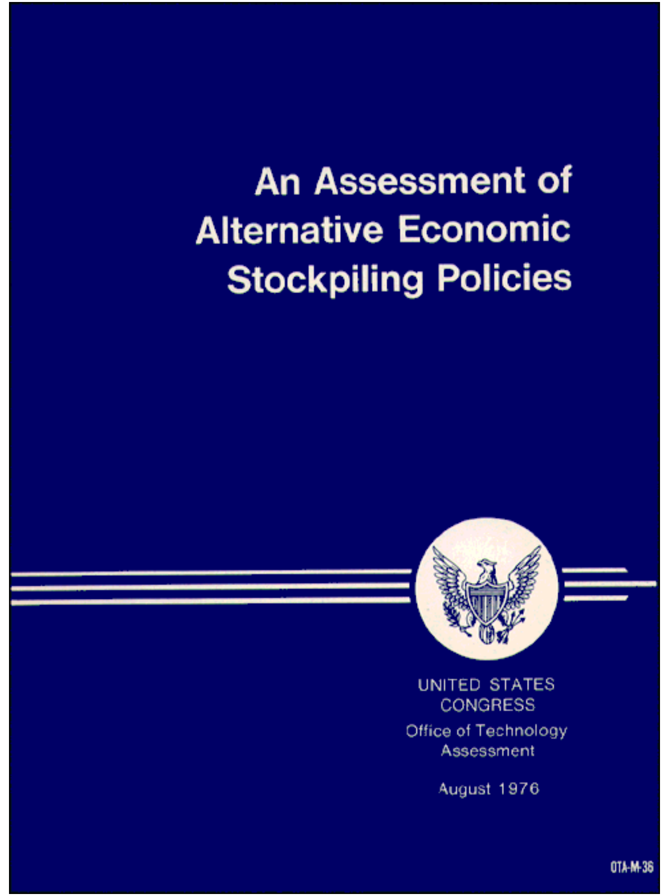
An Assessment of Alternative Economic Stockpiling Policies

August 1976

NTIS order #PB-273191



OFFICE OF TECHNOLOGY ASSESSMENT

DIRECTOR'S OFFICE

Emilio Q. Daddario, Director
Daniel V, De Simone, Deputy Director

MATERIALS ADVISORY COMMITTEE

James Boyd, Chairman
Materials Associates

Earl H. Beistline
University of Alaska

Seymour L, B1um
The MITRE Corp.

Lloyd M, Cooke*
Union Carbide Corp.

Frank Fernbach
United Steelworkers of America

Edwin A. Gee*
E, I. du Pent de Nemours & Co., Inc.

N. Bruce Hannay
Bell Laboratories

Bruce M. Hannon
University of Illinois at Urbana-Champaign

William J. Harris, Jr,
Association of American Railroads

Julius J. Harwood
Ford Motor Co.

James A, Kent
Michigan Technological University

Hans H. Landsberg
Resources for the Future, Inc.

Elburt Osborn
Carnegie Institution of Washington

R. Talbot Page
Resources for the Future, Inc.

N. E. Promisel
Independent Consultant

Lois Sharpe
League of Women Voters

George A. Watson*
Ferroalloys Association

J, H. Westbrook
General Electric Co.

* Members of Subcommittee on Economic Stockpile Policy.

MATERIALS PROGRAM STAFF

John B, Wachtman, Jr., Program Manager
Albert E. Paladino, Program Manager
Harry H. Herman, Jr,, Project Leader
James L. Holt, Project Leader
Richard Wright, Staff
Patricia Poulton, Staff
Spencer M. Beresford, Staff
Gary L. Thomas, Staff
Frank Huddle, Consultant (Congressional Research Service)

CONTRACTORS

Ultrasystems, Inc. . Robert R. Nathan Associates . The Futures Group

CONSULTANTS

Leonard Fischman, Resources for the Future, Inc.
Earl Hayes, Materials Associates
Jacob Levin, Materials Specialist
Max Osias, Materials Specialist
Jonathan Rintels, Attorney at Law
John Tilton, Pennsylvania State University

Congress of the United States
OFFICE OF TECHNOLOGY ASSESSMENT
WASHINGTON, D.C. 20510

AUG 23 1976

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

Gentlemen:

On behalf of the Board of the Office of Technology Assessment, we are pleased to forward a report: An Assessment of Alternative Economic Stockpiling Policies.

