing permanently of spent fuel.
3. The adequacy and timeliness of the Administration's efforts to provide Away-From-Reactor (AFR) storage of spent fuel from reactors where on-site storage facilities are filled.
4. The future and role of the Waste Isolation Pilot Project (WIPP), originally designed as a repository for military transuranium-contaminated (TRU) waste, then suggested as an R&D facility for emplacement of spent fuel and military high-level waste. There are indications that the WIPP project may be dropped.
5. Legislation regarding licensing of waste facilities, both for commercial and for Energy Department wastes.
6. Questions involving the role of State authorities in location and approval of waste facilities.

Reprocessing Concepts and their Relationship to the Proliferation Issue

Reprocessing of spent nuclear fuel would conserve energy resources, but a danger exists that the plutonium thus produced could be diverted and used to produce nuclear weapons. Because of this possibility, U.S. nuclear reprocessing work was halted in April 1977. New reprocessing concepts have since been suggested which might reduce or eliminate the proliferation hazard.

Background

The operation of a nuclear power plant results in the production of spent fuel, which contains significant quantities of fissionable uranium and plutonium. If this material is recovered and recycled, the available supplies of fissionable materials are thereby extended. However, some degree of danger would exist that the plutonium separated in a nuclear reprocessing plant could be stolen or diverted by hostile nations or terrorist groups, and used to produce nuclear weapons. Because of this danger, the Carter Administration decided in April 1977 to halt nuclear reprocessing work in the United States and to discourage it in other nations.

In order to meet this concern, several new reprocessing concepts have been suggested. One of these, called "Civex," was proposed jointly by the U.S. Electric Power Research Institute and the British Atomic Energy Authority. In the Civex process, the plutonium concentration would remain below weapons-grade levels at all times, and the stream containing plutonium would be "poisoned" with hightly radioactive fission products so as to discourage theft. A second new process, proposed by Allied-General Nuclear Services (AGNS), would achieve the same purpose by "spiking" the plutonium-239 with plutonium-238, which is highly radioactive and would be impossible to separate chemically from the plutonium-239. The technical and economic feasibility of these concepts is as yet not proven.

Importance

In the absence of proliferation-proof nuclear fuel cycles, reprocessing work in this country has been halted. The Administration's attempt at discouraging the reprocessing plans of other nations has been largely unsuccessful. Therefore the United States is losing ground to those other nations while this self-imposed moratorium continues.

Civex, the AGNS approach, or some other approach along the same lines could resolve this problem by eliminating or greatly reducing the proliferation hazard associated with nuclear reprocessing. But these concepts are new and require research and development work before they can be brought into use. This will require funding, presumably in the Department of Energy's authorization and appropriation bills to be considered by the 96th Congress. The level of such funding, and the direction that nuclear reprocessing is to take, should be of interest to the committee.

Research and Development for Nuclear Safeguards

The purpose of nuclear safeguards is to limit the risk of the spread, or proliferation, of nuclear weapons from civil use of nuclear power by providing timely warning of diversion of nuclear materials that might be used to make nuclear explosives or weapons. Four U.S. agencies, an international and a multinational, regional agency, and many foreign governments are conducting research and development to improve nuclear safeguards systems.

Background

The civil use of nuclear power involves many materials that might be used to make nuclear explosives and weapons. Uranium-235, uranium-233 and plutonium are nuclear explosive materials the undetected theft or diversion of which would increase the risk that nations now without nuclear arsenals, and terrorist or other subnational organizations, might secretly make nuclear weapons or explosives. Effective safeguards are fundamental to assure nations and their citizens that commitments of many nations under the Nuclear Non-Proliferation Treaty (NPT) not to make or acquire nuclear weapons are kept and to provide time for effective counteraction if theft or diversion is detected. Safeguards systems require both effective technology and effective systems and procedues. Safeguards technology includes ways to sample, analyze and measure nuclear materials in bulk, non-destructive testing to measure them in fabricated nuclear fuels, ways to measure nuclear materials present in radioactive spent nuclear fuels, and also technology for surveillance, such as television and film monitors, and seals. Safeguards systems have to deal with statistical limits of sampling and analysis, frequency and nature of inspections, the kinds and contents of records and analytical methods capable of distinguishing random variations from deliberate diversions of small quantities of nuclear materials.

The Department of Energy, the Arms Control and Disarmament Agency and the Nuclear Regulatory Commission, all fund R&D in support of U.S. and international safeguards systems. In addition, some U.S. funds for the International Atomic Energy Agency are earmarked for safeguards R&D.

Importance

One reason advanced by President Carter for his policy of deferring reprocessing of nuclear fuels and recycling of plutonium in present-type nuclear power reactors is that safeguards are inadequate to provide timely warning for diversion of plutonium from points in the nuclear fuel cycle where it would be present. Critics of nuclear power also have challenged the effectiveness of safeguards for the nuclear fuel cycles now in operation. Title II of the Nuclear Non-Proliferation Act of 1978, P.L. 95-242, provides for the United States to act with other nations to strengthen IAEA safeguards so as to ensure:

(1) the timely detection of a possible diversion of source or special nuclear materials which could be used for nuclear explosive devices;

(2) the timely dissemination of information regarding such diversion; and

(3) the timely implementation of internationally agreed procedures in the event of such diversion.

Timely warning is also a statutory criterion specified in the act for Department of Energy approval of foreign requests to reprocess nuclear fuels of U.S. origin. Title III of the act provides in part that, after 18 months, the NRC can approve nuclear exports only to nations that have agreed to IAEA safeguards for all of their nuclear activities (full-scope safeguards).

The importance attached to safeguards as a deterrent to proliferation underscores the need for effective safeguards, and so supports the need for improvements to be achieved through research and development.

Of likely interest to Congress is how well the purposes of federally funded safeguards R&D are defined; whether or not trends in this research work are responsive to changing trends in national and international nonproliferation policies and actions; what overlaps, or gaps, may exist between the respective responsibilities of the ACDA, DOE and NRC within the United States; and the relation of their work to that abroad.

The fundamental questions are twofold. First, what is the target of the U.S. safeguards R&D? To safeguard present nuclear fuel cycles, or to safeguard possible future breeder fuel cycles? Second, whether or not the present R&D programs are likely to reach their objective.

Goals of the Fusion Program

Nuclear fusion is a potential source of energy which poses comparatively fewer environmental problems than current fission plants and relies on low-cost, readily available, inexhaustible fuels. As one of the most attractive long-term solutions to U.S. energy demands, the progress of the fusion R&D program is of direct congressional concern.

Background

Most proposed nuclear fusion power plants are based on the reaction wherein one atom of deuterium and one atom of tritium (both gases and isotopes of hydrogen) forcefully collide to form an atom of helium. The reaction releases energetic neutrons which are absorbed by and heat the surrounding coolant. The coolant when heated generates steam which is used to power conventional turbine engines. The difficulty in achieving nuclear fusion is that such reactions do not begin to occur until the mixture of deuterium and tritium achieves a minimum density and temperature for a sufficient duration to return more energy than is invested. At such conditions the reaction becomes extremely difficult to contain. The different approaches to nuclear fusion may be categorized by the method used to heat and contain the reaction.

In the magnetic confinement approach to fusion, strong magnetic fields are used to contain the reaction. The inertial confinement schemes employ lasers or charged particle beams to implode a pellet containing deuterium-tritium gas. This implosion derives the contents of the pellet inward creating an environment where fusion reactions can occur.

Importance

The great potential of fusion power as a long-term energy source raises the concern of whether the program goals are appropriate to achieve technical and economic feasibility at the earliest possible date.

One of the major concerns relating to fusion program goals is whether fusion R&D is sufficiently funded to achieve technical goals at the maximum rate possible.

Due to budget constraints and the enormous capital expenditures necessary to pursue the development of any given approach to fusion, the Department of Energy (DOE) has limited its emphasis in fusion R&D funding to a few major approaches. Some argue that alternative approaches should have been more fully explored before efforts were concentrated on a few schemes, in order to determine those approaches with the best potential. Conversely, it is argued that even if those designs currently given the majority of the funding are not the best long-term solutions, either for practical or theoretical reasons, many areas of experimentation common to all fusion schemes are being tested as these devices are built. Thus, the information derived is useful to other programs and the efforts are therefore not wasted.

Another issue relating to the goals of the fusion program is the attempt by some to determine whether or not fusion power will be economically viable before spending further funds. The argument is that if fusion power will

never be able to provide a commercial plant, research efforts in this area are wasted. Opponents of this view claim it would be foolish to judge the future economic viability of fusion power on the present embryonic state-of-the-art. To close the avenues of promising technical achievement because of predictions of poor economic viability may hinder scientific efforts to perfect the technical concept. Once the scientific theory of net energy return from fusion power is proved, design efforts can be concentrated on more economical approaches.

Yet another issue concerning the goals of the fusion program is the primacy of the military applications goals in the inertial confinement program. Opponents of this policy claim that the emphasis of military goals precludes adequate consideration of inertial confinement for civilian power applications, and that money should be allocated specifically for civilian research.

The FY 1980 DOE budget request, including funding for fusion R&D, will be presented to the Congress at the beginning of the 96th Congress. Since many of the policy decisions regarding fusion program goals depend on the amount of funding allocated to fusion research, consideration of the budget offers an opportunity to assess concerns regarding fusion program goals. The decisions of the 96th Congress may impact the long-term success of the program.

International Cooperation in Nuclear Energy Research and Development

One method for reducing the financial burden on any one country for development of expensive technologies, such as fission and fusion reactors, is to form international groups which split the costs. Such a method also allows for coordination of design parameters which may determine the licensability of the reactor in participating countries.

Background

The United States initiated international cooperation in development of nuclear power through the Atoms for Peace Program in the 1950's which allowed other nations access to information obtained in the U.S. civilian reactor program. Thus, when the United States' breeder reactor research program focused on the liquid metal fast breeder reactor, other countries followed suit, rather than perform independent research on other breeder types. Some of the European nuclear R&D programs are cooperative, such as the German, Belgian and Dutch consortium which is building the SNR-300 demonstration LMFBR.

This cooperation was information transfer only, however, not actual project cooperation such as in the case of the European groups. The United States now pursues its own research program for nuclear fission, although it cooperates with other countries in fusion research.

The international cooperation that does exist in fission and fusion research is coordinated by the International Atomic Energy Agency and the International Energy Agency, and in the case of fusion, the Joint Fusion Power Coordinating Committee as well.

International cooperation provides access to increased expertise, additional research facilities and greater funding for research into a specific field. This can provide a broad case of technology for future development without unnecessary duplication. On the other hand, it can be argued that in light of the strategic importance of energy independence, the United States should not give away valuable information to other nations. An additional advantage is that since some countries have significantly different criteria for licensing reactors, a reactor design developed by an international corsortium including the United States would be more likely to meet licensing criteria in the United States, which has more stringent safety requirements than other countries.

Importance

Current and expected budget constraints will almost certainly impact research and development programs, including those for nuclear power. Therefore the most effective use of financial resources is necessary. If it is determined that international cooperation in nuclear research does not result in U.S. giveaway of vital information without equitable return, the 96th Congress may wish to consider mechanisms for increasing such cooperation.

9. FEDERAL R&D SUPPORT

See also items:

13.1 National Science Foundation Social and Psychological Sciences Research Support
14.3 Federal Government Support of a Major Communications Satellite R&D Effort
14.8 Federal Government Support of High-Risk Space Technology
14.11 Support for NASA's Space Science Projects
16.3 NSF Support for Basic Research in Industry
17.2 Utilization of Federal Laboratories by the Private Sector and State and Local Government

Federal Support of Basic Research

There is general agreement from the President on down that the Federal support of basic research by the NSF and mission agencies is desirable and necessary. One problem is that there are admitted differences between funders and performers in distinguishing basic research from applied research activity. How can the Congress ascertain whether basic research is indeed receiving adequate Federal support from the NSF and mission agencies? What effects will recent regulations related to allowable costs of research, and legislation setting a ceiling on salaries of faculty receiving research grants from NSF, and the implementation of the Federal Grant and Cooperative Agreement Act of 1977 have on universities, the principal performers of basic research?

Background

As defined by the NSF, basic research is "systematic, intensive study directed primarily toward greater knowledge or understanding of the subject studied, rather than a practical use of this knowledge or understanding." Other agencies define basic research differently. As the agency with a primary mission to "initiate and support basic scientific research and programs to strengthen scientific research potential..." the NSF has long been a major source of basic scientific research support to investigators at colleges and universities. However, other Federal departments and agencies also support basic scientific research in furtherance of their missions.

Concern at the the growth of Federal R&D during the 1960s, particularly within the Department of Defense, led to reduced funding together with congressional demands that mission agency research to be relevant, and resulted in the enactment of section 203 of P.L. 91-121 (the Mansfield Amendment). This restriction was subsequently modified in 1970 and it is still in effect. Other agencies whose budgets were constricted also tended to cite relevance as a basis for cutting back on research farther removed from their immediate missions.

Importance

For the past several years it has been an Administration policy to reverse the downward trend and to actively support an increase in basic research funding, both by the NSF and the mission agencies. The OSTP has funded major inquiries into basic research support in the mission agencies, focusing first on the Department of Defense, then the Department of Energy. The 10th annual report of the National Science Board issued in 1978 also dealt with basic research in the mission agencies and contains detailed information from a total of 16 agencies.

Recent actions which may impact significantly on universities as the principal performers of basic research were the promulgation of Circular A-21 relating to cost principles at educational institutions receiving grants and contracts, an amendment to the NSF appropriation act for 1979 which set an upper limit on salaries of faculty performing research, and the passage of the Federal Grant and Cooperative Agreement Act of 1977 whose objective is to attain greater uniformity among agencies in instruments used for procurement purposes, including research.

ASRA -- Integrated Basic Research

The Directorate for Applied Science and Research Applications (ASRA), which was established in February 1978 to improve the National Science Foundation's management of its science applications activities, warrants continuing oversight by Congress, particularly the Integrated Basic Research activity. That activity is a key to bridging the gap between basic research and the applications of that research to many national problems.

Background

On February 6, 1978, the National Science Foundation established the Directorate for Applied Science and Research Applications (ASRA) to replace the Research Applied to National Needs (RANN) program. Director Atkinson said that the changes were designed "to provide a more sharply focused scientific and engineering attack on emerging or existing national problems and to help build a better bridge between basic research and the solution of such problems." The new Directorate consists of five major activities: Problem Analysis, Integrated Basic Research, Applied Research, Problem-focused Research Applications, and Intergovernmental Science and R&D Incentives. The Integrated Basic Research (IBR) activity is of particular importance to the success of ASRA because it is through this mechanism that support will be provided for basic research that has a high relevance to major problems.

Importance

Although it is difficult to trace the benefits of a single basic research project, nevertheless the allocation of resources to fields of basic research may determine those areas in which major technological advances are likely to occur. Thus identifying areas of basic research with a high probability of application is important. But the danger exists that the IBR funding will simply add to the existing funding for undirected basic research. Moreover, it is not clear whether, or how, basic research with applications potential will be transferred to applied research.

The Foundation requested $67.0 million for ASRA in FY 1979; there would also be a $6.9 million deferral from FY 1978, making the total available funding $73.9 million. This included $7.0 million for IBR. The final appropriation was $55.0 million for ASRA and not to exceed $5.0 million for IBR. The FY 1979 authorization was $69.7 million for ASRA with no ceiling on funds for IBR. The House Appropriations Committee criticized ASRA for overlap and duplication with mission-oriented agencies and little evidence of goal-oriented planning and management. The committee also objected to the large proposed increase for the untested IBR program.

This is a timely issue for congressional consideration because the Foundation has had nearly a year with which to begin operations in ASRA and the new program will be coming up for review in the FY 1980 budget process. Also, the concern to make the basic research of the Foundation more directly relevant to technology development and national problems is more urgent in light of the domestic policy review on industrial innovation in the executive branch which is concerned with a perceived decline in innovation in the United States.

NSF Support of "Big" and "Little" Science

The balance of NSF funding for "big" and "little" science needs to be reviewed, as well as decision-making procedures for initiating and managing "big" science activities.

Background

A substantial portion of National Science Foundation obligations are spent in support of "big" science activities, basic research activities that depend on the use of pieces of expensive scientific equipment or facilities. Some of the "big" science activities funded by NSF include the National Observatories, the National Center for Atmospheric Research, the Deep Sea Drilling Project, and the International Decade of Ocean Exploration. About 25 percent of the FY 1979 budget request was for such "big" science activities, while "little" science or individual scientific research project support accounted for about 50 percent of the request. The FY 1979 budget process raised questions about the balance of NSF funding for "big" and "little" science, as well as decision-making procedures for initiating and managing "big" science activities.

Importance

There is little debate that the NSF should fund "big" science; it has done so since the early 1950's, with the encouragement of Congress. However, questions have been raised about the appropriate balance between big and little science in the NSF budget. Although big science provides many benefits in terms of enabling research advances that otherwise would not be possible, it concentrates large amounts of funding among a relatively small number of researchers. This occurs at a time when demands for research support are far greater than the Foundation's resources, and when there is great concern that young scientists are unable to obtain support for their research. "Big" science projects also concentrate funds in particular scientific fields, such as astronomy and earth and ocean sciences, and not in others, such as biology and social sciences, thus conceivably stimulating the advance of some fields much more than others. On the other hand, it may be argued that advance in some fields requires large expenditures or that "big" science has higher payoff in terms of applications. The House authorizing committee suggested that NSF should develop measures of the relative costs and benefits of "big" and "little" science support.

Concern has also been raised about the Foundation's decision-making procedures for initiating and managing "big" science projects. In the FY 1979 budget request the NSF requested $4.2 million for feasibility studies and start-up of a new deep-sea drilling project. There was no indication of what the total cost would be over the years and no request for congressional authorization of the project itself. The House authorizing committee suggested that Congress should consider requiring NSF to request authorization for each new "big" science project.

The Foundation has traditionally initiated "big" science projects in response to desires expressed by the scientific community. This raises questions about how NSF assigns priorities to the projects suggested to it. It is particularly notable that the "big" science support is concentrated among a few scientific disciplines.

This is a timely issue for congressional consideration. The House Committee on Science and Technology devoted considerable attention to this issue in considering NSF's FY 1979 budget request. The budget request for a new deep sea drilling project was cut and the Foundation was told that it would have to better justify such an undertaking before increased funding would be authorized. As Federal funds for basic research remain tight the allocation of funds to "big" and "little" science may have to be closely scrutinized.

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The Future of the National Bureau of Standards

Does the National Bureau of Standards have the necessary resources to discharge the wide range of responsibilities which have been assigned to it? Is its present internal organizational structure and its location as a research establishment within the Federal Government optimum for the discharge of its responsibilities?

Background

The National Bureau of Standards is a technical arm of the Department of Commerce, administratively under the Assistant Secretary for Science and Technology. Founded in 1901, the Bureau serves as the national laboratory for physical measurements and standards. It also serves industry and other Government agencies in a range of activities. In addition to its mission responsibilities have been assigned by its organic act, over the years a wide range of additional responsibilities have been assigned to the Bureau by legislation, for the most part without the concomitant assignment of additional resources. The Bureau assigns top priority to these assignments in allocating resources.

In 1978 the Bureau got a new director and underwent a major internal reorganization. Also in 1978, its organic act was amended by P.L. 95-322 to make periodic authorization of appropriations necessary beginning with fiscal year 1981.

Importance

Oversight hearings on the NBS were held by the Senate for the first time in 1978. The last major oversight hearings by the House were held in 1971. Numerous concerns relating to the state of research and the well-being of the Bureau were identified in the report, Basic Research in the Mission Agencies, issued by the National Science Board in 1978. (See pp. 44-54, 242, 304-05). An OTA case study on the National Bureau of Standards of March 1978, as part of its national laboratories assessment, raised similar concerns. Questions which the Committee may wish to address in advance of or in conjunction with authorization hearings on the Bureau are: Does the role and mission of the NBS need to be clarified? Has there been an adverse effect on the NBS through the growing tendency in Congress to assign additional specific responsibilities to it? Is the Bureau able to do the basic research associated with its mission that it believes to be necessary? Has the climate at the Bureau for long-term research suffered because of specific short-term assignments? To what extent should the Bureau perform research for other Federal agencies? Should the Bureau's facilities be available to scientists on a regional or national basis? How can the gap areas in Bureau research (identified at pages 304-05 of NSB report: more accurate techniques for determination of low concentrations of organic compounds in diverse media, obtaining a higher duty cycle accelerator than the present facility, measurement techniques to meet requirements of submicrometer microcircuit devices and beyond, additional resources for basic research, and necessary thermal studies) be addressed? Is the Bureau devoting adequate attention to such identified specific problem areas as corrosion, phase diagram data, energy materials, and the need for critically evaluated physical and chemical data? Is its present organizational structure, both internally and as a research establishment within the Federal Government, optimum for the discharge of its responsibilities?

10. INTERNATIONAL SCIENCE AND TECHNOLOGY

See also items:

8.4 Non-Proliferation Alternative Systems Assessment Program and International Nuclear Fuel Cycle Evaluation
8.6 Reprocessing Concepts and their Relationship to the Proliferation Issue
8.7 Research and Development for Nuclear Safeguards
8.9 International Cooperation in Nuclear Energy Research and Development
12.4 Foreign Exchange of Scientific and Technical Information
14.6 Legal Aspects of Routine Utilization of Space
14.7 International Cooperation in Space

Technology and International Trade Competitiveness

Concern is increasing among industrial and Government leaders that the United States is losing ground with respect to international trade competitiveness in advanced-technology products, which have traditionally been a source of favorable U.S. trade balances. One of the reasons posited for this declining position is a decrease in R&D and innovation in American industry relative to competitor nations.

Background

Concern is increasing among industrial and Government leaders that the United States is losing ground with respect to international trade competitiveness in advanced-technology products, which have traditionally been a source of favorable U.S. trade balances. Testimony in hearings on industrial innovation in the spring of 1978 revealed that the United States is losing world market share in many high-technology products and that we had a $3.6 billion trade deficit in 1977 with Japan in high-technology goods, primarily accounted for by consumer imports.

One of the reasons posited for this declining trade position is a perceived decrease in R&D and innovation in American industry. Industrial R&D has remained essentially constant in inflation-corrected dollars for the last decade, largely due to the decline in federally-funded industrial R&D. Meanwhile industrial R&D in competitor nations has increased. The state of American technology as a whole is probably not deteriorating, but a few U.S. industries, such as steel and shoes, are in a vulnerable position.

It is believed by some that technology exported by the United States in the form of products and production processes may be used by recipient countries to compete with U.S. industry. Others, however, claim that technology transfer stimulates U.S. R&D and enhances U.S. exports. Extant research indicates that the net effect on the U.S. economy is probably positive. However, the increasing imports of foreign high-technology consumer products, such as color televisions, have fueled the concern.

Importance

Two types of policy suggestions have been made: 1) measures to control technology exports and imports, and 2) Government funding or stimulation of R&D and innovation in U.S. industry.

Issues for Congress include:

1) To what extent is the trade problem related to industrial technology and to what extent to other factors such as overall economic growth and Government policy? Will increased industrial R&D and innovation significantly contribute to a solution to this problem?
2) What is the net effect of international technology transfers on the U.S. economy? What sectors are particularly vulnerable?
3) Which of the policy suggestions -- controls or stimulation -- would be more effective in regaining a dominant American trade position?

The timeliness of this issue for congressional consideration is enhanced by the continued worsening of U.S. trade balances and the executive branch domestic policy review on industrial innovation aimed at policy options for stimulating or at least removing disincentives to industrial innovation.

Preparations for the United Nations Conference on Science and Technology for Development

What initiatives should this Nation take to satisfy LDC demands for a greater share of the world's S and T resources and the economic benefits of the application of technology? U.S. preparations for the United Nations Conference on Science and Technology for Development, where these issues will be discussed, apparently are not proceeding as rapidly as many persons would like. Government agencies, labor, industry and significant other interest groups apparently have not been able to reach consensus on these issues.

Background

The United Nations Conference on Science and Technology for Development (UNCSTD), is planned for August 1979 in Vienna. The Conference is intended to develop national, bilateral and international strategies to promote the application of science and technology to the development of the less-developed nations. Many LDCs view the objectives of the UNCSTD in exclusively political, social, and economic terms, i.e. to effect a world-wide redistribution of power and wealth which they believe would also generate structural changes essential for the growth of S and T.

The U.S. Government has been attempting for over a year to forge a policy consensus on the meeting but neither the U.S. national paper (required by the U.N. at least a year prior to the meeting) nor the promised Presidential Review Memorandum have been finished. Delays result from difficulties in reconciling the positions of involved agencies with different vested interests in S and T and technical assistance oriented foreign policies. The major actors in the on-going policy dialogues are the Department of State, the Office of Science and Technology Policy, relevant Federal agencies, and segments of labor and industrial communities. Many scientists also have complained that their voices and concerns for development of S and T have been given short shift. Also the promotion of trade and development of foreign markets favored by industry seems to be perceived as a threat by many segements of labor hoping to protect domestic employment.

The inconsistencies in policy preferences between these sectors were the focus of Senate Commerce Committee hearings in 1977. Other congresssional concerns for the UNCSTD have taken the form of passage of legislation for special funding, statements to endorse the Conference, and legislation to emphasize the importance of "light capital technology" in U.S. plans. It has also been suggested that the proposed Foundation for International Technological Cooperation will constitute a major U.S. initiative for the Conference. It remains to be seen whether these policies will satisfy the demands of the LDCs for a more equitable share of S and T and its attendant economic benefits and whether the Conference will be valued more for policy outcomes than for rhetoric.

Importance

The third preparatory meeting for the Conference is scheduled for February 1979. Congressional oversight of U.S. preparatory activities may improve policy formulation processes. Oversight is required also of compliance with statutory requirements regarding U.S. policy for the Conference.

Creation of the Foundation for International Technological Cooperation

It is expected that President Carter will include funding for creation of the Foundation for International Technological Cooperation in the FY 1980 budget and that the proposed foundation will constitute a major initiative of the United States at the U.N. Conference on Science and Technology for Development, planned for August 1979. The proposed foundation will be organized by assuming functions of S and T, development assistance, and research from existing institutions under the aegis of the proposed new International Development Cooperation Administration.

Several potential legislative issues are involved. One is that of government reorganization. The foundation will be organized by assuming the functions of S and T transfer, development assistance and development-oriented research from existing Federal agencies under the aegis of the proposed new International Development Cooperation Administration. An involved second issue is more in the nature of a policy shift since the proposed foundation is intended to develop a new pattern of technological and scientific cooperation with the developing countries to insure significant improvement upon the oft-criticized U.S. foreign assistance efforts.

Background

The decision to proceed with a Foundation for International Technological Cooperation was made within the executive branch in early 1978 and announced by President Carter in Venezuela on March 29. A planning office has been established and has held meetings and issued several documents to advise John Gilligan and Frank Press of OSTP about organization and functions for the FITC.

It is proposed that the FITC will become a semi-autonomous part of the proposed International Development Cooperation Administration (IDCA). The largest component of IDCA would be the bilateral AID program. The FITC will be responsible for research, related institutional development, and adaptive application of development technology at the country level. OPIC, the Peace Corps and development activities of multilateral organizations that are carried out by Treasury and State are also being considered for inclusiion in AID.

The Foundation is planned to work directly with U.S. institutions and with developing country institutions and agencies in improving scientific and technological capabilities in developing countries and in addressing cooperatively critical problems of development and of longer-range global concern. A problem-focused, rather than a country-focused, approach will be used. It is planned that the principal problem areas for the Foundation will be: rural productivity, diseases of rural areas, population growth rates, developing countries' technological skills, information and communications, non-agricultural employment, environmental planning and natural resources, energy, and nutrition improvement. FITC will make grants and award contracts and will emphasize host country involvement in FITC sponsored research. Discussions have addressed the issue of including LDC officials on FITC advisory planning groups. FITC will also support the exchange of technical information relating to development, attempt to strengthen capacity in

S ant T in an LDC, attempt to bring more harmonious planning and improved coordination among various U.S. agencies with S and T and development responsibilities, and attempt to strengthen the capabilities of U.S. scientific and technical institutions.

Importance

The FITC proposal will be presented to the Congress in January. Administration spokesman expect to be operational via legislation or executive order in the fall of 1979. The committee should be prepared to assess this important new institution of science and technology policy and to evaluate the proposed functions and organization in relation to existing functions and organizations.

The Emergence of U.S.-People's Republic of China Relationships in S and T

It is expected that scientific exchange activities and agreements between the United States and the People's Republic will become more systematic, larger and more formal during the 96th Congress. Recently the scientific exchange activities administered by the National Academy of Sciences have been augmented by negotiated agreements for two-way exchanges of scholars, formal exchanges of high-level scientific advisory and administrative personnel, and agreements on specified types of scientific and technological cooperation, such as in energy. Oversight may be needed of the National Science Foundation funding programs in these areas and of the commitments embodied, the coherence, and the consistency of formal cooperative agreements for science and technology.

Background

Formal scientific exchange activities between the United States and the People's Republic of China had been limited to high level exchanges of scholars and information via the NAS-affiliated Committee on Scholarly Communication with the People's Republic of China, funded partially by the National Science Foundation. However, the recent thaw in relations between the two nations has been accompanied by an increased level of scientific exchange activity and by the beginning of negotiations to undertake formal reciprocal exchange activities. Presidential science advisor Frank Press accompanied by a high level scientific delegation, visited China in July 1978 and set in motion activities leading to conclusion of an 11-point verbal pact between China and NSF officials to exchange scholars in technological, scientific and social science subjects. The NAS committee is undertaking negotiations to be named executive agency for these agreements and to help set in motion lower level student exchanges, especially in technology and energy-related subjects desired by both countries. The International Communications Agency has completed a three-part assessment of the feasibility of enlarging scientific and technical exchange activities. The National Research Council is augmenting this effort with an extensive study of China's science and technology, under chairmanship of Leo Orleans, PRC specialist in the Library of Congress. More recently in November 1978 it was announced that Energy Secretary Schlesinger and Chinese officials had concluded preliminary agreement for U.S. cooperation in five energy-related areas: coal mining, hydoelectric power, renewable energy, oil and gas and high-energy physics.

Importance

U.S. experience in concluding and implementing scientific exchange activities indicates that such agreements must be based on well formulated plans for nuturing S and T exchanges most beneficial in a reciprocal (scientific and political) sense to all participants. Funding has to be adequate and political goals appropriately appreciated. It would seem wise for the Congress to assess the possibilities for more formal exchange agreements with the PRC before the executive branch undertakes commitments which it might not be prepared to implement judiciously.

Implementation of Presidential and Department of State Responsibilities for Science and Technology in Foreign Policy as Mandated in P.L. 95-426

Title V of P.L. 95-426, the Fiscal Year 1979 Foreign Relations Authorization Act gives the President and the Department of State special responsibilities for systematically improving the formulation of foreign policies dealing with science and technology. Annual reports are required on steps taken to implement these actions.

Background

Title V of P.L. 95-426, the Foreign Relations Authorization Act is entitled "Science, Technology, and American Diplomacy." Not only does it underscore the importance Congress gives to S and T in foreign policy making, but it gives the President (in consultation with the Office of Science and Technology Policy) and the Department of State specific training, information gathering and assessment, and reporting responsibilities in foreign policy making that deals with S and T.

These provisions are based on extensive legislative history compiled by the House Committee on International Relations, starting with publication in 1970 of a multi-volume report series on "Science, Technology, and American Diplomacy," and culminating with hearings held in April 1978 by the Subcommittee on International Operations. The legislation and functions specified in the law may grow increasingly more important as S and T pervade domestic and international policymaking as well and public and private initiatives.

Importance

The importance and timeliness of the issue are based logically on the provisions of the statute. Several reports to indicate compliance with the legislation are required during the 96th Congress.

The presidential report, to be presented to the Congress first on January 31, 1980, and annually thereafter, requires that recommendations be made on: (1) needs for training and personnel standards for all Federal staff involved with foreign policy and S and T, and (2) status of bilateral and multilateral S and T agreeements, including assessment of the S and T benefits of such agreements, the adequacy of the funding for such agreements, and plans for the evaluation of such agreements.

The Secretary of State, who has overall responsibility for implementation of the Act, is required to report to the Congress on January 20, 1979 on: training and personnel requirements, research and analysis including contracting needs to better apply S and T to foreign policy, and recommendations regarding how S and T could best be applied to foreign policy.

Multinational Corporations, Technology Transfer to the LDCs, and Appropriate Technology

Technology transfer is a vital element in a country's growth and development since it provides the means by which nations can acquire new technologies without extensive research and development. In the developing world, multinational corporations (MNCs) are a primary conduit for technology transfer and, as such, the activities of these companies impact significantly on the less-developed countries (LDCs). The transfer of appropriate technologies by the multinational company can encourage the utilization of technologies designed to reflect the technical skills, indigenous resources, and needs of the LDCs.

Background

The concept of appropriate technology (AT) is an attempt to work within the socio-economic structure of the LDC to ensure that the technologies adopted meet the nation's industrial, financial, educational, and employment capabilities. Because the multinational corporation is a major participant in the technology transfer process in the developing world, the issue of appropriate technology in its activities is pertinent. The technologies transferred by MNCs are generally capital-intensive and often do not act effectively to expand employment, innovation, or demand in the developing nation, conditions which are important to the economic and technical development in these countries. Capital-intensive production also tends to require skills and materials not indigenous to the LDC.

On the other hand, multinational operations can provide training, produce in quantities to compete in the international marketplace, and manufacture with the least money in the shortest amount of time. Thus, an approach to transfer which best matches the needs of the LDCs and the resources and expertise of the MNCs may be the best solution to the conflicting demands of the situation.

Importance

The United States Government is beginning to incorporate the concept of appropriate technology in its international development and assistance programs. Appropriate technology is also an initiative to be put forth at the United Nations Conference on Science and Technology for Development in 1979. The role of the multinational firm in the promotion of AT has not been fully developed, yet these corporations are a major factor in the economic growth and industrialization process in LDCs. An understanding of the situation, and the potential policy options by Congress, can increase the consideration and utilization of alternative technologies and technical processes in these countries commensurate with the work being accomplished in the governmental aid and assistance programs.

Issues Relating to the Competitiveness of Japanese Technology and Production Methods

Japanese technological prowess and industrial production processes have proven significant competitive threats to American technological and industrial markets overseas. How can the United States learn from these experiences in order to improve its competitiveness abroad?

Background

Japanese firms apparently have copied, purchased, or adapted American technological knowledge and innovations as a basis for developing world-wide economically competitive auto, electronics, computer and communications technologies. In some cases the strength of the Japanese export position has been attributed to its management and production methods -- company towns and families; voluntaristic savings programs, keeping wages low to permit noninflationary venture capital reinvestment cycles, more cohesive shared value schemes permitting harmonious labor/management relations for the sake of improving the Japanese technological export position.

It has also been asserted that Japanese companies are posing additional potential threats to American firms: they have been buying "outmoded" U.S. plants, especially in the communications and electronics sectors, and have made them profitable using domestically derived management and technological growth strategies. Profits have accrued to Japanese firms posing a significant drain on U.S. resources. However, at the same time these firms have provided additional employment possibilities for Americans.

Importance

It may be wise to assess those technological adaptation and management factors which make Japanese industry such a competitive threat to the United States in order to evaluate how American firms might profit from these techniques. It might also be wise to assess the extent to which Japanese firms are purchasing unprofitable and outmoded American industrial firms and turning a profit on them. What technologies, management techniques, and other factors have the Japanese employed to do this? Have they retained American managers with Japanese management techniques to do this? What regulatory or legislative steps could be taken to improve the American position with respect to these types of enterprise?

Fuller Utilization of World Ocean Resources: Legal, Political, and Institutional Aspects

Since the development, exploration, and fuller use of world ocean resources pose a new dimension of legal and institutional problems, the legal and political implications of this development -- with a view toward international scientific planning, analysis, and cooperation -- could be examined concurrently with that development rather than after the fact.

Background

At a time when the law governing use of the world ocean and its resources is in flux, legal, political, and institutional considerations are associated with a more comprehensive and productive use of the sea, and at least several issues need to be examined. These might include:

1. International jurisdictional issues: The siting of oceanic facilities and systems presents a number of international legal problems, many of which are jurisdictional in nature.
2. Spatial and emerging use conflicts: The many possible additional uses of ocean space in the future, when combined with an already broad spectrum of competing uses, could lead to conflicts over the utilization of ocean space.
3. Regulatory and liability aspects: Research is needed to resolve a fundamental question concerning the nature of the framework of applicable Federal and State regulatory law as regards the construction and operation of large-scale ocean energy systems. These same investigations may be extended to encompass the problem of what international regulatory authority is likely to develop or be modified in the context of present deliberations at the Third United Nations Conference on Law of the Sea.
4. Domestic and international environmental aspects: Reference here is to the environmental regulatory requirements of the National Environmental Policy Act for preparation of programmatic environmental impact statements and the possible desirability of updating the statements at various stages in oceanic development projects. International environmental law, U.N. environmental programs, and other international cooperative scientific endeavors, and application of international agreements in force or in the process of negotiation, warrant consideration.

Importance

Research regarding the legal, political, institutional, and international scientific aspects of enlightened sea use is viewed as fundamental to the negotiation of the oceanic frontier of the future. Multidisciplinary efforts now could guide America's turn to the sea, technologically, and in the development and application of this technology, in order to minimize future conflicts and constraints which might otherwise inhibit the economic benefits to be derived from fuller and more comprehensive use of the world ocean and its bounty.

U.S./Latin-American Relationships in Science and Technology

Scientific and technological relationships between the United States and the Latin American nations take on new meaning as this Nation attempts to devise policies to cope with conflicts between Latin American demands for a "New International Economic Order," and U.S. domestic needs to open up new markets for U.S. products, gain favorable terms of trade to insure access to Mexican oil, and meet national security and foreign policy commitments toward Latin America. Public and private policies, both bilateral and multilateral, may not be adequate to cope with these conflicting requirements.

Background

The assumption of a special relationship between the United States and Latin America takes on new meaning in the S and T area. Many critics say that this Nation has not developed clear-cut policies to help promote S and T development of these nations. Existing bilateral and multilateral relationships and U.S. private investment and technology transfer policies are cited for inconsistency and inability to meet the region's needs to overcome dualistic development patterns and to build S and T infrastructure. Two-class societies persist, with upper classes profitting inequitably from foreign aid and assistance measures. In an effort to overcome these problems some Latin American nations are beginning to establish common markets with trade barriers to developed nations, restrictions on the inflow and outflow of technical information (to prevent MNC takeover of domestic resources and markets and to help develop indigenous knowledge bases and production skills needed to enlarge the import substitution sector to meet product needs of lower and middle classes). Some countries are calling for a special tax on foreign investors whose nations have unbalanced trade with Latin America to develop a special fund to finance S and T infrastructure and capital needed to promote indigenous industrialization processes. These nations are also instituting policies to stem the braindrain and develop knowledge bases applicable in Latin America. Evidence of these policies is seen especially in Mexico, the Andean Pact nations, and Brazil.

Importance

It is alleged that these Latin American instituted policies will cost the United States in terms of jobs, balance of payments, and access to cheap labor intensive natural resources. Is there sufficient understanding in this Nation of the costs and benefits to the United States of Latin American development initiatives? What are proper U.S. responses given the needs to promote Latin American development and U.S. economic growth? What efforts does the United States have to make to insure access to Mexican oil? What compromises and consistencies are required in public and private scientific and economic policies to achieve mutual goals? How will these issues be handled at the U.N. Conference on S and T for Development, the UNCTAD session on NIEO demands, and during debates on the Foundation for International Technological Cooperation?

Alternative Energy Technologies and the Developing Countries

The increasing cost for conventional energy has stimulated interest in developing and adapting alternative energy technologies. The need for new energy technologies based on renewable resources is especially great in the developing world where currency to purchase fuel supplies is limited, where a large portion of the population lacks the means to buy and use conventional energies, and where other resources which can provide fuel are more abundant.

Background

The U.S. Government and the private sector are exploring and developing alternative forms of energy in light of the expense and eventual limit of conventional energies. The research performed here has potential for adaptation in the developing world where imported energy resources are expensive and where conventional fuels such as firewood are being rapidly depleted. The appropriate technology movement in the less developed countries (LDCs) is an added impetus to the adoption of energy technologies which reflect the needs and resources of the population.

Section 111 of PL 95-424, the International Development and Food Assistance Act of 1978, amends section 119 of the Foreign Assistance Act of 1961. It directs the President

> . . . to furnish assistance under this chapter for cooperative programs with developing countries in energy production and conservation, with particular emphasis on programs in research and development, and use of small-scale, decentralized, renewable energy sources for rural areas. . .