The report concludes OTA'S assessment of the attributes and ramifications of a national program to acquire, hold and dispose of materials for selected economic (nondefense) purposes.

This assessment was performed in accordance with your request to the Office of Technology Assessment dated December 13, 1974. An earlier summary of this report was transmitted to the Committee in February 1976.

Sincerely,

Olin E. Teague
Chairman

Sincerely,

Clifford P. Case
Vice Chairman

Enclosure

Congress of the United States
OFFICE OF TECHNOLOGY ASSESSMENT
WASHINGTON, D.C. 20510

AUG 19,1975

The Honorable 01 i n E. Teague
Chairman of the Board
Office of Technology Assessment
Congress of the United States
Washington, D. C. 20515

Dear Mr. Chairman:

The enclosed report, "An Assessment of Alternative Economic Stockpiling Policies," presents OTA'S analysis of the impacts of implementing one or a combination of several alternative materials stockpiling policies for economic (nondefense) purposes.

The assessment was requested by the Chairman and the Ranking Minority Member of the House Science and Technology Committee, and was prepared by the Materials Program staff, under the supervision of Dr. A. E. Paladino, with the assistance of the OTA Materials Advisory Committee, personnel from three major contractors, and several consultants.

The report specifically: (1) delineates the possible legislative options which the Congress may want to consider in deliberating the issue of economic stockpiling; (2) presents the economic, political, social, institutional, and legal impacts of five economic stockpiling policies; and (3) suggests possible management and operational guidelines for establishing and operating an economic stockpile.

While the request for the assessment originated in the House Committee on Science and Technology, it has been extensively used by the National Commission on Supplies and Shortages (NCSS) and the Joint Committee on Defense Production, Subcommittee on Materials Availability. In separate briefings of both staff and the Commissioners, OTA project personnel have made concerted efforts to assist the Commission in evaluating the complex nature and impact of economic stockpiling--including coordinating with NCSS staff presentations for the August 1976 Engineering Foundation Conference in Henniker, New Hampshire, on the "Engineering Implications of Chronic Materials Scarcity."

OTA project personnel also have assisted the staff of the Joint Committee on Defense Production, Subcommittee on Materials Availability through several detailed briefings and discussions, as well as during the planning of their hearings conducted June 8-9, 1976 on the "Purposes and Organization of Economic Stockpiling."

Sincerely,

EMILIO Q. DADDARIO
Director

Enclosure

PREFACE

This assessment is an analysis of the attributes and consequences of a national economic stockpile program to acquire, hold, and dispose of materials for various public purposes. The assessment is one element of a broad consideration of materials-related problems being undertaken by the Office of Technology Assessment (OTA) in support of the policymaking activities of Congress. Related projects in the OTA Materials Program concern materials information systems, recycling and resource recovery, conservation, and minerals accessibility on Federal lands.

The present assessment was requested by the House Committee on Science and Technology which asked for an analysis of the "legislative options in the uses of a national stockpile to assist in the development and use of materials technology for public purposes. " The principal objective of the assessment is to provide data and information for Congress to use in considering, first, the attributes and consequences of an economic stockpile implemented as a possible national strategy for discouraging or counteracting materials supply and price problems, and second, what methods are required to establish and operate such a stockpile. While the assessment is in response to the House Committee on Science and Technology, the results will also provide information and analyses useful to Congress at large, as well as to the National Commission on Supplies and Shortages.