Similarly, Title V of The Nuclear Non-Proliferation Act of 1978 mandated a program to assist the developing countries in "the application of non-nuclear technologies consistent with . . . economic factors, . . . material resources . . . and environmental protection." The program will include evaluation of energy alternatives, facilitation of international trade in energy products and processes, development of enrgy resources, and application of energy technologies.

The Congress expressed its support for encouraging the United Nations to convene a World Alternate Energy Conference in the FY '79 Foreign Relations Authorization Act, P.L. 95-426. In declaring that conventional energy supplies are being depleted and that expanded development and use of alternative, nonconventional, and renewable sources of fuel could meet energy demands, the Congress endorsed such a conference aimed at establishing an International Alternate Energy Commission to encourage utilization of new technologies. The Secretary of State was directed to transmit to the Speaker of the House and to the Senate Foreign Relations Committee a report on actions taken pursuant to this section.

Importance

The clear legislative mandate for the development of alternative energy technologies, the established Federal programs in this area, the international aspect of the issue, and the energy needs of the LDCs should encourage the subcommittee's participation in formulating policy and encouraging practices concerning the development of alternative energy technologies for application in the developing world.

11. MATERIALS R&D POLICY

See also items:

5.3 Underground Stockpiling or Waste Storage
5.6 Resource Conservation
5.7 Resource Recovery
7.2 Efficient Underground Mining Systems
10.8 Fuller Utilization of the World Ocean Resources: Legal, Political, and Institutional Aspects
19.5 Continental Scientific Drilling Program

Research and Development Aspects of National Materials Policy

Federal programs for various national goals (particularly those affecting energy and the environment) have impacted adversely on materials industries, both supply and processing. Research and innovation in materials technology are lagging and warrant attention to restore balance.

Background

There has been a long history of efforts to define a national policy for materials. Repeated recommendations have come from various commissions (Paley, Boyd, and most recently the National Commission on Supplies and Shortages) that institutional arrangements be established and policies affecting materials be defined and implemented.

Efforts were begun by the House Committee on Science and Technology, Subcommittee on Science, Research and Technology, to clarify the need and to explore ways to meet it, starting with the issuance December 1972 of a committee print, Industrial Materials, Problems and Issues for the Congress. Subsequently, the subcommittee addressed various tentative legislative proposals, the most recent being H.R. 10859 and H.R. 13025, in the 95th Congress. Several sets of hearings were held on these predecessor proposals. Other committee prints on material issues were published. Four committee prints late in 1978 completed the record; these are: a 985-page hearing record, an 80-page summary, a subcommittee final report on materials policy in the 95th Congress, and the proceedings of an Engineering Foundation Conference on national materials policy. At the close of 1978, a new draft of proposed legislation on the subject was in preparation. Additionally, the Senate Commerce Committee, Subcommittee on Science, Technology and Space, held hearings on materials policy in 1977 and considered in particular the recommendations made by the National Commission on Supplies and Shortages.

Importance

Abundant documentation exists of the relationship of sound materials management to a stable (non-inflationary) economy, healthy industry, employment opportunity, orderly international trade, a benign environment, and technology to conserve energy and expand its availability.

In late November 1978, the price of cobalt (100% imported) rose to a quoted $46 a pound (up from $6). Cobalt is essential in high temperature alloys, magnet alloys, hard facing of rollers in steelmaking, and cementing of hard carbides for machine tool cutting tips. Throughout 1978, there were warnings of a possible future shortage of chromium (100% imported) from Rhodesia, and South Africa (some 90% of world reserves). Chromium is the most widely used of all ferro alloy additives in steelmaking. Efforts to restore the stability of the American dollar are contravened by rising costs of many materials imports, yet policies of the Federal Government virtually compel increased resort to costly foreign supplies. The materials industry is calling increasingly for a resolution of policy conflicts in this area.

An International Materials Congress, sponsored by the National Academy of Sciences, is to take place in Washington, March 26-29, 1979, to examine some of these issues as they relate to the world's economic development. Assurance of a well-thought-out U.S. position is indicated.

Research and Development Aspects of Materials Conservation

The U.S. domestic materials posture has deteriorated steadily over the past several decades as evidenced by declining reserves of key industrial raw materials and increased imports of these materials from abroad. Consequently, accelerated research, development, and innovation in materials conservation appears necessary to help achieve, where feasible, a better balance between domestic production and consumption of these materials.

Background

Rapid development and exploitation of basic U.S. materials deposits during the Nation's first 200 years has exhausted many primary deposits of such materials and necessitated increased reliance upon secondary domestic deposits and imports from abroad. As the domestic secondary deposits have become more difficult and expensive to mine, increased emphasis has been placed upon foreign imports. It has been suggested that this import dependence should be stabilized, and possibly reduced, through such conservation methods as reduced usage, increased recovery and recycling of waste materials, and substitution of more plentiful materials for those that are scarce. For example, it has been suggested that U.S. consumption of materials, currently the world's largest both totally and per capita, could be reduced significantly without adversely affecting the Nation's existing lifestyle. Regarding solid waste materials, it is estimated that increased resource recovery and recycling of these materials could provide about 40 percent of the metals, glass, plastics, fibers, and rubber needed by U.S. industry each year. Finally, it is maintained that the Nation's import dependence could be decreased significantly by the substitution of such plentiful or renewable resources as glass and wood for plastics and metals that now must be imported from abroad. Increased research, development, and innovation in all three areas -- decreased usage, recycling, and substitution -- is seen as a necessary requirement to help meet future materials conservation goals.

Importance

Imports of many basic industrial raw materials now amount to as much as 90-100 percent (for example, alumina, chromium, cobalt, columbium, manganese, mica sheet, platinum-group metals, and strontium). Such heavy dependence upon imports is seen not only as increasing the Nation's trade deficit but, perhaps more important, as adversely affecting the national security. It has been claimed, for example, that interruption of needed supplies of such materials as chromium, cobalt, and manganese could cause disturbances perhaps more far-reaching in the U.S. economy than those experienced during the oil embargo of 1974. Increased materials conservation efforts could reduce this dependency and help soften the adverse efforts of potential future materials shortages.

The importance of materials conservation has been explored as a vital element of National Materials Policy in several past studies by such organizations as the National Commission on Materials Policy, the National Commission on Supplies and Shortages, the National Academy of Sciences, and the Federation of Materials Societies. The subject has featured prominently in hearings on National Materials Policy conducted during both sessions of the 95th Congress by the Science Committee's Subcommittee on Science, Research, and Technology. However, a need still exists to determine the extent to which materials conservation is feasible and the appropriate legislative role in stimulating the necessary supporting research, development, and innovation.

National Needs in Semiconductor Microstructure Fabrication

Solid state microstructure fabrication is fundamental to a wide range of microelectronic applications in the computer, electronics, and telecommunications industries, as well as in other areas of science, technology, and medicine. The competitive strength of U.S. industry in this very important area is being seriously challenged by other nations, particularly the Japanese.

Background

Solid state microstructure fabrication of microelectroic circuit components is basic to a number of industries, like the computer industry. This U.S. industry, among others, is being challenged seriously now by the Japanese electronic industry, supported by a Japanese industry-university-government consortium. The Japanese have correctly identified semiconductor microfabrication as being of basic importance in competing successfully internationally in microelectronic components and the high-technology products made therefrom.

There is evidence that United States industry, which has been very successful thus far in microstructure fabrication, may require governmental support to meet the increasing international challenges in this field. For example, there is currently "an insufficient level of basic research underlying microstructure fabrication in the U.S., especially in the academic community" according to a recent resource paper of the Solid State Sciences Committee of the National Research Council.

Importance

There are a number of unmet national needs in microstructure fabrication in science, technology, instrumentation, and education. In regard to the third and forth points, for example, "much of the instrumentation developed for this field has relied (either primarily or secondarily) on personnel educated abroad." Because microstructure fabrication is so basic to the Nation's high-technology industries, which contribute a positive component to the Nation's generally unfavorable balance of trade, a concern and response at the Federal level is appropriate. Among specific issues that could be addressed are questions like "What is the organizational framework(s) within which the U.S. research and development effort can be optimized?"

Congressional concern with the broad aspects of this issue is already apparent, for example, in the hearings of the Senate Committee on Commerce, Science, and Transportation on Government policy and innovation in the semiconductor and computer industries, held on October 30, 1978. Similar concern is evidenced by the continuing congressional attention to the state of U.S. R&D and innovation vis-a-vis that of Japan, Europe, and other industrialized nations.

Scientific Aspects of the Carbon-Hydrogen Bond

At the interface of materials and energy are such questions as the substitution of plastics and other organic materials in place of metals; the production and processing of biomass; and the capture and conversion of solar energy into useful forms by organic routes.

Central to these technological matters is the need for an understanding of the fundamental science of the chemical interactions of carbon and hydrogen, common to virtually all organic chemical processes and products.

Background

The 1974 report on the Survey of Materials and Man's Needs (COSMAT) of the National Academy of Sciences made a strong recommendation for research in renewable resources. The NAS Committee on Renewable Resources for Industrial Materials (CORRIM) reported in 1976 on the need for, and the economic and energy opportunities in, renewable resources. A detailed examination of the opportunities in this area was presented by Dr. Ingomar Falkehag at the 1976 Henniker Conference on National Materials Policy, citing:

- o safeguarding raw material supply;
- o less capital-intensive technology;
- o less energy-intensive processes;
- o improved environmental control;
- o less dependence on depletable resources; and
- o better utilization of all resources.

Finally, a world conference on future sources of organic raw materials, convened by the International Union of Pure and Applied Chemistry (IUPAC) in Toronto in July 1978, urged a substantial increase in basic research related to the field of organic chemistry associated with the potential use of renewable resources.

Importance

Photosynthesis creates in biomass daily 17 times as much energy as man consumes. Genetic and organic chemistry research can more than double this rate according to the CORRIM and other Academy studies. Fossil fuels (coal, petroleum, natural gas, peat, oil shale) represent past solar energy stored in the earth. As these are consumed, man must rely on energy from the atom or the sun, or both. The technology of the use of solar energy for fission will exhaust available uranium in due course; and fusion energy is still chancy. The technology of biomass utilization offers many options of high probability.

There is no urgency to the use of renewable resources, as long as man is content to use up the capital of energy stored in the earth in the form of fossil fuels and uranium. However, if man is to rely ultimately on solar energy, he must learn how to do so most efficiently. The central scientific question to be dealt with is a more complete understanding of the carbon-hydrogen bond. This is a major scientific undertaking that will require time. If it is to be ready when needed, a start should be made very soon to secure it. In the words of J.F. Mathis, vice president of technology, Exxon Chemicals USA, there must be a better understanding of the carbon-carbon, carbon-hydrogen, carbon-oxygen, and similar bonds and how they are cleaved selectively both in vivo and in vitro. This was, he said, the most important implication of the IUPAC conference. In a separate private conversation, William O. Baker, President of Bell Telephone Laboratory, confirmed this judgment.

Synchrotron Program

Emergence of an apparent need warranting assessment for an array of new research tools employing synchrotron radiation.

Background

In January 1976, a panel of the Solid State Sciences Committee, Assembly of Mathematical and Physical Sciences, National Research Council, assessed the need for synchrotron radiation facilities as a research tool. Its report, published in the latter part of 1976, urged: (1) a "substantial number of stations" receive X-ray capability in two critical wavelengths, with maximum intensity; (2) a supporting set of detection optics; (3) geographic distribution of facilities; (4) special radiation source elements; (5) a substantial scope of operation at each station, with associated chemical amd biological laboratories; and (6) adequate in-house research staffs.

Importance

The report concluded: "The scientific and technological impact of synchrotron radiation research has enormous breadth, spanning many disciplines and encompassing many techniques. The most promising experimental techniques at the moment are X-ray diffraction, photoelectron spectroscopy, and absorption studies throughout the ultraviolet and X-ray spectral range. These techniques will advance the frontiers of knowledge in a number of fields. In surface science, basic information will be obtained concerning the structural and electronic properties of surfaces and heterogeneous catalysis. Techniques of structural analysis (X-ray diffraction and X-ray absorption) should provide insight into the organization and function of complex systems of importance in chemical and biological processes such as nitrogen fixation, photosynthesis, and the oxygenation of blood. Our understanding of liquid and polymer-bound catalytic reactions should also be improved. Various techniques will contribute to our knowledge of the properties of materials under a variety of chemical and physical conditions. For example, new insights into the effects of radiation and defects on the strength of materials can be expected.

"Improved understanding of catalytic reactions, nitrogen fixation, and radiation damage can easily be seen to have a significant impact on energy-related technology. Elucidation of the functioning of complex biological systems and the effect of impurities on them will play a significant role in medical- and environmental-related technologies. Finally, X-ray lithography should directly affect the development and manufacture of microminiature electronic devices, which will be a cornerstone of the technological society of the future."

Synchrotron radiation holds great promise for X-ray lithography. The radiation used is in the soft X-ray region 10 to 20 angstrom units in which it has no substitute. Resolutions approaching 50 angstrom units in one second can be achieved. This technique is important for submicron fabrication of integrated circuits (below one micron), and is actually being used at this time for silicon "writing" of the polymer mask on minute silicon chips.

The NRC report also declared that expanded construction of synchrotron radiation facilities was needed to meet requirements over the next decade, and that such facilities involved a five-year lead time for planning and construction. Continued the report:

> Needs for synchrotron radiation beyond the next five years can be satisfied only if a commitment to the construction of new dedicated facilities is made now, because full expansion and dedication of existing facilities would satisfy less than one half of the national need projected for 1986. Even with an immediate commitment to the expansion of existing facilities and the construction of new facilities, there will be a chronic undercapacity that will become most acute five years from now.

12. SCIENTIFIC AND TECHNOLOGICAL INFORMATION

Federal Scientific and Technical Information Management and Congressional Oversight

Congress long has been concerned with the effective and efficient collection, management, dissemination, and use of scientific and technical information (STI) by the Federal Government. Previous legislation, dealing both directly and indirectly with STI, has created a framework by which information programs and policies in the public and private sectors could be delineated. This attitude was continually fostered in the 95th Congress with the introduction of still more STI-related measures. Initiatives on the part of the executive branch to coordinate and standardize STI activities have coincided from time to time with these congressional efforts. No "national information policy" currently exists, however, and the examination and oversight of STI practices and procedures by Congress continues.

Background

The question of governmental management of scientific and technical information -- especially in the realm of tools and techniques for the storage, retrieval, and use of STI -- is not a new one. Key executive pronouncements from the Office of the President and the Office of Management and Budget have attempted to either set policy functions or provide STI guidelines in such areas as: STI dissemination (Executive Order 12309); telecommunications and information policy (President's Reorganization Plan #1 of 1977, Executive Order 12046 and OMB Bulletin 78-15); and automatic data processing procurement (OMB Circulars A-76 and A-109).

Historically, these attempts to implement some type of STI management guidelines have proven to be ineffectual. One indicator of the lack of a successful operation has been the issuance of over 200 audit reports since 1965 by the U.S. Comptroller General of the General Accounting Office. For the most part, these reports have been critical of current Federal agency management processes involving computer-based information systems, computer and information system procurement practices, and automated decisionmaking procedures. In addition, legislation designed to aid in the advancement and use of STI and its allied man-machine techniques (i.e., P.L. 89-306, the Brooks Bill; P.L. 94-533, the Copyright Revision Law; P.L. 94-282, tthe National Science and Technology Policy, Organization and Priorities Act of 1976; and P.L. 95-220, the Federal Programs Information Act) have either met with certain management difficulties or have yet to be examined for their effectiveness.

Importance

The study and oversight of the practices and means of delivery of STI is an ongoing congressional function. Over the years, Congress has conducted numerous hearings concerning new legislation and has performed its oversight duties that relate to the STI environment. A broad spectrum of legislative activities were considered in the 95th Congress. A certain number of these pieces of legislation (e.g., the Communications Act of 1978 and the Foreign Relations Authorization Act,

have been the topic of a series of hearings during the current congressional sessions. Congress also has pursued several STI-related matters in the course of authorization, appropriations, and special oversight hearings that include a review of the President's Reorganization Plan #1 of 1977, the implementation of P.L. 94-282, and oversight of the National Science Foundation.

Moreover, two executive branch documents -- one already in the public domain and the other a draft report -- should be of interest to Congress and its related committees. In 1976, the staff of the Domestic Council Committee on the Right of Privacy issued a report entitled "National Information Policy -- Report to the President of the United States" that recommended the development of a coordinated national information policy with certain councils and advisory committees to aid in the formulation of such a policy. A more recent Presidential initiative -- the President's Federal Data Processing Reorganization Project -- soon will be issuing a "Summary Report" of its findings in the Government's use and management of data processing and information utilization.

While oversight activities are an integral part of a committee's functions, some observers in the private sector would argue that executive involvement and legislative oversight of corporate prerogatives are inappropriate and best could be monitored by the industry's professional associations.

Due to its past concerns for STI matters and the ever-increasing dependence of the Nation on information and related technologies, Congress should continue its present practice of legislative oversight in the area of scientific and technical information.

High Level Interagency Policy Mechanism for STI

Is a high level interagency policy mechanism for handling scientific and technical information (STI) matters needed; if so, what would be its character and organizational placement?

The scope and nature of Federal management of scientific and technical information activities has been of concern to both the public and private sector entities involved, over a period of 20 years. The placement, charter, and controls over such an interagency policy mechanism have found no present day solution.

Background

The establishment of a viable permanent interagency mechanism which could create and enforce a range of STI-related activities initially took the form of a Committee on Scientific and Technical Information (COSATI) which worked closely with the now also defunct Office of Science and Technology (OST); these were supported by the Science Information Council. The range of activities hopefully to be "managed" by COSATI was to include:

- o Maintaining non-duplicative information services at minimum cost;
- o Providing selective access to critical information;
- o Ensuring retention of essential data emanating from R&D undertaken in the national interest;
- o Facilitating knowledge spread in order to minimize redundant R&D endeavors;
- o Assisting planners responsible for policy and program determination and resource allocation;
- o Creating a "storehouse" of knowledge for technology transfer.

After a hiatus of several years, which saw the disappearance of the three governmental groups noted above, the Congress through P.L. 94-282 created an Office of Science and Technology Policy (OSTP) whose areas of purview would include improved information management and the dissemination of research findings.

Importance

The criticality of strengthening "planning, management, and evaluation of scientific and technical information activities" has been attested to during the 95th Congress. Representative Olin E. Teague, Chairman of the House Committee on Science and Technology, has stated that:

> ...information management today may be suffering from wasteful neglect of available knowledge and the funding of needless research with respect to findings already in the literature. This waste should not continue to be tolerated.

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This issue merits consideration in the 96th Congress, both through oversight review of steps taken to accomplish P.L. 94-282 objectives and a broader look at the multiple roles which STI now fulfills. These include: a clarification of the STI role in foreign policy, improving STI practices in government, using STI to alleviate national problems, and employing STI to advance U.S. scientific research and development.

The "pros" related to this subject and policy area enunciated in the background statement above are that the volume and variety of STI material continue to grow, with concomitant problems of categorizing, storing, and disseminating these graphic, narrative, and statistical data. The "cons" would include the question of public intrusion on private enterprise, competitive postures by government and commercial institutions in the national and international marketplace, and the residual question of "too much government."

As already noted, the several role areas involving STI have not been resolved and in most cases only cursorily considered by the Congress in recent years. Formal consideration through regular authorization and appropriations hearings, conferences or workshops and special studies offer alternatives for Committee exploration of this issue at this time.

Public and Private Sector Coordination of Scientific and Technical Information

STI activities often receive a low priority during policy and budget considerations in the executive branch. In addition, little effort is made to formally optimize existing resources within the public and private sectors through coordination of STI programs.

Background

STI has historically been viewed as either a by-product of research and development efforts, or as a support function to policy makers. As such, it often has lacked a consituency which can adequately represent the importance of STI to society to those at the decision making level. Increasingly, STI has become more pervasive as its value is ascribed to more than the basic research community. STI is often a valuable resource in developing programs for alleviating national problems and promoting national goals. Particularly as our more technologically oriented society requires more responsive and hence often more complex approaches to solving problems, STI will become more critical.

Importance

Improvements in this area will help to alleviate inefficiencies in current STI programs, augment ongoing activities, and provide less duplication of effort between the public and private sectors. Historically, congressional hearings have provided both public and private sector representatives with the opportunity to present proposals for upgrading information practices and services. In order to ensure that future programs are responsive to the needs of both government and non-government groups, congressional forums can prove highly benficial.

The advantages to such hearings are evident in terms of producing stronger support for STI activities in all sectors, highlighting the pervasiveness of STI in society today, and allowing users of systems (as well as designers) the opportunity to air opinions and suggestions. On the negative side are the obvious budgetary problems associated with introducing new programs and expanding existing support staffs.

The 96th Congress, faced with more budgetary restraints and new sunset proposals, will be required to identify which information resources and services are vital and should not be lost in the process of cutting resources. In addition, efforts by Congress to persuade key Federal executive branch groups -- such as OSTP, NSF, OMB, and NTIA -- of the importance of improving STI organization in government and their needs to the ever broadening community could prove particularly valuable at this time.

Foreign Exchange of Scientific and Technical Information

Currently U.S. policy on exchange of STI with foreign governments is handled in several arenas. Questions regarding what priorities should be addressed have been raised recently in light of the growing concern over the declining U.S. international economic standing.

Background

The United States has traditionally made most of our scientific and technical information openly available to other countries. Although we continue to engage in much scientific research, the U.S. percentage of global STI produced is decreasing, while other nations are launching major efforts to enhance their STI activities. STI has been made available to other nations through bilateral agreements, major aid programs, involvement in international agency activities, and via commercial enterprises abroad. At the same time, we have not developed any permanent coordinated mechanism for gathering STI from other countries.

Importance

This area has become increasingly critical as the U.S. seeks ways to protect America's industrial standing and international commercial interests. In addition, as the world becomes linked through technological advances and multinational corporations proliferate, new policies must be developed to reflect the new environment. This issue also addresses our concern with the future advancement of the developing countries and their needs for scientific and technical information support.

A coordinated approach in dealing with STI exchange internationally would have the advantage of safeguarding one of our basic resources (STI) from being transferred with disadvantageous effects to the United States. One approach might involved the use of some quid pro quo approach in our STI dealings with foreign nations. While placing conditions on our exchange of STI might prove beneficial in regard to some countries, it might have a negative effort concerning Third World development or it might restrict the flow of certain information which could prove vital to our interests.

This issue is particularly critical within the time frame of the 96th Congress because of specific pending events. During 1979 and 1980 several important international meetings will be held which will determine future policies in the communications and information fields. The need to develop U.S. policies in these areas was underscored in the Foreign Relations Authorizations Act, FY 79 which included a requirement that the President transmit to Congress a report outlining our goals and positions to be presented at such meetings. A second, related matter, involves the passage of data protection laws by a growing number of European countries. The next Congress could be instrumental in shaping the position this country will take in these forthcoming debates. Also of note is the recent proposal by the executive branch of a Foundation for International Technological Cooperation within the Agency for International Development. These actions may have the potential of restricting the flow of data across borders and thus have an adverse effect on certain U.S. commercial interests.

Utilization of Information Systems

Substantial investments have been made in the development of large-scale information systems which contain data of potential value to both scientists and non-scientists. However, these systems and possible applications of them often are not known to user communities which might benefit from them.

Background

Recent years have seen a continuing escalation in the amount of scientific data being produced by research and development activities. It has become increasingly difficult for scientists either to acquire or determine relevant materials which can be used to support ongoing research tasks. Large automated information systems have become a mechanism for indexing, storing and accessing these accumulated data. At the same time, decision makers require a growing amount of technical information to support the policy formulation process in today's more complex society. The potential for tapping information systems to provide technical support is becoming more widely recognized.

Importance

This area presents an opportunity to enhance both the traditional R&D activities as well as the policy making arena through strengthening the utilization of created or developing information systems. A major thrust of this effort would involve the orientation of both scientists and non-scientists to the potential value and availability of various information resources.

The advantages of such a program would include wider dissemination of research results within the United States, enhanced utilization of STI within in the non-scientific community, more comprehensive coverage of the available scientific and technical literature and improved systems development in response to a larger audience of users. Disadvantages revolve around the difficulty of adequately orienting a constantly changing community of users, additional expenditures which might result from new efforts at information dissemination, and a possible conflict between public and private sector responsibilities in this area.

This question should be considered in the 96th Congress due to several recent events. The National Science Foundation has reorganized and changed the former Division of Science Information to the Division of Information Science and Technology. This new division is in the process of developing long-range programs and approaches to be followed. Congressional input at this stage could prove critical in determining the direction this group pursues. In addition, a proposed OMB Circular has been circulated widely for advance reactions, conerning the collection of scientific and technical information and a new director has been appointed to head the National Technical Information Service, Department of Commerce. This transitional period could be particularly important in developing STI policies and priorities.

Encouraging Public Utilization of Scientific and Technology Information

The encouragement of scientific and technical information dissemination is predicated on the policy of effective utilization of federally funded efforts. Implementing this policy has been difficult in that coordination and integration processes of programs have not always been effective. Concerns have been focused on appropriate channelling of scientific and technology information, research and development findings, and related information that is consistent with national goals.

Background

Over the last two decades Federal funding of advance technology, research and development, and scientific information has stimulated concern regarding the effective utilization of these efforts. The dissemination of technical information has been available through the use of the National Technical Information Service (NTIS) in the Department of Commerce (15 U.S.C. 1151-1157). In early 1978 President Carter issued Executive Order 12039 ("Relating to the Transfer of Certain Science and Technology Policy Functions.") The Executive Order outlines elements and functions of the National Science and Technology Policy Organization, and Priorities Act of 1976 (90 Stat. 459, 42 U.S.C. 6601 et. seq.) providing for the reorganization of science and technology policy elements. The Office of Management and Budget draft Bulletin No. 78, presently being circulated for comment, specifically addresses the dissemination of technical information: "that all technical information which results from Federally funded research and development shall be made publicly available, consistent with the need to protect individual privacy, national security and proprietary interests."

The specific measures outlined in the draft OMB Bulletin may require congressional attention to improve and promote public access to technical information. Criticism has been leveled that Federal research and development efforts have not always been appropriately identified, and that access to reports and studies has remained a continuing problem.

Importance

Information dissemination policies continue to be debated and discussed with concern focussed on the need to balance dissemination of all federally funded efforts and issues of national and economic security. The Office of Management and Budget examination has considered access to, dissemination and disclosure of technical information within the provisions of the Freedom of Information Act (5 U.S.C. 552). Recent concerns with regard to business data transfers and "reverse Freedom of Information" and associated judicial cases have stimulate further interest in developing appropriate policies. The finalized OMB Bulletin 78 and

judicial decisions [e.g. Chrysler Corp. v. Schlesinger, 412 F. Supp. 171 (D.Del. 1976)] represent measures that may impact on public access to scientific and technical information, and including research and development findings.

Assessing the utility and effectiveness of science and technical information also remains a critical problem. Congressional assessment of the contribution and impact of greater public access may be needed. The formulation of a cohesive policy and coordinated response will require additional consideration.

The following issues may require further examination:

Is there a need to develop a coordinated and uniform policy to encourage use of scientific and technical information by the private and public sectors? Does this require different approaches and structures to assist in promoting access to many potential users?

Are additional resources needed to collect and promote dissemination of science and technical information and research and development findings? What justification is required to develop these resources?

What contribution will the greater dissemination of government sponsored research have on economic and national security factors?

Should information impact statements use be required for all research and development programs?

13. SOCIAL SCIENCE RESEARCH

National Science Foundation Social and Psychological Sciences Research Support

The NSF social and psychological sciences research support programs have undergone many changes in the last 10 years, i.e. since the Committee's last in-depth review. While funding has increased, criticism has been heard that congressional actions regarding the NSF's social and psychological sciences research budget are not based on sufficient appreciation for subtleties in the growth of the disciplines. Issues identified in a 1977 committee oversight report on NSF support programs in these disciplines might warrant attention.

Background

NSF funding for social and pscyhological sciences research appears to have grown consistently over the last 10 years. Although inconsistent reporting precludes precise comparisons or historical trend description, it is generally acknowledged that since the fiscal year 1969, psychological sciences research funding has almost tripled (from $6.3 to a $15.1 million budget request for the fiscal year 1979) and that social sciences research funding has almost doubled (from about $16 to about a $27 million budget request for the fiscal year 1979). In addition, NSF initiated a large problem oriented social research program in 1969 with funding rising from about $4 million that year to about $34 million requested for the FY1979 budget.

Although these figures are not expressed in constant dollars it is evident that they demonstrate increases in funding patterns. Quantitative increases requested by the Administration and supported by the Congress show appreciation and confidence in the disciplines. Yet some observers criticize congressional actions on NSF's social and psychological sciences budget as being capricious and, because of rapid up and down fluctuations in congressionally defined levels of support and priority selection, as reflecting insufficient appreciation for the need for stabillty in support patterns adequate priority-setting.

Importance

The committee's last public inquiry into NSF social and pscyhological sciences support patterns occured in 1968 right before the Foundation's enabling act was amended to make explicit NSF's responsbilities to support social and applied research. In 1977 the Committee published an oversight report on the topic, The Psychological and Social Sciences Research Support Programs of the National Science Foundation: A Background Report, but no action has been taken to receive public reaction to the oversight report or to insure action on its findings or on the findings of an NAS oversight report on the same topic. It may be timely to do so in the 96th Congress. Issues identified in these reports include: need to achieve an appropriate support balance between basic and applied research to develop knowledge adequate for application, need to balance quantitative versus qualitative studies, correction of imbalances in nonsuccessful proposal/award patterns, need to balance continuing versus new awards, overcoming concentration of awards in certain schools, using advisory panels properly, eliminating funding overlaps with other agencies, and refining the "NEC" reporting category to permit better oversight of problem oriented applied research.

Regulatory Decisionmaking

There is a need to examine the decisionmaking process of Federal regulatory agencies. What are the general problems? What is the impact of organization and process on the outcome of regulation? Are there means of comparing the results of regulation against predetermined objectives? Do the agencies have valid information for decisionmaking?

Background

Much of the recent growth of Federal regulations has been social rather than traditional economic regulation. Several common problems arise in determining health, safety, environmental and other social regulations which are not being satisfactorily addressed.

Methodologies used in the decisionmaking process establishing regulations might be studied to determine whether there is an optimum procedure. Alternatives to the setting of standards may not be getting sufficient attention in the regulatory process.

Better measures of the social, environmental, and psychological benefits resulting to society from regulations are needed in order to weigh these benefits against costs. Better predictive models, which may involve probabalistic techniques might be developed. Problems of establishing acceptable levels of risk tolerable to society need to be treated.

Regulations are often dependent upon scientific and other types of information which may be inherently uncertain, or suspect because those being regulated supply it. Agencies address these information problems in various ways. The process of obtaining and using information should be examined to improve the basis upon which regulations are based. This may require changes in the internal R&D capabilities of the agencies, or increasing use of external sources of information and/or means of resolving conflicting scientific views.

Importance

Federal regulation has repeatedly been blamed for contributing to inflation, a decrease in innovation in the United States, and other problems.

The President has recently taken steps to make government regulations simpler, to increase public involvement in the regulatory process, and to reduce duplication and the inflationary impacts of regulation. Several bills concerned with regulatory reform, which were introduced into the 95th Congress focus on eliminating needless regulation and reducing the economic impact, paperwork and adjudication connected with necessary regulations. The problems mentioned above do not appear to be sufficiently addressed by these efforts.

There has been much criticism of legislation which does not give the regulatory agencies sufficient flexibility to administer in a manner which allows them to reconcile multiple societal objectives. Congress may wish to investigate whether statements of the goals and performance measures to be used and prescriptions to employ cost/benefit analyses through legislation which authorizes regulation may bring about desired improvements.

Effects of Requirements for Social Impact Statements

Both benefits (especially more informed decisionmaking and enlargement of public participation in decisionmaking) and costs (especially paperwork costs) accrue from the burgeoning number of governmental requirements for the preparation of impact statements. Improved identification of adverse consequences of program or policy actions which presumably result from impact statement preparation will not insure improved decisionmaking. Data, more quantitative understanding, and analysis do not always improve decisionmaking. But tradeoffs should be determined.

Background

Increasingly government is requiring the preparation of impact statements or studies in a variety of important public policy areas: family impacts, social impacts, urban impacts, environmental impacts, judicial impacts, arms control impacts, and, inevitably, paperwork impacts.

These requirements appear to have both benefits and costs. They provide jobs for social scientists and thereby take up employment slacks. They also help to insure that adverse social, economic, political and technological consequences or risks are identified and possibly evaluted before project implementation, and they are an incentive toward the refinement of social impact research techniques.

However, impact statements also cause social costs. They often require rigorous social research, yet are criticized for promising more than they can deliver since understanding of social change processes so fundamental to preparation of impact statements usually is inadequate for the task at hand. Some critics say that these requirements pose needless paperwork burdens and that they generate reams of paper and research reports decisionmakers don't have time or inclination to read. Others criticize that such statements are a futile exercise in improving the so-called quantitative basis of rationality in governmental decisionmaking because report writers are neither candid enough nor able to determine precisely the metric of political calculation and decisionmaking which are the basis of much governmental decisionmaking.

Importance

The types of impact statement requirements described above -- ranging from arms control, through economic and family, to urban impacts are all required by statute or Federal regulation. It may be propitious to assess these requirements, their origin, expected utility and costs and their actual utility to improving decisionmaking. GAO may be a likely performer of such research.

Social Indicators Research

Oversight may be required of Federal agency programs for the support and utilization of social indicators research. Involved agencies include: NSF, the Department of Commerce, and the Office of Management and Budget. Issues include progress of research, Federal policies to promote refinement and use of new measures, and institutionalization of social indicators systems.

Background

Impetus for development of social indicators and for their use in policy began in the second half of the 1960s concomitant with congressional consideration of a bill to create a national social accounting system and a Council of Social Advisors in the White House. Social indicators differ from normally collected descriptive social statistics for three reasons: their normative properties, their level of aggregation, and their ability to be manipulated in a social accounting system. Quality of life, for instance, would be measurable in a social accounting system and in the ideal system would be linked to programs or program intervention strategies so that a policymaker would be able to determine if a modification in a program caused a change in quality of life.

NSF's program of support includes funding to individual researchers to develop more refined data bases (to give social indicators explanatory and predictive qualities), models of social systems dynamics with appro- private data categories, and kinostatistics (computer manipulable graphic capabilities to permit a policymaker to overlay several different data plots or series on the same geographic area to correlate multiple factors). Also since the late 1960s, NSF has supported the Center for Research on Social Indicators at the Social Science Research Council, to give the Foundation advice about priorities for its research program and to serve as a central research center on the subject.

OMB and Commerce have been working on applications and use of social indicators as evidenced by publication of Social Indicators, 1976, a complilation of social indicators useful to policymakers. Currently the focus of applied work is in the Commerce Department (by virtue of congressional mandate and executive order). Current efforts are governed by policies in a combined OMB/ Commerce Department effort called A Framework for Planning U.S. Federal Statistics, 1978-1989, and by efforts to institutionalize a rudimentary social indcators system in the Domestic Information Display system being developed jointly by NASA and Commerce for all agencies and the White House.

Importance

Attempts to institutionalize social indicators systems, in which decisionmakers have confidence, should incorporate advanced research findings. It seems appropriate to ask if current systems do, and if research programs, such as of NSF (totaling about $2 million for indicators and related research) are adequate.

Criminal Sentencing Reform

Judges across the Nation do not have a uniform system of deciding terms of imprisonment for convicted criminals. How can this situation be remedied? Would more research into possible guidelines for sentencing be a step in the right direction? What can Congress do to help alleviate this problem?

Background

The United States criminal justice system is regarded by some experts as being in disarray. It has been stated that the system neither controls crime nor punishes criminals. Crime statistics show that serious offenses have more than doubled since 1960. Also, the United States has longer prison sentences than any other Western country or Japan. Recently, discussions have increased regarding the country's criminal sentencing process. One authority says that the Nation's system of justice can define crime, organize police forces, and design due process trial methods. However, problems arise when determining why, when, or how to sentence, or who should or should not be imprisoned and for how long. Surveys have shown that in both the Federal and State courts, judges, when confronted with sentencing offenders, react essentially in individualistic ways. Across the Nation judges, using their own discretion, give out greatly divergent sentences to offenders with similar criminal backgrounds and who have been convicted of the same type of crime. The Federal Judicial Center conducted a study to test disparity in sentencing. Fifty judges participated by reading presentencing reports and making recommendations. In 16 out of 20 cases given to the judges, they disagreed, even on the basic question of whether or not a prison sentence was advisable. The criteria for determining various sentences may include -- whether the setting of the court is urban or rural; a judge's opinion regarding the seriousness of the crime; and a judge's perception of the defendant.

Importance

There are no direct guidelines in the Federal code to assist judges in deciding a term of imprisonment for offenders. Therefore, disparity exists. Indeterminate sentencing, some experts argue, should be completely eliminated and replaced by legislative sentencing in the form of "flat-time" or "presumptive sentencing," or "mandatory sentencing." If this is done, all criminals convicted for the same crime would receive the same term of imprisonment unless there are exceptional factors established. On the other hand, proponents feel that through indeterminate sentencing, the offender would become "rehabilitated" before entering society again. Then, there are those who propose a middle ground. Disparity, evident in the indeterminate procedures, would be retained, but legislatively mandatory sentences would also be provided with the exception of ignoring justifiable distinctions among offenders. What are the appropriate criteria to follow? Should there be specific guidelines for sentencing? Answers to such questions may be determined through more comprehensive research regarding the advantages and/or disadvantages of applying more uniformity to the sentencing of criminals. Hence Congress might consider the proper role to take in helping to alleviate this concern.

Social Science and Government: Better Methods to Determine Research Priorities

Although Federal obligations for social and psychological sciences research are approaching $1.5 billion annually, there seem to be important research and policy topics which are not receiving attention. Current research priority patterns seem not to make maximum use of the Nation's storehouse of such knowledge nor do they permit adequate growth of the knowledge base of social science disciplines.

Background

At the request of the National Science Foundation, the Study Project on Social Research and Development was established within the National Research Council to assess several complex issues in the interface between social research production and the public policy process. One part of the five-volume series focussed on how research agendas are formulated.

Obligations for social research and development (called social knowledge production and application in the terms of the report) now approach about $1.5 billion. Despite these expenditures, the study group, composed of highly qualificed academics and policymakers, concluded that "The setting of research agendas is largely a reactive process, with few examples of systematic planning. The incentives for planning are weak and inconsistent. Although there is little duplication of research effort, there is also little coordinated planning among agencies. Hence there are important problems that fall in the gaps between agencies and little attention is given to identifying and planning research on emerging problems that are not well matched to the existing responsibilities of mission agencies."

The following were among recommendations made to oversight agencies, especially the Congress, to improve research agenda setting:

- o Federal research administrators and oversight officials should devote more resources to developing systematic planning as a distinct aspect of efforts to produce and use knowledge of social problems.
- o Program decision makers should have greater input into the planning of program-supporting research and policy makers at the departmental and presidential levels and in Congress should have greater input into the planning of policy-forming research.
- o Special attention should be given to building problem-exploring research agendas through task forces and conferences and the creation of presidential or joint presidential-congressional temporary commissions.
- o A number of problem-centered research programs should be created to undertake intensive and sustained work on major social problems.
- o More adequate methods should be developed for forecasting new or emerging social problems and creating research agendas directed to them. [This should include user priority identification.]

Importance

Social research and psychological sciences research are increasingly important elements of the Nation's R and D budget. Development of these disciplines is also frequently invoked as a method of generating information to help answer seemingly unsolvable public policy issues. The committee writing the report cited the DISPAC Subcommittee as a major oversight agency for these areas.

Social Science and Government: Better Ways to Apply Knowledge Generated in Federally Funded Social Research and Development Programs

Approximately $500 million is obligated annually for research and development to apply or adopt the findings of federally funded social and psychological sciences research and development to solve public policy problems. However, much of this knowledge is never applied. Problems arise from difficulties in disseminating research, involving decision-makers in priority setting and problem identification, and from faulty communications between researcher, administrator, and decisionmaker.

Background

At the request of the National Science Foundation, the Study Project on Social Research and Development was established within the National Research Council to assess several complex issues in the interface between social research production and the public policy process. One part of the five-volume series focussed on issues in the application of such knowledge.