The assessment focuses primarily on materials problems related to sudden discontinuities in the long-range supply/demand of a given material, resulting in complete or partial disruptions and abrupt price changes. The study specifically excludes an analysis of food commodities, which are being analyzed in another OTA assessment, and concentrates on metals and minerals.

One of the major propositions of the study is that economic stockpiling policy can and should be made independently of specific materials properties or characteristics. In contrast, the usual approach for analyzing materials stockpiling has been to start with specific materials and then develop public policies to satisify their individual requirements. Furthermore, economic stockpiling policy should be made and implemented in full consideration of the expected benefits and costs of such action.

This Final Report was prepared by the Office of Technology Assessment materials program staff, with contributions from: (1) an Advisory Committee comprised of individuals drawn from the materials field, academia, labor, public interest groups, and private industry; (2) several private contractors; as well as (3) numerous other private and public agencies. The Advisory Committee provided advice and critique throughout the assessment, but does not necessarily approve, disapprove, or endorse the report, for which OTA assumes full responsibility.

CONTENTS

SUMMARY

Stockpiling critical materials has long been practiced by the United States to insure a minimal supply in the event of war, with the marketplace being relied upon as the primary means of correcting temporary shortages and price fluctuations. However, increasing U.S. dependence on materials imports, together with increasing competition for materials among other nations, pose new dangers to the supply required by a healthy economy—dangers which neither the strategic stockpile nor the normal operations of the marketplace have effectively averted or counteracted. Stockpiling for economic purposes has therefore been examined by the Office of Technology Assessment (OTA) as a possible component of a national strategy for insuring materials supply during peacetime.

The OTA assessment includes an analysis of the attributes and consequences, both quantitative and qualitative, of stockpiling nonfood commodities for selected economic purposes. The objective of the study was not to develop economic stockpiling policy, but rather to provide information regarding the options available to Congress in considering such policy.

The economic stockpile assessment was requested by the House Committee on Science and Technology which asked for an analysis of the "legislative options in the uses of a national stockpile to assist in the development and use of materials technology for public purposes."

While the assessment was in response to the House Committee on Science and Technology, the results also provide information and analyses useful to the House Committee on Banking and Currency, the Joint Committee on Defense Production, the Senate Commerce Committee, the Senate Committee on Government Operations, the House Armed Services Committee, and the National Commission on Supplies and Shortages. The results of this study are particularly relevant to the work of the National Commission on Supplies and Shortages, which is charged with drafting the "necessary legislative and administrative actions to develop a comprehensive strategic and economic stockpiling and inventories policy which facilitates the availability of essential resources."

ASSESSMENT SCOPE

Economic stockpiling is defined in the assessment as the accumulation and storage of materials for the express intention of being able to effect their distribution to accomplish public purposes other than the wartime emergency conditions stipulated in the strategic stockpile. An economic stockpile is similar to insurance in that acquisition and holding costs are paid in anticipation of reducing the costs of possible future problems. A decision to establish an economic stockpile depends on the belief that there will be eventual net benefits either through deterrence of a problem or through relief if a problem occurs. Because an economic stockpile necessarily involves some intervention in the marketplace, it is of great importance that estimates of the benefits and costs—including direct market impacts, as well as other, less direct impacts—be considered and estimated to the extent possible. The assessment addresses the following questions:

- Should the United States consider establishing an economic stockpile?
- What possible economic stockpiling policies might be established?
- What possible impacts might result from implementing these policies?
- What are the alternatives to an economic stockpile?
- What options and institutional arrangements are available to Congress in considering possible legislation?
- What considerations require further analysis?

ASSESSMENT FINDINGS

Findings Regarding Current or Anticipated Materials Problems

There is a real potential for shortages of materials critical to the U.S. economy to occur suddenly and unexpectedly. This stems largely from the increasing degree of U.S. dependence upon imported materials, as well as from the increasing international competition for materials. Shortages could occur as a result of one or more of the following:

- Cartel or unilateral political actions affecting price or supply,
- Nonpolitical import disruptions,
- Dwindling U.S. sources of scarce materials,
- Fluctuating domestic markets, and
- Fluctuating international markets.