The study which encompassed knowledge production and use in all Federal agencies, and surveyed use in specific policy areas reported:

> Effective application of knowledge is hampered by doubts as to the quality or relevance of the results of research and other knowledge production activities, by the lack of clear policies on the dissemination and use of results, and by a weak sense of the appropriate audience for many results. An excessive focus on individual projects discourages efforts to synthesize and cumulate results. Research administrators have limited understanding of how new information fosters innovation and change.

Recommendations made to improve the dissemination and application of knowledge are:

- o Oversight agencies and research administrators should give more attention to the dissemination of high-quality research results to appropriate audiences.
- o Federal agencies supporting social knowledge production and application should sponsor periodic syntheses of the knowledge gained from the research they fund.
- o More intensive research on the process of social change and the adoption of innovations by federal and nonfederal policy makers should be undertaken by agencies supporting social knowledge production and application.

Importance

The committee's jurisdiction for R and D implicitly encompasses social science R and D. In addition the study group directed recommendations to the DISPAC Subcommittee. NSF has also sponsored considerable work on utilization and dissemination; it may be timely and appropriate to review the fruits of NSF work in this area. The committee's interest in computer disseminated information coincides with this topic.

Social Science and Government: Possible Need to Improve Management of the System of Funding and Dissemination

Federal obligations for social and psychological sciences research are approaching $1.5 billion annually. A recent National Academy of Sciences study indicates considerable deficiencies in the management, production and use of such research. "Rapid turnover of leadership at the highest levels of government, combined with arbitrary staff ceilings and unresponsive hiring policies for support agencies" is said to undermine the system. There is little stability in funding and little appreciation for use of contract versus grant, and other research support instruments for producing different types of research products.

Background

At the request of the National Science Foundation, the Study Project on Social Research and Development was established within the National Research Council to assess several complex issues in the interface between social research production and the public policy process. One part of the five-volume series focussed on management of the Federal social research production and application system.

Management of the system is handicapped by staffing problems: rapid turnover among high level decisionmakers affecting the quality and coherence of social knowledge production programs; overburdened mid-level staff responsible for planning and monitoring; overtight controls threatening free inquiry; problems of unstable funding: erratic swings up and down damaging the research production environment; and inappropriate choice of support instruments. Recommendations made to improve the system are:

- o Appropriate oversight agencies should regularly review the allocation of social knowledge production and application resources among policy areas, organizations, and categories of activities within their jurisdictions.
- o Oversight agencies should periodically review the staffing and funding of agencies supporting social knowledge production and application and tailor the capabilities of these agencies to their missions and responsibilities.
- o Departments and agencies should organize their planning and budgeting activities to provide a significant role for knowledge brokers, who should assume increased responsibility for policy planning and program development.
- o Each agency should review its grant and contract policies to increase its awareness of available options and to base its choice among alternative instruments of support on a clear view of how responsibility for research planning and problem choice should be shared between the agency and the research performer.
- o Departmental planning, policy analysis, and evaluation offices should promote periodic evaluations by knowledge-production agencies of the work they fund, with priority given to the largest and most important programs of support.

Importance

The problem of inefficient use of social resources and knowledge produced with Federal funding is pervasive. Probable attention to "Sunset" legislation in the House suggests prompt attention to this subject. The need to improve oversight of social R&D generally gives intrinsic meaning to these issues. The study group identified the DISPAC Subcommittee as a major oversight agency.

Threats to Behavioral and Social Research Posed by Secondary Effects of Federal Regulations Designed to Mitigate the Risks to Human Subjects of Biomedical and Behavioral Research

As a result of being regulated by many of the same factors that govern biomedical and behavioral research, social research encounters legal and ethical dilemmas in protecting confidentiality of personal data, welfare of participants in some experimental situations and individuals in predictive studies. Various research and regulatory methods have been proposed to minimize conflicts between the researcher's need for high quality information and legal and ethical standards. The recent signing of P.L. 95-622 established a presidential commission to study these subjects and further refine protective mechanisms, recommend their adoption to Federal agencies and report annually on measures taken to protect human subjects. OMB, GAO and the courts share these concerns as do researchers who see conflicts between the issue of accountability to sponsors and confidentiality of participants.

Background

Recently considerable attention has been devoted to the topic of developing legal, regulatory, research mechanisms to protect the integrity of human subjects in biomedical, behavioral, and social research and experimentation. Recommendations have resulted from legislative initiative and regulatory reform based on recommendations of various commissions reporting to Congress and the President. As a result, according to Robert Boruch:

> Policy related social research, especially evaluations of social programs, will at times engender some notable conflicts between the researcher's need for high quality information and law or ethical standards. Those conflicts involve privacy, for example, where the researcher may find it difficult to elicit information on child abuse on account of Federal regulations on privacy. And having obtained the data, he or she may find it difficult to maintain the confidentiality of individual responses against appropriation by government agencies for nonresearch purposes. The conflicts occur in field tests of new social programs: The random assignment of individuals to alternative programs, often essential for a fair comparison, has been attacked on grounds that it puts individuals at risk, deprives them of their rights and so on. These and other kinds of conflicts can and have occurred in research on criminal and delinquent behavior, program evaluations in manpower, mental illness, and education, surveys of physical health, and tests of alternative judicial and correctional procedures. (Remarks for NSF-sponsored symposium, March 1978 on "Multiple Approaches to Resolving Ethical and Legal Problems in Social Research.")

Refinement of statistical procedures, adherence to procedures of informed consent and establishment of institutional review boards have been adopted to minimize adverse effects of privacy and human experimentation regulations on research. However, increasingly recommendations are made

45-884 - O - 79 - 11

to tighten up restrictions, viz P.L. 95-622 and the creation of the President's Commission for the study of Ethical Problems in Medicine and Biomedical and Behavioral Research and GAO's recent report on Audits and Social Experiments (PAD-79-1) and on privacy and replication.

Importance

The committee may wish to be prepared to react to the Commission's regulations and annual reports in anticipation of insuring an adequate and appropriate balance between freedom and integrity of scientific research on the one hand and the protection of human subjects on the other.

Program Evaluation Research

Obligations for program evaluation research totaled approximately $243,000,000 in the fiscal year 1977. Such research is intended to measure efficiency and effectiveness of Federal programs. According to experts most of this research is of poor quality or not used, although requirements for performance of evaluation are increasing. The General Accounting Office recently identified nine major inadequacies with the Federal program evaluation effort and by virtue of authority in P.L. 93-344 initiated major programs intended to improve Federal program evaluation and to help committee staff refine legislative requirements for evaluations. Issues of importance include cost and effectiveness in relation to methodology used, adequacy of findings for policymaking, and dissemination methods. Probable passage of sunset legislation compels attention to these issues.

Background

Momentum that began in the 1960s for statutorily required program evaluation to assess the efficiency and effectiveness of federally funded programs, especially social programs, has continued unabated during this decade. Recent requirements for evaluation appear to be motivated by initiatives for accountability, budget balancing, and "sunset" legislation. OMB reported in recent hearings on evaluation before the Senate Human Resources Committee that approximately $243,000,000 was obligated for evaluation research during the fiscal year 1977. Accompanying the trend toward increased expenditures for evaluation is a trend which sees Congress defining specific legislative requirements for evaluation. In recent legislation Congress has begun to specify program goals, measurable, operational, and acceptable levels of goal attainment, data systems required for evaluation, types of evaluation research required (experimental vs. non-experimental), sampling methods and population, and other facets of research design. These issues formerly were the exclusive prerogative of executive agencies administering and evaluating the programs.

According to the GAO, improvements in evaluation management and research methods have not kept up with increasing requirements for the conduct of evaluation. GAO identified basic deficiencies, including: lack of clear evaluation policy, definitions, and objectives; inappropriate or missing incentives for accountability; mismanagement of the evaluation function in agencies; inappropriate priority setting; inadequate guidelines and standards for evaluation; difficulties in designing research methods to examine program implementation and effects; and shortcomings in improving state-of-the-art despite Federal funding incentives to social scientists.

Importance

The importance of inappropriate evaluation, from management and budgetary standpoints seems to compel attention to research and management issues, especially since House attention to "sunset" legislation, requiring considerable evaluation, seems likely in the 96th Congress.

Domestic Violence -- The Victims

Concern for domestic violence victims has significantly increased over the last few years -- especially for abused children and battered wives. What are the causes of violence within the family? What methods can the Federal Government utilize in providing assistance for the victims?

Background

Domestic violence pervades all socioeconomic levels. Abuse tends to be just as prevalent among college educated families as in those less educated. Summoning the police for help seems to be the only resort for the poor; therefore crime statistics reflect a larger number of abuse cases among the less educated. The more affluent usually seek the assistance of marriage counselors or psychiatrists.

Statistics show that within one year there were reported approximately 3 1/2 million severely battered wives -- those who needed shelter, some type of hospital or police intervention; 1/4 million abused husbands; 5 million battered siblings; 350,000 abused children; and elderly of which there were no local or national estimates. Studies have indicated that as many as five million wives suffer exteme violence during some time in marriage. Almost two million couples reported using a lethal weapon at some time in their marriage.

Various aspects of family violence may be interrelated. Occasionally, child abuse is the direct result of spouse abuse. Parental Anonymous, a national organization that assists parents who are child abusers, has reported that in almost all of their 750 chapters there are women who are victims of spouse abuse. On the other hand, it is believed that women who grew up in a violent home atmosphere may be more likely to accept beatings in their marriage than other women. Furthermore, children who observe their parents using violence to solve problems may develop the idea that violence is an acceptable way to deal with stress. They, then, may use violence in their homes as adults.

On February 14-16, 1978 hearings were held by DISPAC on the issue of domestic violence

Importance

Financial support to establish emergency shelters and other services for domestic violence victims and their dependents is an immediate factor that Congress may consider. However, it may be important to enlarge research activities concerning the causes and interconnections between different factors involved in the domestic violence problem. Do violent homes beget violent homes? Is there a correlation between a family's drinking behavior and/or drug use and domestic violence? It may also be important for Congress to acquire more knowledge regarding the origin of the problem within the family structure in order to learn how to approach the issue so that the appropriate services necessary for domestic violence victims may be provided. More comprehensive research concerning the victims of domestic violence may be the means of accomplishing this task. Domestic violence is increasingly becoming a matter of public attention. Some individuals feel that this is not an area for government intervention. Others who deal with the victims on a daily basis and are becoming more aware of its consequences feel that there may be a role that the Government can play. What position could the Federal Government take? This may warrant the attention of the 96th Congress.

14. SPACE R&D

U.S. Civilian Space Policy

Twice in 1978, President Carter issued directives relating to U.S. space policy. These policies were viewed in some quarters as giving little more direction to the U.S. space program that there had been prior to the directives, and that a stronger policy statement is needed.

Background

During the 20 year history of the U.S. space program, U.S. policy regarding space exploration has fluctuated dramatically, from the 1961 Presidential mandate to send men to the moon by the end of the decade to the current program of low-level space budgets providing for few new programs.

For some years there had been discussion about the need for a formal U.S. space policy. In July 1978, President Carter issued the first of two policy statements concerning the U.S. space program, focussing on interagency coordination and cooperation. This statement, Presidential Decision (PD) 37, also established a Policy Review Committee (Space) in the National Security Council headed by Presidential Science Adviser Frank Press to facilitate this coordination and help establish policy guidelines. The first task for this committee was preparation of recommendations for a U.S. civilian space policy for the next ten years.

In October 1978, the Policy Review Committee's recommendations, as approved by the President, were released. Rather than proposing specific guidelines for conduct of the civilian space program, the study only set forth the various alternatives that could be followed. For example, the study said that as funding requirements for NASA's most expensive program, the space shuttle, phase down, "we will have the flexibility to give greater attention to new space application and exploration, continue programs at present levels or contract them." This type of statement, which permeates the study's conclusions, led to criticism that the "policy" could in fact support any level of space activity, large or small, and does not elucidate the President's preferences regarding the future of space.

Importance

During the closing days of the 95th Congress, two bills were introduced in the Senate establishing their own space policies, in light of what was considered lack of direction in the Presidential arena. One of these suggested widely expansive programs for NASA into the 21st century, including orbital civilizations, bases on the Moon, and manned exploration of the solar system, while the other concentrated on a program for the next ten years, recommending goals such as prototype satellite power stations and continuing research into applications satellite systems. It seems likely that these bills will be reintroduced during the 96th Congress and that a continuing effort will be made in Congress to evaluate the Nation's space policy.

Managing the Operational Space Shuttle Program

The space shuttle is expected to make its first manned orbital flight late in 1979 and to start operational activities shortly thereafter. How the operational space transportation system should be managed, and what organization, inside or outside of the Federal Government, should do it, is of increasing concern to the Congress, NASA, and many public and private sector potential users.

Background

NASA estimates that over the anticipated twelve years of shuttle operation (1980-1991), there will be approximately one mission every ten days. Thus routine shuttle operations will place extensive demands on whatever organization is chosen to manage it. NASA has never before managed an operational system of the nature of the space shuttle, and such a large program would undoubtedly impose new organizational and management requirements within NASA. NASA has been developing a comprehensive shuttle operations management implementation plan. One possible approach being considered by NASA is for NASA to retain overall shuttle management but to decrease internal resources which would need to be devoted to shutttle management by contracting with industry for launch operations and payload operations.

Other alternative suggestions have been proposed for shuttle management. One is that the Defense Department, as the single largest user, should operate the shuttle. Another is that a user agency, such as the Department of the Interior or Department of Commerce, should manage it. Still other suggestions are that a separate Federal agency be formed to manage the shuttle program; that a quasi-private corporation be formed to manage it; or that private industry could provide the best shuttle management system. The pros and cons of each alternative are being studied by organizations in the public and private sector.

Importance

The space transportation system will come into operational status during the 96th Congress; therefore its operational management is of immediate importance to the Congress. During 1979 and 1980, the Congress will be examining NASA's plans for shuttle operations as well as any other proposals which may be advanced for alternative shuttle management possibilities which might require enabling legislation. The operation of the space transportation system is a large task and, whatever mechanism is chosen, the decisions made at this point will have ramifications which will impact on the whole civilian space program in terms of costs of space operations, launch scheduling and availability, and transfer of space benefits to the user community, both domestic and international.

Federal Government Support of a Major Communications Satellite R&D Effort

The United States no longer has a major communications satellite R&D effort sponsored by the Federal Government. Given the inability of private industry to assume large-scale projects in this area, the issue of reassigning to the National Aeronautics and Space Administration (NASA) a major communications satellite R&D effort has emerged.

Background

From 1960 to 1973, the Federal Government (primarily NASA) assumed the dominant role in communications satellite R&D. This research provided the basis for low-risk operational system development by private enterprise in the 1960's and 1970's. Since NASA's disengagement from an active R&D role in 1973, private industry has not assumed a broad-scale R&D activity. Some argue that industry has introduced improvements rather than innovations. Principal reasons cited include the large required financial outlays and the risks involved.

While it is true that in the past the military communications satellite program has developed significant applicable technology, its contribution to commercial missions is hampered by an increasing divergence in military and civilian applications. For example, most of the military work is done at non-commercial frequencies and is thus of limited utility to commercial companies.

Importance

Whereas the U.S. Federal communication satellite R&D budget has been drastically reduced, other nations are sponsoring ambitious programs. Japan, Canada, and the nations of the European Space Agency have government-sponsored communications satellite R&D budgets several times greater than that of the United States. Without a strong R&D program, dominançe by foreign countries of the strategic multi-billion dollar international communication satellite markets of the 1980's may be possible.

NASA plans to include in its FY 1980 budget request sufficient funds to begin a major communications satellite R&D effort. Issues concerning the importance of U.S. technological leadership in the area of communications satellites both to our ability to market technology abroad and to the benefits which may accrue to U.S. users from advances in technology are relevant to the consideration of the NASA budget request.

Establishment of an Operational Landsat Program

Landsat is an experimental Earth resources satellite program. Although Landsat imagery has proved useful in such areas as agriculture, environmental monitoring, hydrology, cartography, and geology, there is no operational Landsat program, and indecision as to its future remains.

Background

Through the use of various sensors, Landsat spacecraft have, since 1972, relayed a wealth of information which has enabled scientists to determine crop condition and yield, predict snowmelt, assess flood damage, monitor the environment, make accurate maps, and chart geological anomalies. One of the major goals of the experimental Landsat program was to gain sufficient knowledge and experience to determine the advisability of establishing an operational Earth resources satellite system. After five years of experimentation and three Landsat spacecraft, there is no comprehensive long-range plan which will lead to a decision on whether or not to establish an operational system.

Congressional efforts to establish an operational system have reflected a concern that the uncertainty of continuous data availability restricts a more extensive use of Landsat by many current and potential users. To realize maximum benefits from Landsat data, many experiments would require continuous data for extended periods of time. In order to justify such investments and before long-term experiments can be initiated, it is necessary to have some assurance of program continuance. A national commitment to go operational would, according to its proponents, provide the user community with the assurance it needs. Without such a commitment or a definite point of program termination, the experimental phase of the program will continue indefinitely, thereby leaving the users in a continuous state of uncertainty regarding the future. Congressional initiatives to establish an operational Landsat system have met general acceptance in the Congress. Disagreement has centered on the institutional arrangement for the Landsat system and the best means of encouraging the participation of the private sector.

Given the magnitude of the investment in data interpretation equipment and personnel training, the uncertainty of the commercial market, the non-aggregate status of the user community, and the fear of lack of support from the Federal Government, the private sector has been reluctant to establish its own operational system.

The current administration's position is that its funding of the fourth satellite, Landsat D, and its backup satellite demonstrates a commitment to a continuing Earth resources satellite program of sufficient duration and certainty to satisfy the user community. It is the administration's intention to establish an interagency task force to study expected technical, programmatic, private sector, and institutional arrangements for remote sensing, and to examine options for integrating current and future systems into a national system. The task force is expected to complete its review prior to the FY 1981 budget cycle.

Importance

In terms of benefits, Landsat is one of the most heralded of NASA's space programs. If it is true that the potential users of Landsat technology are reluctant to invest in the system because of its indeterminate future status, a national resource is being underutilized.

In response to its efforts to establish an operational Landsat system, the Congress was told by the administration that such initiatives were premature, and that further study of the subject was needed. Having waited for over a year to obtain the results of the administration's study only to be given the news that another study was required, the Congress may decide that the time for its reconsideration of the issue has arrived.

Establishment of a Space Industrialization Trust Fund

In order to facilitate industry involvement in the industrialization of space, especially materials processing in space, it has been suggested that a space industrialization trust fund be established to provide funding for innovative industry-sponsored experiments which might lead to production of superior products marketable on Earth.

Background

For many years there has been interest in the potential of processing materials in the near zero gravity environment of space. Gravity, which is ever present on Earth, affects some processes by causing convection currents and settling of materials of different densities into layers rather than becoming a homogenous mixture. By performing processing in space, it is expected that, for example, new alloys can be produced which might have superior qualities (such as better superconductors) than Earth-based materials.

A number of experiments have been performed by NASA on three Apollo flights, Skylab, the Apollo-Soyuz Test Project, and the SPAR (Space Processing Applications Rocket) sounding rocket program. Many claims have been made by advocates of materials processing in space that large markets would exist for space-produced materials. The ultimate success of such a program will depend to a large part on industry reaction -- whether they will use and/or market products made in space, and whether they themselves would be interested in performing materials research in space.

This latter area, industry interest in performing space processing experiments, is addressed by the Space Industrialization Trust Fund concept. The idea, as proposed by Dr. Sherwood Fawcett, President of Battelle Memorial Institute in testimony before the House Science and Technology Committee in September 1977, calls for a trust fund to be established which would provide funding for innovative industry experiments which might lead to production of marketable products. If marketable products do result from the experiments, royalties will be paid to the fund up to the cost of the experiment plus interest. This money will then be used to finance other experiments.

Importance

In setting up such a Trust Fund, the question of who would operate such a system arises: the government, private industry, a quasi-government corporation, or a public corporation. In the closing days of the 95th Congress, a bill was introduced in the House to establish a Space Industrialization Corporation, generally patterned after the Fawcett model. The bill suggests intitial funding by the government, but with eventual public ownership. It seems likely that this bill will be reintroduced for consideration in the 96th Congress, and the general subject of funding for space processing research and development will arise in NASA's budget requests.

Legal Aspects of Routine Utilization of Space

The first space shuttle flight is scheduled for launch in 1979. Operational flights will begin in 1980. Although a body of space law exists, many legal questions relating to operational aspects of shuttle utilization remain unanswered.

Background

The existing codified body of space law consists of four laws: (1) the Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies; (2) the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space; (3) the Convention on International Liability for Damage Caused by Space Objects; and (4) the Convention on Registration of Objects Launched into Outer Space. These laws establish that space shall be used for peaceful purposes, that space exploration shall be conducted for the benefit of all mankind and in accordance with the United Nations Charter, that a launching State shall be absolutely liable to pay compensation for damage caused by its space objects, that States shall aid in the rescue and return of astronauts, and that a launching State shall furnish the United Nations with the name, basic orbital paramenters, and general function of each satellite launched. Generally, this body of law covers relations between governments in the exploration of space. The routine utilization of the space shuttle by nongovernmental entities from a variety of nations is not covered and raises new questions of space law. First, there is the fundamental question of whether air law or space law will apply to the space shuttle. The jurisdiction of the shuttle astronauts is also in question. Such jurisdiction becomes important in cases of acts of violence perpetrated by one astronaut against another and in the determination of civil liability. Given the large expense of space shuttle operations for private companies, joint ventures may be desirable. The effect of antitrust laws on such ventures will be important. Yet another area of concern involves patent rights: both basic and applied research will be conducted on the shuttle and in Spacelab. Private industry will be greatly interested in the patent policy regarding marketable space technologies and processes resulting from shuttle utilization. Currently, the United States does not reimburse for launch failures and aborted missions. Some type of insurance may be an important factor in the willingness of private industry to risk capital in shuttle ventures. If industry sends its own astronauts into space, the possibility of aberrant behavior resulting from the effects of the space environment and the question of whether an astronaut will be held to a higher level of conduct than his/her counterpart on Earth also become important considerations in terms of insurance for shuttle utilization by the private sector. There may also be a need for new labor and corporate law defining crew performance standards, rights, and responsibilities.

Importance

One of the purposes of the space shuttle was to open the environment of space to industrial applications. If legal impediments to industry use of the shuttle exist, the potential of the shuttle program will not be fully realized.

The process of writing laws defining the relationships of all parties aboard the space shuttle and determining rights and liabilities will be lengthy. Much discussion and debate is needed before the legal requirements for the space regime can be decided. With the launch of the first operational shuttle in 1980, such debate is timely.

International Cooperation in Space

International cooperation has been a major aspect of the U.S. space program since the creation of NASA. Throughout the years, cooperation has been achieved in one form or another with over 50 nations, including American's main competitor in space, the Soviet Union. As space projects become more expensive and available money diminishes, international cooperation may provide a mechanism for funding projects which otherwise could not be undertaken.

Background

The National Aeronautics and Space Act of 1958 specifically directs NASA to promote international space activities. NASA established an office of international affairs in 1963 to facilitate international cooperation in space, and during the intervening years, has worked jointly with over 50 other nations on projects involving foreign experiments flown on NASA missions, foreign satellites launched by NASA either on a cooperative or a reimbursable basis, analysis of data from NASA satellites and the manned lunar program, and sounding rockets. The most significant cooperation with the Soviet Union was the 1975 Apollo-Soyuz Test Project in which a U.S. Apollo spacecraft docked with a Russian Soyuz spacecraft and the crews conducted joint experiments for two days. Both the United States and the other countries benefit from these programs.

As space program costs rise and budgets throughout the world become more constrained, international cooperation may provide a means for conducting space programs which otherwise would be out of the economic reach of a single country. This has already been accomplished to some extent with the construction of the Spacelab module for the space shuttle by the European Space Agency. Future projects, such as satellite power stations and permanent orbital civilizations, could benefit from the expertise and money available through international programs.

If the United States wants to expand international cooperation in space, it should be attuned to problems which might develop or have already developed in relations with other countries in this area. For example, some consternation was evident when the United States decided to withdraw from the Aerosat (aeronautical satellite) program, leaving Canada and the European Space Agency without its lead partner in the project. Conflicts between U.S. commitments to the International Telecommunications Satellite Organization (INTELSAT) and to countries wanting launch services for their own communication satellites have already arisen, and were partially responsible for the European decision to build its own launch vehicle rather than relying on "launch assurances" from the United States. All these factors may inhibit future cooperation.

Importance

Areas of special interest to the 96th Congress in the area of international cooperation in space might include: (1) space science projects, contributions to which are often negotiated with other countries prior to time NASA requests funding for the program; if Congress then denies funding for the project, frustration and ill feelings in other countries may be generated leading to an unwillingness to cooperate with the United States in the future; and (2) assessing whether NASA is doing all it can to foster international cooperation and and identifying programs which could benefit from such cooperation.

Federal Government Support of High-Risk Space Technology

There is a continuing philosophical debate as to who should pay for high-risk space technology R&D -- the private industry which gains economic benefit from the research or the Federal Government.

Background

In 1973 the Nixon administration discontinued NASA's major R&D efforts in the communications satellite area. The reason cited was that the commercial communications satellite industry, rather than the taxpayers, should finance advanced communications satellite R&D.

This philosophy that space applications programs should be self-supporting extended to other programs, such as the Landsat program. In evaluation of the success of Landsat and whether or not it is ready to go operational, much discussion centers on Landsat's ability to attract private capital and its potential for profit. The assumption is made that Landsat is not ready for operational status until private industry is so enthusiastic about the program that they would assume responsibility for advanced R&D. And if, for one reason or another, such a program cannot attract large investments from the private sector, its worth is somewhat lessened.

Recently, several factors have contributed to a reconsideration of this issue. Criticism that private industry cannot support an innovative communications satellite R&D program has surfaced. Also, the increasing competence of our foreign competitions in this area became more apparent. In addition, there is continuing difficulty in attracting private industry to become involved in an operational Landsat without a commitment from the Federal Government to continued support of advanced R&D. It has also been recognized that some areas of high-risk R&D, such as public service communications satellites, may provide great benefit to the public but may never receive private industry support. Such considerations have been the impetus to reopen debate as to whether the Federal Government should support high-risk R&D for space technology.

Importance

High technology ranks second to agricultural products as our most successful export. Thus, our loss of leadership in space technology becomes significant in balance of payments considerations. In addition, the effect which the lack of Federal commitment for high-risk space technology R&D has on the appeal of space applications programs to private industry is also important.

Given the fact that R&D requires from 15 to 20 years to move from theoretical work to practical applications, as well as the imminent demise of NASA's last two experimental communications spacecraft, ATS-6 and CTS, this is an issue of present concern for the 96th Congress.

Shuttle Utilization and User Needs

The space transportation system (STS) was designed to enable many economies in routine space operations because of the shuttle's reusability and because of the benign launch environment it promises. However, realizing these economies will depend on achieving a high level of shuttle utilization. Whether this expected utilization will materialize, how utilization is being encouraged by NASA, and how user needs are integrated into the shuttle program are areas of concern at this time.

Background

Since 1972, NASA's planning for the STS has revolved around a mission model of 560 shuttle flights over the anticipated 12 year operation of the space shuttle (1980-1991). These missions would be carried out by a fleet of five orbiters. There has been some question that utilization levels would be sufficient to keep five orbiters in operation. In 1978 the administration proposed, for FY79, that production of only four orbiters be funded, and the General Accounting Office supported this plan. The Congress did fund long lead production items for the fifth orbiter but will reassess further production funding for FY80 to see if anticipated utilization levels will be achieved.

One of the key points of the President's newly enunciated civilian space policy is the utilization of the shuttle to reduce the cost of operating in space. However, predicted shuttle economies will only occur if maximum utilization is made of the shuttle and it replaces expendable launch vehicles. NASA must find paying users in sufficient numbers to economically utilize the shuttle as a national resource.

NASA has studied mechanisms to broaden interest of potential STS users and has conducted symposia to reach potential users in industry and the scientific community. Whether NASA is doing enough to stimulate the potential non-NASA user community, and whether user needs (such as the necessity for larger amounts of power in space and longer periods of time in orbit) are being considered adequately by NASA, is a matter of current concern. Shuttle pricing policy might be used as a tool to encourage shuttle utilization and NASA's initial pricing policy is being examined in this light.

Importance

During the 96th Congress, decisions on whether to continue funding for the fifth shuttle orbiter will be made. In part, this decision will be based on whether shuttle utilization levels are perceived to require five orbiters and whether U.S. space program goals can be met with less than five orbiters. In reviewing the shuttle program in 1979 and in funding orbiter production, the Congress will be considering NASA's plans for attracting shuttle users and for considering user needs as the shuttle program progresses.

Space Program Contributions to Solving the Energy Crisis

As a result of its experience in building spacecraft and launch vehicles, NASA can contribute to solutions to the energy crisis in a variety of ways, including construction of electrical generating plants in orbit about the Earth (satellite power stations); research and development in support of other agencies' programs on conventional energy sources such as coal and alternative energy sources such as photovoltaics and fuel cells; and locating deposits of energy materials such as coal, uranium, oil and geothermal energy with Earth resources satellites.

Background

One manner in which NASA could contribute to solving the Nation's energy problem is by supporting the Department of Energy (DOE) program for Solar Power Satellites (or Satellite Power Stations, SPS). The SPS concept calls for constructing large solar panels in space for collecting energy from the Sun and converting it into electricity. The electricity would be converted into microwaves and beamed to receiving antennas on the surface of Earth and reconverted into electricity. Each SPS, as currently planned, would provide 5 gigawatts of power, as compared to coal and nuclear plants which average about 1-1.2 gigawatts per plant. The program officially comes under the jurisdiction of DOE, although NASA provides support for space-related components of the system. There are many questions about the viability of SPSs, both economically (estimated cost for the first SPS is between $40 and $80 billion dollars), and environmentally, in terms of possible effects of the microwave radiation on the atmosphere and in the area surrounding the receiving antennas.

NASA can also contribute to the energy solutions by research and development activities in support of other agencies' programs based on NASA experience in building spacecraft and launch vehicles. For example, NASA is assisting DOE in R&D on coal combustion mechanisms, based on their experience with turbines and engines. NASA is also very active in turbine technology for windmills. In addition, experience with spacecraft power supplies such as fuel cells and photovoltaic solar arrays is transferrable to other energy projects.

In addition, NASA Earth resources satellites can be used to locate deposits of energy materials such as coal, oil, and uranium, geothermal energy, and ocean temperature gradients for ocean thermal energy conversion systems.

Importance

Because of NASA's experience in turbines, engines, photovoltaics, fuel cells and other energy systems, the agency may have an important role to play in finding solutions to the energy crisis.

It seems likely that during the 96th Congress there will be continued debate over funding for satellite power stations, both for NASA and DOE. In addition, the House passed a bill in the 95th Congress (although the Senate did not) providing for a Solar Power Satellite Research Development and Demonstration project. This measure may be reintroduced in the 96th Congress.

Annual budget requests by NASA for its energy programs within the Office of Aeronautics and Space Technology and for satellite projects within the Office of Space and Terrestrial Applications will have to be considered during the 96th Congress. The Congress may well consider the question of whether NASA should receive more funding for energy projects, or should continue receiving most of its energy funding through DOE.

Support for NASA's Space Science Projects

The past decade has seen a decline in the level of activity in the space science area, based partially on the overall decline in NASA's budget and partially on the large funding requirements for another NASA program, the space shuttle. Criticism of this decline has become more vocal in the past few years, as the lack of support for space science in the early 1970's is emphasized by few space science launches now.

Background

The very first satellites, Sputnik for the Soviet Union and Explorer for the United States, had space science missions, since they were ostensibly launched in support of the International Geophysical Year. Since that time, a large number and variety of space science missions have been accomplished including earth-orbital satellites, deep space probes, and experiments using sounding rockets and balloons. These programs provide information on the Sun, planets and other celestial bodies which is applicable to an understanding of forces which affect our planet. Studies of the Sun in the 1920's led to an understanding of nuclear fusion; current space studies provide information on how the Sun communications, weather and climate may lead to more discoveries as significant as fusion. Information about the planets can be used to develop a greater understanding of Earth. For example, Venus is approximately the same size and mass as Earth, but environmental conditions are drastically different. The reasons why a planet of similar characteristics would develop an atmosphere composed of compounds such as sulphuric acid, and which creates surface pressures 90 times that on the surface of Earth and temperatures of over 1000 degrees Celsius, may be vital to the future of this planet.

Space science programs were given a relatively low priority as NASA's budget declined and funding demands for the space shuttle rose. Many of the projects launched in the early 1970's were funded years earlier, so as the decade progressed, fewer and fewer space science projects were launched. Space science programs encountered difficulty not only in winning approval within the agency and the Office of Management and Budget, but in Congress as well. Several planned programs were shelved and, although the Large Space Telescope program was funded, it was not until its size was reduced to where it is now simply called the Space Telescope. The rationale behind the low funding appears to be that since the universe will always be there to explore, these missions can wait until such time as there are fewer constraints on the Federal budget. Space science advocates hoped that once the space shuttle passed its funding peak, more money would be made available to the space science programs.

Importance

President Carter's recent space policy directive said that pursuit of space science programs would depend on the "promise of the science, the availability of the particular technology, and the budgetary situation." Such a statement does not appear to provide a great deal of support for future space science missions. In its deliberations on NASA's annual budget requests, the 96th Congress may want to assess whether space science programs are receiving adequate funding based on potential application of the knowledge gained therefrom to our own environment, and whether there is a role for seeking basic knowledge about the universe for the sake of that knowledge alone.

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Utilizing Space Technology

The President, in his new civilian space policy, evidenced concern with obtaining the maximum return for the resources invested in space activities and deriving the greatest benefit from space technology by increasing its utilization, rather than starting major new space initiatives. In the Congress, space program proponents and critics alike perceive the necessity for the greatest possible return on the space investment through utilization of space technology.

Background

In 1963 NASA established the Technology Utilization Program to accelerate and broaden the transfer of aerospace technology to the public and private sectors. Since that time, NASA has used a variety of mechanisms to achieve program goals. In 1977, the Congress directed NASA to study the cost-benefit relationship of the Technology Utilization Program. The summary study results, prepared for NASA by the Denver Research Institute, suggested that for every dollar spent through the program, the net economic gain was about six dollars.

However, many people believe that the potential to transfer aerospace technology to users and to apply such technology in practical ways is much greater than has been realized and redoubled efforts by NASA are called for. In a time of limited funds for space, they cite the necessity to obtain increased benefits for resources expended, to enhance technology transfer and applications, and to stimulate space applications which will bring benefits to the public and private sectors. With shuttle expenditures expected to decrease from now on, the question of reorientation of NASA's efforts toward transfer and application of available space technology has arisen.

In its oversight of NASA, the Congress has indicated that NASA should explore ways to strengthen its ties to the user community and ways it can work with other Federal agencies to stimulate domestic technology utilization. The mechanisms of technology transfer are not well delineated and NASA hopes, through studies, to achieve a better understanding of the mechanisms in order to increase the efficacy of its Technology Utilization Program.

Importance

During 1979, the Congress, in both its oversight and funding roles, will be exploring the questions relating to increasing the benefits to be derived from space through technology utilization as NASA adheres to the principles contained in the new U.S. civilian space policy.

15. SURFACE TRANSPORTATION R&D

Surface Transportation R&D

Should there be a R&D agency (such as NASA for space) for surface transportation? Is it appropriate for the Federal Government to support R&D? What would be the most effective institutional mechanism? Is there sufficient coordination among the various Administrations of the Department of Transportation (DOT)? Do we need a national transportation policy?

Background

National needs in transportation include (1) assuring the development of the Nation's transportation system to meet the needs of commerce and the public; (2) promoting safe, reliable, and efficient operation of that system; and (3) ensuring that transportation programs help meet the Nation's energy, environment, and social goals. To meet these needs, the Government will spend over $14 billion during this fiscal year. A large part of these funds will be used for surface transportation R&D programs carried out by DOT and other agencies.

Federal R&D activities for surface transportation are carried out by several agencies including DOT through several of its Administrations (e.g., the National Highway Traffic Safety Administration which carries out research on highway and motor vehicle safety), as well as the Departments of Commerce, Defense, and Energy. This scattering of surface transportation R&D programs in various agencies poses the question -- should there be a NASA-type agency for surface transportation R&D that would conduct research on automobile design, fuel efficiency, pollution control, safety, etc., as well as conduct R&D for the other surface modes? Also, is it appropriate for the Federal Government to support R&D? On the other hand, without the NASA-type agency, is there sufficient coordination among the Administration within DOT?

Secretary of Transportation Adams issued a transportation policy statement in February 1978, that emphasizes conservation and reorients priorities with special consideration being given to energy conservation and production, environmental protection and enhancement, safety, quality of life, and improved human and material resources allocations. In reviewing the R&D segments that would be necessary to achieve these goals, the question arisesas to the adequacy of this policy. The question also may be asked -- do we need a national transportation policy? And, if so, why? If not, why and what are the alternatives?

Importance

Because transportation is so important in our lives, i.e., it uses about one-fourth of the gross national energy output, it is important to coordinate our surface transportation R&D efforts to improve the transportation system, and, in turn, to make better use of our limited resources.

16. TECHNOLOGICAL INNOVATION AND INDUSTRIAL R&D

See also items:

3.5 Pharmaceutical Innovation
5.1 Environmental Regulations, R&D, and Technological Innovation
6.2 Energy Technology Commercialization
6.4 Solar Commercialization: The Need for Comprehensive Federal Policy
6.7 Stimulating Industry Participation in Fuel Cell R&D
10.1 Technology and International Trade Competitiveness
10.7 Issues Relating to the Competitiveness of Japanese Technology and Production Methods
11.3 National Needs in Semiconductor Microstructure Fabrication
13.2 Regulatory Decisionmaking

Industrial R&D/Innovation and Economic Growth and Productivity

Concern continues to grow that the economic performance of the United States is slipping compared to past performance and relative to other nations. One of the causes that has been cited for this is a relative decline in the level and quality of U.S. industrial R&D and innovation. Additionally, since the demise of the National Center for Productivity and Quality of Working Life at the end of FY 1978, the Federal Government has had no focus for improving productivity.

Background

Although absolute productivity levels in the United States exceed those of France, Japan, West Germany, Canada, and the United Kingdom, U.S. productivity gains between 1960-1976 were the smallest of these nations. Japanese productivity increases were more than five times greater than U.S. increases, although the actual productivity level was still 40 percent below that of the United States in 1976.

Although changes in economic growth and productivity depend on many factors, technological change is an important factor among others. Econometric studies have found strong correlations between R&D expenditures and growth, especially at industrial and sector levels. Thus one of the causes cited for the decline in growth and productivity is a perceived decline in the level and quality of U.S. industrial R&D and innovation. Industrial R&D performance has essentially stagnated (in constant dollars) for a decade, partly due to the decline in federally-funded industrial R&D.

Importance

Substantial debate remains on this issue as to whether the declining growth of the economy and productivity are serious problems or are simply natural signs of a maturing economy. There is debate about the extent to which a decline in R&D and innovation are responsible for the decline or whether an increase in these activities would alleviate the perceived problem. There is controversy over the economic benefits of federally-funded, as opposed to industrially-funded, R&D. Less attention has been paid to the role of general economic conditions in affecting the rate and direction of R&D and innovation.

The domestic policy review on industrial innovation in the executive branch is forcing consideration of policy options. Two basic types of Federal policies have been suggested: 1) general policies to stimulate the economy as a whole, and 2) policies to fund or stimulate R&D and innovation.

Some of the issues which may warrant congressional consideration are:

1) To what extent are productivity and growth problems due to stagnating R&D and innovation, and to what extent to other basic changes in the U.S. economy such as the shift from manufacturing to services and the entry of inexperienced laborers?

2) Should the Federal Government attempt to enhance the contribution of technology to the economy? If so, should it do this through stimulation of the economy as a whole or through direct stimulation of R&D and innovation?

3) How can technology policy be better integrated into economic policy-making?

4) Would subsidization be more or less effective than stimulation?

5) Should certain sectors or industries be singled out for attention?

6) What, if any, policy disincentives to R&D/innovation should Congress consider removing?

Industrial Support of Basic Research

Industrial interest in maintaining broad-banded basic research programs has declined over the past 18 years. Industry spokesmen cite a number of reasons for this trend, and have suggested revisions to our tax, patent, and regulatory laws to remedy the situation. It seems appropriate to ask whether the reasons for their recommendations are fundamental, or whether other forces are at work.

Background

United States' industry has a long history of research support. In the early years of this century, major firms such as American Telephone and Telegraph, Westinghouse, and General Electric established outstanding laboratories for the purpose of discovering and understanding basic phenomena which could lead to the development of new products, or the improvement of old ones. Though the research was broadly related to potential areas of product interest, it was not limited necessarily to specific products in being, or under development. At the close of World War II, GE officials considered the continued availability of scientists and engineers to be so crucial to the future of the company that they instituted and financially supported a large program to train high school science teachers. Though smaller firms were not capable of such large investments in research, some of their needs were met by the establishment of the Battelle Memorial Institute, the Mellon Institute, and other non-profit organizations which could be hired for specific problems, but which maintained some general research of their own. Following World War II, a large number of high technology firms initiated general basic research laboratories. IBM, Hughes, Boeing, Lockheed were typical of these. Firms such as Ford and General Motors entered the picture as well.

Around 1960, industrial interest began to wane. At first, some laboratories were restricted to doing research on specific problems. Staffs were trimmed and investments in "non-affiliated" research areas were trimmed or terminated. Many of the large older firms were among those "redirecting" research. Toward the late 1960s, changes in the Armed Services Procurement Regulations limited the R&D costs that could be allocated to defense contracts to those projects having a direct relationship to the contract, whereas previously a company could claim more general research expenses. This change reduced the amount of basic research supported by firms whose primary business was with the Government.

The late 1960s also saw the beginning of Federal regulations relating to the environment, food and drugs, and consumer protection. These regulations directed a number of industrial sectors, though certainly not all sectors, toward more "defensive" research. Though a great deal of basic research is still supported by industry, most of the activity is said to be either associated with definite product lines, or with meeting regulatory demands.

Where industrial support of basic research has remained almost constant (in constant dollars) since 1960, Federal support grew appreciably. The result is that the Federal Government is now by far the major supporter of basic research, and it seems to be assumed that general basic research is

the Government's, rather than industry's, responsibility. Industry spokesmen have called for: changes in patent policies; outright Federal support of industrially based general basic research; tax relief, write-offs of research expenses, etc.; reductions in regulatory requirements; etc. The question is whether these measures are proper, are needed, or are addressing the basic problem of industry's disaffection with general basic research.

Importance

The trend in industry away from the support of general basic research began at a relatively stable time, considerably before inflation, Federal regulations, the Mansfield Amendment, or changes in Armed Services Procurement Regulations were in prospect.

Industry spokesman have stated that their firms cannot afford to invest in basic research, yet Business Week reports that major industrial firms are holding very large amounts of uninvested capital: IBM has $5 billion in such funds, and a number of other companies are above the $1 billion mark. It would appear that these firms have the funds necessary to support large amounts of general research, and that if they had been supporting such research they might now be using this capital to produce the new products that might have resulted from the research.

Though existing patent laws may be inimical to research investment, these same laws have been essentially in effect for many years during which industrial research was being promoted much more heavily. However, the products of Government-supported research in industry can be subject to mandatory licensing and free Government use. There is therefore a question about whether industrial firms should retain proprietary ownership of the results of research that is supported by Federal investment. On the other hand, the licensing requirements associated with Federal research support might be a stimulus, rather than a disincentive, to private investment in research.

The changes in procurement regulations seem to have had an effect on industrial investment in basic research in defense-related industries. These merit study to see what revisions are necessary.

In considering other reasons for industry's reluctance to support general basic research, Jacob Rabinow claims that modern management is primarily interested in immediate profits rather than long term prosperity, whereas the founders of companies were interested in the future of the firm and therefore in the aggressive development of new products. If product competition is now lacking in industry, so that the incentives for research are not strong, then it might be wise to consider how best to rekindle such competition.

NSF Support for Basic Research in Industry

National Science Foundation policies and programs with respect to the support of basic scientific research in private industry appear to warrant examination with respect to the objective of stimulating technological innovation and the solution of national problems.

Background

Since the 1968 amendments to the National Science Foundation charter, the Congress has encouraged the Foundation to devise ways of making its basic research contribute more directly to technological development and the solution of national problems. The IRRPOS, RANN, and ASRA programs have been responses to this encouragement. During the FY 1978 authorization process, Congress explored the issue of NSF's policy with respect to support for basic research in industry and mandated that the Foundation encourage cooperative industry-university research and exchange of personnel. In January 1978 the Foundation announced that it will encourage and "significantly expand" cooperative industrial-university research. Support for basic research in private industry without university cooperation will continue to be provided only under exceptional circumstances.

Importance

Analysts concerned with a perceived decline in U.S. innovation performance have attributed this partly to declining levels of basic research in industry. They argue that basic scientific research often underlies major technological advances. They have therefore argued that the Federal Government -- and the National Science Foundation, in particular -- should financially support basic research in industry. The Foundation has argued on the other hand that its primary mission is the support of basic scientific research and education in universities and colleges. Moreover, it argues that the most effective stimulant for industrial R&D, including basic research, is not Federal subsidy but the provision of economic incentives and removal of disincentives to innovate. However, some feel that industry researchers should not be ineligible for NSF awards solely because of their institutional affiliation; they argue that the Foundation should support the best basic research, no matter where it is done.

The NSF announcement of support for cooperative research indicated that no new program office is being established and it appears that no new budget account will be established. Cooperative proposals will be received and evaluated through the regular procedures for scientific research project support and the usual NSF patent provisions will apply. This approach has the advantage of integrating the concern for application into the Foundation's basic research programs, but lacks the visibility and thrust of a program office and funding.

This may be a timely issue for congressional consideration for several reasons. In the executive branch a domestic policy review is currently in process which will develop policy options for the President to stimulate or to remove disincentives to industrial innovation. The NSF has announced its support for cooperative industry-university research. The House Committee on Science and Technology has published a committee print reviewing NSF's policy and funding patterns with respect to nonacademic institutions.

Commercialization of Federally-Funded Research and Development

Examination of mechanisms to encourage the commercialization of federally-funded research and development so that these technologies are brought to the marketplace where they can contribute to the economic and technological growth of the nation.

Background

In pursuit of their missions, Federal departments and agencies fund and perform research and development which has resulted in a wealth of new products and processes. However, most Federal units lack the authority (with the exception of the Department of Energy) and/or ability to further develop, adapt, and commercialized the results of the R&D endeavor. Thus, many of these technologies do not reach the marketplace where they can contribute to the innovative capabilities of the private sector and improve our technological competitive advantage. The commercialization of technology also presents sought-after solutions to technological needs which are expressed through market demand and private sector production to meet these needs.

The commercialization of federally-funded R&D is impacted by various factors; some hinder such activities while others encourage it. Present Government patent policy concerning the results of Government funded research and development are often viewed as a deterent to commercialization by the private sector. Because Government patents are available to anyone by licensing, business is hesitant to invest time and money since the uniqueness of the technology can not be assured. Of the approximately 28,000 patents owned by the Federal Government, only approximately 5% have been utilized.

On the other hand, the Federal Laboratory Consortium for Technology Transfer promotes commercialization of Government R&D. Originally developed under the auspices of the Department of Defense to provide the means by which technologies developed in pursuit of military goals could be applied to the solution of civilian-oriented problems, the Consortium has now expanded to include most of the non-defense agencies. The Consortium works in part with private industry -- especially small business -- to identify technologies available in member laboratories for further development and commercialization.

Importance

Given the large amounts of money and time expended on the Federal R&D enterprise, it seems desirable to expand the return on our investment. Commercialization of technology by industry and small businesses brings new products and processes into civilian sector where they meet certain needs as expressed by market demand. The science and technology endeavor in the private sector creates employment opportunities and contributes to our economic viability and thus strenghthens the national economy. The increasing number of problems requiring technical solutions (i.e., energy and resource scarcity) places added responsibility on the R&D community and the Federal Government which both funds and performs research and development. The present concern for our decreasing technological lead, expressed in various hearings held in the 95th Congress, should encourage further consideration of promoting commercialization of technologies developed in the Federal laboratories.

Government Patent Policy

The ownership of inventions resulting from federally supported R&D is an important aspect of the Nation's increasing concern with the state of U.S. industrial R&D innovation.

Background

A number of problems involving the ownership of inventions resulting from federally supported R&D has arisen, and remained unresolved, over the past 35 or so years since Federal support has become a major factor in the national R&D effort. These problems include issues like (1) whether title to inventions should remain with an inventor or be transferred to the Federal Government, (2) what are the Federal Government's rights in contractor/grantees' patents and inventions which were made before or outside of a particular contract effort, (3) the rights of Government employee-inventors to their inventions, (4) the need for an uniform Government patent policy to cover the above and related issues, and recently, (5) the acceptability of a standard Institutional Patent Agreement to cover rights to inventions made by universities, colleges, and other nonprofit organizations and funded by the Federal Government.

Importance

Hearings are held by the House Committee on Science and Technology in the 94th Congress, and House and Senate bills were introduced in the 95th Congress on this subject. Those bills incorporated many of the concepts of the proposal made by the Committee on Government Patent Policy of the Federal Council on Science and Technology in 1976. The bills introduced in the 95th Congress generally reflect the often-stated interests of the private sector in modifying the structure of Government patent policy to permit the retention of title by contractor/grantees in inventions resulting from federally funded R&D. On the other side of the issue, however, are some strongly held views, especially by Federal Government representatives, that the existing agency-by-agency policies, which transfer title to inventions to the Federal Government, should be continued in large part.

It is likely that Government patent policy bills will be introduced in the 96th Congress and that the issue will receive even more congressional attention than in the past since it has a significant relationship to the broader, and quite pressing, issue of the strengths and weaknesses of U.S. industrial R&D and innovation vis-a-vis that of Japan, Western Europe, and other industrialized nations.

17. TECHNOLOGY TRANSFER

See also items:

3.6 Use of Existing Technologies for the Handicapped
10.6 Multinational Corporations, Technology Transfer to the LDCs, and Appropriate Technology
12.0 SCIENTIFIC AND TECHNOLOGICAL INFORMATION
14.12 Utilizing Space Technology

Organization for Intergovernmental Transfer of Science and Technology -- The Future of the Intergovernmental Science, Engineering, and Technology Advisory Panel

A major initiative to emerge from the efforts at developing an intergovernmental science and technology coordination mechanism is the creation of the Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP) within the Office of Science and Technology Policy. Established by the National Science and Technology Policy, Organization, and Priorities Act of 1976, ISETAP was mandated to identify and promote Federal programs to increase State and local utilization of federally-funded R&D. An analysis of the present operation and organization of the Panel raises the question whether ISETAP is reaching its intended audience and whether its impact has been commensurate with policy intentions.

Background

The Intergovernmental Science, Engineering and Technology Advisory Panel was established by section 205(b) of P.L. 94-282, the National Science and Technology Policy, Organization, and Priorities Act of 1976. Located within the Office of Science and Technology Policy, ISETAP was created to focus attention within the Executive Office of the President to intergovermental needs and to facilitate the technology transfer process. The assignment of ISETAP to assist in "fostering policies to facilitate the transfer and utilization of research and development results so as to maximize their application to civilian needs" was delegated to the Director of the Office of Management and Budget under Reorganization Plan No. 1 and Executive Order 12039. This implied a coordinating function with respect to the diverse technology transfer activities of the Federal Government. It is unclear what the implications of the removal of this assignment have been on the interchange of intergovernmental technical expertise and information.

Questions have arisen as to the effectiveness of the Panel, as well as to whether its operation is meeting the policy objectives of the enabling legislation. Lack of visibility and recognition have been complicating factors. The absence of a means to enforce participation in the Panel's programs and a lack of authority to implement recommendations directly have been obstacles to the development of an effective program. Uncertainties surrounding ISETAP's activities, Presidential support, and the reorganization of the Panel have not helped in this respect.

Importance

State and local governments are increasingly responsible for the provision of goods and services. In light of this, President Carter, in a memorandum dated February 25, 1977, directed the heads of the executive departments and agencies to involve State and local officials in the development of the administration's policy and budget priorities and programs. The Panel is one such mechanism for application of this directive.

The Intergovernmental Science, Engineering, and Technology Advisory Panel falls under the provisions of the Advisory Committee Act which limits such groups to two years of operation. Thus, the Congress will want to look into the present organization of the Panel to determine whether its mandate should have been extended and if the Panel should continue to operate in its present form, or whether new organization and functions are needed to increase their impact of the intergovernmental endeavor.

Utilization of Federal Laboratories by the Private Sector and State and Local Government

Examination of the potential for utilizing the technological resources of Federal laboratories for problem-solving State and local government and the private sector.

Background

Approximately $28 billion was spent on research and development in the Federal Government in FY78. Over 500 laboratories and research centers participated in the science and technology endeavor. The transfer of technology and technical assistance to State and local government and the private sector provides a means by which to extend the benefits of federally-funded and performed R&D beyond those incurred by their original usage. The technical resources available in the Federal Government can be applied to meet the needs of State and local jurisdictions in providing goods and services and can provide assistance to the private sector in improving its innovative capabilities.

At the present time there is uncertainty surrounding the issue of utilization of Federal laboratories and a lack of institutional mechanisms to support such activities. The problems arising from considerations of patent policy, legal restrictions on Department of Defense laboratories, conflicting priorities in parent departments and agencies, and interference in free enterprise all combine to impact on the increased utilization of Federal facilities. One major initiative, the Federal Laboratory Consortium for Technology Transfer, works with both State and local agencies as well as industry to promote utilization and adaptation of technologies developed in Federal laboratories. However, at the present time, this endeavor does not have a legislative mandate.

Importance

Various studies associated with policy formulation concerning technology transfer have recommended the increased utilization of the Federal laboratories and research centers. Increasing demands on State and local governments for the provision of goods and services and the decreasing technological competitive position of business in the United States, both underscore the necessity of expanding the application of technology and technical expertise available in the Federal system. Yet, the extent of the utilization of Federal laboratories has yet to be determined. A pervasive uncertainty surrounds the issue relating to conflicts of issues, patent rights, and competition with other sectors. Interpretation of the Mansfield Amendment to the Military Procurement Authorization of 1970 (limiting expenditure by the Department of Defense on non-defense R&D) is ambiguous. Given the resources available in the Federal laboratory network, a coherent approach to this subject is in order.

Examination of NSF State Science, Engineering, and Technology Program

In an attempt to increase the ability of State executive and legislative branch organizations to understand and participate in science and technology decisionmaking, the National Science Foundation was instructed to establish a grant program to meet this objective. An examination of the State Science, Engineering, and Technology (SSET) program in the Applied Science and Research Applications Directorate, as well as other intergovernmental programs within NSF, will give an indication of how, and to what extent, the program are meeting the needs of State and local governments.

Background

The National Science Foundation Authorization Act for FY 1977 set aside $2,500,000 for study grants to States for funding of a State Science, Engineering, and Technology Program, to be administered by the Intergovernmental Science and Public Technology Division in the Research Applications Directorate of NSF. The Conference Report to accompany the legislation, House Report 94-1689, specified the allocation of funds for the SSET program, to be divided into $50,000 grants available to each State for funding up to two-thirds of the cost of conducting a study of the process of developing and implementing a State science and technology endeavor. As delineated in the Conference Report:

> these grants are to be used by the States to identify and analyze potentially useful ways in which State and local governments can increase their capabilities for using science, engineering and technology in meeting the needs of their citizens, including consideration of the establishment of science and technology policy offices within both the executive and legislative branches.

Results of these studies are to be submitted to the National Science Foundation. Evaluation of the reports will be made NSF in conjunction with the Office of Science and Technology Policy to determine scope, size, funding, and orientation of future efforts under this activity.

Importance

The House Science and Technology Committee, in directing the creation of the SSET program has responsibility for determining whether the intentions of the legislation are being met. The increasingly complex environment in which State and local officials operate requires an understanding of technological impacts and an awareness of potential technological solutions. The increasing demands on State and local governments for the provision of goods and services have been accompanied by the increased technical needs of these jurisdictions. The National Science Foundation's program are directed toward furnishing State and local governments with the capacity to deal with science and technology and to utilize available R&D resources.

Oversight of NSF's Appropriate Technology Program

As the present supply of energy and natural resources becomes more scarce and expensive, increasing attention in the United States is focused on developing alternative means of providing goods and services. Government efforts in support of these endeavors are underway in several agencies. In pursuit of developing technologies which are general labor-intensive, decentralized, and utilize renewable resources, the National Science Foundation was mandated to implement an appropriate technology program.

Background

The House Science and Technology Committee has been instrumental in inducing the National Science Foundation's interest in appropriate technology. In the House report (H.Rept. 94-930) to accompany H.R. 12566, authorizing FY77 appropriations for NSF, the Committee instructed the Foundation to consider those aspects of AT which might warrant support:

> Consideration in the RANN [Research Applied to National Needs] program seems suitable, but the Committee also suggests that "appropriate" or "intermediate" technology may be a topic deserving attention in the Science Education Directorate. The Committee notes that this area was a concern of participants in the public hearings in the Science for Citizens program; the Committee agrees that the Science and Society Division of the Science Education Directorate should consider intermediate technology a legitimate aspect of its programs. (p. 39)

In the House report (H.Rept. 95-98) to accompany H.R. 4991, a bill authorizing FY78 appropriations for the National Science Foundation, the Committee on Science and Technology again expressed its interest in NSF's involvement in the issues surrounding appropriate technology. It recommended that RANN and the Science Education Directorate continue their work in appropriate technology and reaffirmed that the following programs are likely candidates for consideration of AT: Research in Science Education, Development in Science Education, Comprehensive Assistance to Undergraduate Science Education, and Ethics and Values in Science and Technology. In addition, the Committee recommended that the international programs and the Policy Research and Analysis program (within the Directorate for Scientific, Technological, and International Affairs) conduct research and development on appropriate technologies. The Foundation was requested to present within six months a report to the proper House and Senate committees on future plans and programs in AT. This document was delivered in February 1978.

Importance

The issue of appropriate technology has been the basis for various congressionally mandated studies and hearings. Legislation promoting AT activities has been implemented. Now that these programs are in the formative stage, the Committee may be in a position to influence the future direction of program operations to insure that they meet the objectives of the enabling legislation.

Multinational Corporations and the Transfer of Technology

As the principal agency for international technology transfer, what are the contributions and costs of the multinational corporation to U.S. economic growth, innovation, employment opportunity, overseas markets, inflation, and aid to the less-developed countries (LDC's)?

Background

The multinational corporation provides technology transfer across national boundaries as technologies move from one portion of the firm or from one subsidiary to another. Regulation of these companies is difficult given their large size and sphere of operation. Yet the impact is great. There have been attempts to change the patent, licensing, and regulatory structures set up to handle the multinational corporation to insure that economic, technical, and scientific posture of the United States is not threatened by the actions of international firms. Yet, the multinational firm, because of its size and resource base, can provide the vast resources often necessary to undertake certain technological developments. Antitrust legislation and various other regulations can serve to hamper productive operation of the firm to the detriment of the U.S. position. A balance must be struck with an understanding of all the impacts of Federal action on the operation of the multinational corporation.

Importance

The world economy is becoming increasingly interrelated and the United States' lead in science and technology is decreasing. A progressive policy of encouraging technology transfer through the multinational corporation, which in turn would provide for the efficient use of resources, may prove beneficial to the U.S. economy. The increasing number of problems requiring technological solutions (like energy and resource scarcity) places added responsibility on the R&D community. The present concern for our technological competitiveness, as expressed in various hearings in the 95th Congress, should encourage promotion by Congress of actions concerning the multinational firm and its relationship to continued U.S. economic growth, innovation, employment, and international relations.

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18. UNIVERISTY RESEARCH, EDUCATION, AND MANPOWER

The Future of University Research

There are numerous indications that universities which are presently experiencing constraints from several directions will be even more hard-pressed within a few years. Many problems have been identified; should the Congress take a coordinated look at the situation?

Background

The value of university research was proven during the Second World War in dramatic ways. Congressional recognition of the necessity to assure that a stockpile of knowledge is available led to implementation of a policy of support of basic scientific research, first through the Office of Naval Research, later through the creation of the National Science Foundation, and through the mission agencies as well. The Cold War and the Space Race resulted in dramatic increases in funding, particularly in the period following Sputnik. By the mid-1960's doubts began to be raised that the R&D budget which had reached $15 billion could continue to grow at the 15% rate of the past several years. A subsequent slowing down became serious by 1970 as budget constraints caused by the competing needs of the Vietnam War and the civilian social needs resulted in cut-backs of research effort which could not be directly tied to a national purpose. Although the necessity to support academic science was subsequently recognized through a conscious Administration policy to increase funding for basic research, the universities continue to feel the effects of cumulative forces. Among these are the decreased purchasing power of funds, the lack of continuity and stability of funding, making long-range planning difficult, the decreased demand for trained scientific and technical manpower and a foreseeable smaller student body resulting in fewer employment opportunities, and an increase in accountability for grants funded by the Federal Government.

Importance

The problems associated with university research have been treated in various recent reports, including the 1978 report of the National Science Board entitled, "Basic Research in the Mission Agencies," in the Science and Technology Report submitted to the Congress in October 1978 by the National Science Foundation and in several addresses by the President's Science Advisor and Director, Office of Science and Technology Policy.

Among current issues are the level, composition, and distribution of Federal funds for academic science, the obsolescence of equipment and instrumentation and the high cost of remedying the situation, whether the increasing proportion of older tenured faculty is depriving younger scientists from teaching employment opportunities, and the effects of new guidelines in OMB Circular A-21 revised, "Cost principles for educational institutions," which imposes new guidelines for cost-sharing on grants and contracts to educational institutions, and recentlyset maximum salary levels for faculty receiving NSF grants.

A study by Edward Denison on accounting for U.S. economic growth in the period 1929-1969 found that an estimated one-third of the national income during the postwar period flowed from advances in knowledge, particularly in the sciences and in the resultant new technologies. Since there is almost always a considerable lag time between a basic research finding and its application, it is necessary to assure that the strength of American academic science be continued at stable and adequate levels. This is an issue which the Committee may wish to investigate in depth in the 96th Congress.

Implementing Technology in the Educational Environment

Through the years, the potential for substantial improvements in the Nation's educational processes frequently has been raised by the introduction of new technologies, psychological theories, curricula, organizational forms, or educational techniques. Yet, the continued decline in pupil test scores, the inability of some graduating high school seniors to read, write, and compute, and the necessity for colleges and universities to offer courses in the three R's to some students has undermined some of the public enthusiasm for rapid adoption of new educational innovations. "Back to basics" is a familiar plea in many public school districts. Since the profound development and implementation of automatic data processing systems in the past 20 years, the use of computer technology in the educational process -- i.e., teaching, testing, and management -- may continue to foster skepticism of new innovations in education or provide the impetus for an educational revolution.

Background

The introduction of computers into education caused some educators to predict excitedly a new revolution in learning. Unfortunately, recent studies have revealed limitations to these "oracles." While major changes have taken place in the Nation's educational system as a result of modern technology, most have neither been sweeping nor revolutionary. Documentation exists citing numberous examples across the country where computer-based technologies have shown promise in both the classroom and the administrator's office.

In the 95th Congress, the Subcommittee on Domestic and International Scientific Planning, Analysis and Cooperation (DISPAC) held six days of oversight hearings on "Computers and the Learning Society." From those hearings, five specific recommendations were made concerning the use of computer-based technologies in the educational process. An ensuing legislative measure highlighting one of those recommendations -- H.R. 14329, a bill to establish a national commission to study the use of computers in the Nation's educational system -- was introduced and referred to the House Committee on Education and Labor.

Importance

While one of the subcommittee's recommendations has been introduced, the remaining four recommendations have yet to recieve any congressional action. Follow-up activities might be appropriate in such areas as: sponsoring workshops on the role of executive branch leadership in the research and development of new computer-based educational systems; requesting congressional research reports on specific computer-assisted instruction (CAI) or computer managed instruction (CMI) systems for public dissemination; and initiating technology assessment reports regarding the growth of microelectronics and the development of "cheap" computers.

The home will become a leading technology-oriented center for learning as new automated tools and techniques are adopted. The committee might decide to review the potentials these systems have in providing in-home educational programs to the Nation's citizenry and the research and development being conducted on these media.

Science Resources and Education

Is there evidence for underutilization of U.S. scientific and technical personnel? In particular, has engineering education been subordinated in favor of other areas of emphasis, and what can be done about it? Can improved manpower studies contribute to better education and utilization of engineers?

Background

Underutilization of our scientific and technical human resources has been cited as a factor in a reported decline of the preeminent position which the U.S. has held in technological performance.

Over the past twenty-five years, the demand for engineers has undergone three large fluctuations. This is due in part to an overreaction by students to current demand and salaries in selecting engineering as a career. Changing governmental R&D priorities also cause manpower demand fluctuations in specific fields.

We are now in a period of excess demand for engineers. Job offers to recent B.S. recipients have risen 41% and 53% in the past two years. Technical manpower shortages may cause industry to export jobs by shifting development work to foreign subsidiaries and to import technology in the form of products produced abroad. In times of excess manpower, trained personnel may be lost permanently by shifts to other careers.

Importance

There are concerns that the government is not paying enough attention to engineering education. There is no separate emphasis given to engineering education within the NSF science education programs. The total funds for science education allotted to the NSF have been decreasing for several years. This situation may worsen if science education programs are shifted to the proposed Department of Education.

The structure of engineering education appears to warrant examination in the light of constantly changing manpower needs. Curricular may have to be redesigned to increase emphasis on fundamentals and interdisciplinary studies, which allow for more flexible careers. Continuing education programs may be needed for established engineers to avoid personal obsolescence. Retraining may be necessary as new programs demand new talents. Efforts to increase the pool of available personnel by encouraging women and minorities to enter scientific and technical fields might be examined. Work-study programs, five-year engineering degrees, and part-time employment programs could all be evaluated to see what buffering effects they may have on the supply of manpower.

A postulated decrease of emphasis on engineering programs due to the growth of large State universities at the expense of the A&M colleges may warrant corrective action if found to be occurring.

Improved forecasting of short- and long-term needs for technical personnel can have an impact upon their utilization. If reliable information on future manpower needs in specific fields is made available in a timely fashion, individuals can make informed career decisions and educational institutions can adjust their programs. Some feel that manpower planning should be a part of the annual budget cycle so that requirements of new programs can be identified.

Whether or not science education is incorporated into a new Department of Education or remains within the NSF, the broad subject of science resources and education appears to warrant attention by the Congress in the 96th Congress.

Job Opportunities for Trained Scientists

Job opportunities for trained scientists -- young men, women, and those in the minorities -- are reportedly declining in college and university settings. How can the Federal Government help to remedy this situation? Will the creation of National research centers serve as a partial solution?

Background

In 1974, 70% of doctoral science and engineering faculty members had tenure; 28% of this number were young faculty members. In 1968, 39% of a comparative number of young faculty members had tenure. The increase in proportion of "older" faculty may, in the opinion of the President's Science Advisor, adversely affect employment opportunities for younger scientists. It is projected that available employment for new doctorates will decline annually in the academic sector. An expert has stated that the inflexibility of the tenure system and the inability to employ young scientists because of the reduction of faculty positions may discredit the research done by some of the better and more productive scientific departments in the nation. On the other hand, recent NSF studies question whether the proportional age imbalance is significantly more serious now than it has been.

Importance

Colleges and universities are the chief performers of basic research. Qualified research scientists are needed for the conduct of research. Most Ph.D.s plan to work in academic positions and do research in academic institutions. Recent degree recipients, reportedly, are more likely to be employed in two-year colleges, and elementary and secondary schools. A prediction has been made that between 1981 and 1995, there will be a 20% reduction in college-age students. Such a drop in enrollment will cause a change in the academic job market and there will not be many job opportunities in the academic setting for young people. If the academic institutions are to continue to be scientifically effective, some alternatives need to be considered.

Establishing research centers across the nation has been suggested as an appropriate outlet for the conduct of basic research. National Research Centers would be designated from various university science departments. Criteria for selection would be past and current research performance, commitment of the school to the scientific field, and in some instances, geographic distribution. Government agencies would provide initial funds for each center, which would also receive area grants for three to five year intervals. This would not mean that the centers would continuously be automatically funded, but funding would be determined individually and competitively. Recent Ph.D.s would basically staff the centers, being supported full time by Government grants.

The research centers might prove attractive to both younger and older investigators. Science departmental faculty members could perform research projects at the centers for one to three years. The centers could also provide an opportunity for young scientists to be brought into the academic community in close association with established science departments.

Another suggestion is that staff members between 55 and 65 years of age could allow young scientists opportunities at universities and continue to make valuable contributions in various ways -- working in local government, teaching at small colleges, or writing. The 96th Congress might review this overall subject and consider possible solutions to improve employment chances for young scientists and "mid-career" faculty, if found to be necessary.

19. WEATHER, CLIMATE, AND EARTH SCIENCES

See also items:

4.1 Earthquake Prediction Technology
7.1 Coal Mining R&D -- For Production and Health and Safety
7.2 Efficient Underground Mining Systems

Weather Services and Research

A re-examination of the role of the Federal Government in providing weather services and supporting meteorological research, as well as the organizational responsibilities and authorizing legislation for such meteorological activities, may be desirable.

Background

The National Weather Service (NWS) of the National Oceanic and Atmospheric Administration (NOAA), in the U.S. Department of Commerce, currently provides the major portion of civilian weather prediction services in the United States, including public "convenience" weather services, severe weather warnings, and specialized weather services (e.g., aviation, marine, agricultural and forestry, and air pollution.) Specialized services are also provided to, and in conjunction with, other Federal agencies whose various missions require such information. Meteorological research, much of which is in support of weather services, is sponsored by NOAA and by other Federal agencies. Some particular questions which need to be addressed include the following:

(1) What is the responsibility of the Federal Government in providing public weather services, severe weather warnings, and specialized weather services? To what extent should the private sector be involved in providing weather services?
(2) What are the proper roles of NOAA and other Federal agencies in providing weather services to the public and within the Government?
(3) What should be the role of NOAA in atmospheric and development in contrast to the roles of other Federal agencies?
(4) What are the proper relationships between NOAA and other Federal agencies and the academic atmospheric sciences community?

There is currently no specific legislation which provides an explicit charter to NOAA for its activities, though there are a number of statutory authorities under which that agency carries out atmospheric and oceanic responsibilities which have been assigned to it. A NOAA organic act should be more than an enumeration and re-statement of existing authorities; rather it could be a vehicle through which the Congress identifies the major issues regarding the atmosphere and oceans, clarifies existing or establishes new policies related to these issues, and provides necessary authorities and mechanisms for carrying out such policies.

Importance

It is particularly timely to consider the role of the Federal Government in providing weather services and in supporting pertinent atmospheric research as well as the consolidation of authorities for such activities through an organic act which gives a charter to the chief agency for civilian weather services. It is a time when weather services are being re-examined and improvements are being considered, especially in view of new requirements and a new awareness of the value of weather services. It is also a time when research and development have brought to the horizon a number of technical breakthoughs by which services can be improved. At the same time funding and personnel for current and projected services are assertedly inadequate, especially as inflation, new demands, and improvements contribute to increasing expenses.

National Climate Program

The Federal effort in implementation, performance, and support of the goals and objectives of the National Climate Program Act will be a matter for oversight in the 96th Congress. What will be the relative budget priority and organization of the National Climate Program? Should an immediate objective include the establishment of a national climate information system? Will the Federal interagency and public sector coordination mandated in the act be successfully and constructively undertaken?

Background

Congress is clearly concerned over the apparent increase in incidents of such weather phenomena as droughts and severe winters. Amid reports of what these events portend for climates of the future and discussions, generally, of the nature, impact, and predictability of climatic variation and change, legislation was enacted in the 95th Congress (P.L. 95-367) to create an expanded national program that could offer the hope of understanding and anticipating true variations of climate; their expected magnitude; through prediction and assessment, their probable positive or adverse impacts; and what can be done to amplify or ameliorate the effects in order to maximize economic planning and development, human welfare and social development, and quality of life.

Importance

In the 96th Congress, as the National Climate Program enters its first full year of operation, there may be some debate about the scope and focus of the expanded national program in climate research and its relative budget priority and organization. For example, a program combining individual agency capabilities and resources into a coordinated effort needs to be implemented with due regard for continued satisfaction of existing agency responsibilities in support of each agency's mission requirements. Attendantly, will the Federal interagency coordination mandated in the act be successfully and constructively undertaken? What plans are being developed to interface with and involve the planning processes of State and local governments, industry, academia, and the public sector? What new intra-agency organizational structures will be set up to implement the national program in NOAA and other concerned agencies?

While benefits would derive from a foreknowledge of climatic variation on any time scale, the greatest utility in fiscal and budgetary planning, policy formulation, and decisionmaking occurs in the range of a year or so. Hence, predictions and assessments of positive or adverse impacts, to be most useful, would aim primarily at the natural year-to-year fluctuations of climate and the cumulative climatic impact of human activities. An immediate objective of the national climate effort, therefore, could be the formation of a national climate information system that would aid in achieving rapid and significant improvements in the utility of currently available climatic information and existing monthly or seasonal climatic predictions.

Effects of Increased Carbon Dioxide in the Atmosphere

Are the effects of civilized existence capable of impacting climate on a global scale to a measurably significant extent? One persistent question concerns increasing concentrations of atmospheric carbon dioxide that could result from continuing and expanding use of fossil fuels. What climatic changes might result from increased carbon dioxide concentrations and, attendantly, what would such changes portend for the natural environment, quality of life, and U.S. energy policy? What is the scope of the Department of Energy carbon dioxide program, and how does it interface with the National Climate Program established by P.L. 95-367?

Background

Concern has been expressed over the increasing concentration in the atmosphere of carbon dioxide from the burning of fossil fuels. Some analysts argue that a point of critical choice may be approaching: whether to continue reliance on fossil fuels as a principal source of energy or to accelerate the pace of research and development that will make it possible to substitute other energy sources for fossil fuels within the next 50 years. The second alternative presents many difficulties, but the possible climatic consequences of reliance on fossil fuels for another one or two centuries may be critical enough as to leave no other choice.

Importance

What concentrations of carbon dioxide can be expected in the atmosphere at different times in the future, for given rates of combustion of fossil fuels? In 100 years since about 1860, a 12% increase in the concentration of carbon dioxide had taken place, but because of the exponential nature of the consumption of energy and the burning of fossil fuels, the next 12% increase would take only 20 years and the next 12% increase beyond that only about 10 years. In this connection, it is the amount of carbon dioxide remaining in the atmosphere that is most important. Since the amount of carbon dioxide accumulating in the atmosphere is about half the total released from fossil fuels, it is assumed that the ocean and both the land and marine biospheres serve as additonal sinks for carbon dioxide. The problem is further complicated by current appraisals that suggest the terrestrial biomass may be an additional source of carbon dioxide as large or larger than the fossil fuel source. A better understanding of the roles of both the biosphere and the world ocean in the carbon cycle would seem necessary.

What climatic changes might result from increased atmospheric carbon dioxide? The most complete, though still imperfect, climatic models suggest that a doubling of the amount of carbon dioxide in the atmosphere relative to its present amount would increase the average annual temperature of the lower atmosphere at middle latitudes by about 2.4 to 2.9 C (4.3 to 5.2 F).

What would be the consequences of such climatic warming for human societies and for the natural environment? Would such a warming influence the extent of ice and snow at the polar caps or alter the level of the world ocean? How and where would such warming benefit or disrupt present patterns of agriculture?

What, if any, human actions could enhance or diminish the resultant climatic changes in order to amplify or mitigate their consequences?

What would happen if society elected to ignore the problem of carbon dioxide until it manifested itself (perhaps in another 20 years) in the form of a clear signal that a global warming trend had begun that was unmistakeably attributable to the further accumulation of carbon dioxide in the atmosphere? The most disturbing aspect of this problem is that the effects of carbon dioxide would endure for hundreds of years, even after abandonment of the fossil fuel economy, because of the long recovery time associated with the processes that would rid the atmosphere of excess carbon dioxide and establish an equilibrium condition.

Weather Modification Policy

There is an apparent need to develop a national weather modification policy, including definition of the role of the Federal Government in research and development, regulation, and possible support of operations.

Background

For over thirty years a number of weather modification activities have been underway in the United States, at all levels of Government and on the part of the private sector. These activities and interests have included operational projects, sponsored by private and public funds; enactment of laws in about thirty States, designed mostly to regulate such activities; sponsorship of mission-oriented research and development programs by about a half dozen or more Federal Departments and agencies; conduct of a number of Federal studies undertaken within agencies or mandated by the Congress; and introduction in the Congress of a host of pertinent bills, from which six public laws dealing with weather modification have been enacted. There has also been increasing international interest in weather modification, from the standpoint of concern by foreign governments about possible negative effects resulting from nearby U.S. activities and in terms of international cooperative research projects. There is also increasing social concern about potential negative effects and a swell of opinion on the need for further and more uniform regulation of weather modification activities.

The National Weather Modification Policy Act of 1976, enacted October 13, 1976, required the Secretary of Commerce to undertake a comprehensive study of weather modification and to recommend a national policy and define a Federal program in research and development. Pursuant to passage of this act the Secretary of Commerce named a non-government Weather Modification Advisory Board to undertake the study and prepare a report which would contain the required recommendations. The Advisory Board completed its study in July 1978, and the Secretary of Commerce is currently studying the report, which will be submitted formerly, along with her comments, to the President and the Congress.

Importance

In view of greater concerns over water shortages and losses from severe weather, the possibilities for technological breakthroughs and better understanding with increased research and development, the apparent fragmentation and low-key research effort underway in about six Federal agencies, increasing social concern and demand for regulation of weather modification activities, and expanded international interest, it seems appropriate and timely to re-evaluate and re-define the Federal weather modification policy. Such policy development is particularly appropriate in view of the groundwork which has recently been completed through the study by the Weather Modification Advisory Board. The new policy must clearly define the Federal role in research and development as well as in international cooperation, regulation, and possibly operational support.

Continental Scientific Drilling Program

How can both the mission program results and the scientific information output of a national continental drilling activity already well underway be maximized?

Background

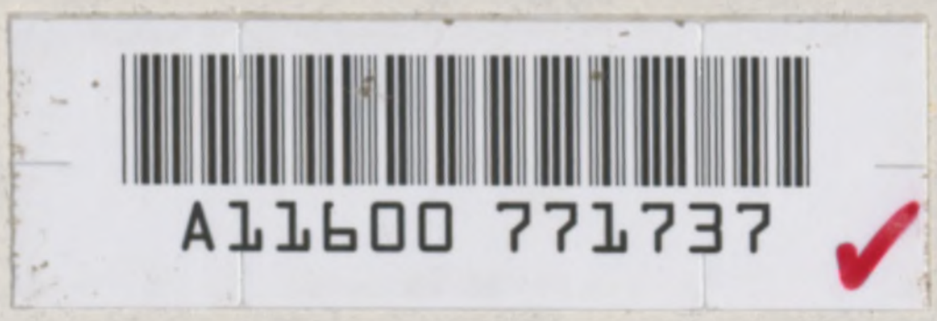
Two convergent activities are involved. On the scientific side (with sponsorship by the U.S. Geologic Survey, National Science Foundation, and Office of Naval Research) a panel study was undertaken in July 1978, of ongoing activities in continental drilling for scientific purposes. In the course of the study it became evident that, largely under the sponsorship of the Department of Energy, an ambitious federally-funded program of deep continental drilling to support the department's mission was already underway. Current Federal outlays for such drilling exceed $500 million annually. Accordingly, the National Academy of Sciences, NRC, Assembly of Mathematical and Physical Sciences, U.S. Geodynamics Committee of the Geophysics Research Board, is about to issue a formal report ("Continental Scientific Drilling Program") which will declare that the perceived issue is that "of maximizing the scientific value of current and planned efforts of Federal agencies and industry and supplementing these efforts with holes drilled solely for scientific purposes."

Importance

Drilling is currently being undertaken for oil and gas, mineral exploration, delineation of hot brine and magma bodies for geothermal energy use, and other potential commercial applications. The scientific outputs are correlative: the expansion of knowledge about basement structures, thermal regimes, mineral resources and processes of their generation, and improved knowledge of earthquakes. According to the unpublished NAS report:

> "Three areas stand out in which a lack of fundamental knowledge concerning earthquakes has seriously impeded programs of generally accepted high national priority:
>
> - o The finding of suitable sites and techniques for isolating nuclear waste products;
> - o The siting and earthquake-resistant design of nuclear power generating facilities;
> - o The siting and design of major dams.
>
> Specific seismological research central to solving these problems include seismicity distribution, earthquake prediction, seismic-hazard assessment, and induced seismicity."

Since the high-cost part of this activity is already underway, it is suggested by the Academy report that early action to coordinate its scientific information aspects would serve the public interest. A plan to do this is to be released by the Academy before the end of 1978. The program is of interest to at least three subcommittees of the Committee on Science and Technology: those dealing with geothermal energy, earthquakes, materials, basic science, and nuclear energy.


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