The nature of these materials problems requires that the U.S. Government evaluate several policies which might compliment normal industry operations.

Findings Regarding the Feasibility of Economic Stockpiling as a Response to Materials Supply or Price Problems

Economic stockpiling can be considered one means of responding quickly over the short-term to the materials problems identified above, but it should not be considered a means of effecting long-term solutions to those problems. On the other hand, an economic stockpile could have value in providing the time required for the United States to implement such long-term solutions as substitution, conservation, or the development of alternative supply sources.

Economic stockpiling is inherently a process of market intervention and will create economic impacts (i. e., benefits and costs) which are distributed unequally throughout the U.S. economy. These economic benefits and costs (i. e., gains or losses in domestic economic welfare) must be estimated for the economy in general, as well as for specifically impacted groups. An economic model developed in the assessment (Economic Welfare Model) permits the stockpile managers to estimate economic benefits and costs in terms of an assumed future which includes probabilities of supply interruptions and elasticities of supply and demand.

The Economic Welfare Model has been used to estimate the economic impacts of implementing five selected stockpiling policies. These estimates indicate that some policies will have positive economic net benefits and some will have negative economic net benefits. It should be emphasized that the estimates apply only to the specific materials examined and within the scenario assumptions described, and should therefore not be taken to indicate that precise quantities of specific materials should or should not be stockpiled. Nevertheless, the nature and magnitude of the estimates are sufficient to indicate that an economic stockpile should be given detailed consideration as one component of a more comprehensive national materials policy and that measuring the benefits or costs of a supply disruption in terms of its probability, rather than its certainty, will significantly reduce the quantity of material to be stockpiled.

Economic stockpiling will create social and political impacts which need to be considered together with the economic impacts. The implementation of an economic stockpile will also create legal and institutional impacts which are contingent upon the nature of any stockpiling agency established and the oversight mechanisms exercised by Congress.

Because a U.S. economic stockpile can have strong impacts on other countries, and because several foreign countries are either planning or have already established economic stockpiles, the United States should consider economic stockpiling in terms of foreign policy as well as domestic affairs. The policy objectives of a particular stockpile should be clearly delineated. Analysis of the Strategic and Critical Materials Stockpile indicates, for example, that it has been used in a limited manner to achieve selected economic purposes, Further, the operation of an economic stockpile will create enough problems and pressures to warrant its being sufficiently insulated from the political process that it may act in the public interest, yet remain responsive to congressional scrutiny.

The benefits and costs of an economic stockpile depend upon specific future actions outside the control of the United States, If undertaken, economic stockpiling should therefore be done on the basis of forecasts of trends and possible events, but in a manner flexible enough to permit adjustments to changes. The decisions relating to the establishment and operation of an economic stockpile-specifically, the acquisition and disposal of materials—should be systematically made and documented using an approach similar to the decisionmaking process developed in this assessment (Decision Criteria Model). Specific materials which should be considered prime candidates for an economic stockpile have been identified with a set of materials selection criteria which directly relate to the supply or price problem the stockpiling policy is designed to alleviate.

Two or more stockpiling policies could be implemented simultaneously in order to solve more than one materials problem. In fact, such a program could provide a high degree of commonality of purpose and operation. Similarly, an economic stockpile containing more than one material could be operated in conjunction with other existing stockpiles, either domestic or international.

Findings Regarding Alternatives to Economic Stockpiling

Alternatives exist which may offer equal or greater benefits than economic stockpiling, These alternatives may require either more or less intervention in the marketplace than economic stockpiling. Many of these alternatives have been utilized for some time, and this experience should be drawn upon in assessing their possible usefulness, Several of the alternatives to economic stockpiling are long-term solutions to materials problems, and as such could be implemented in conjunction with a short-term economic stockpile as an overall strategy of combating such problems, In any case, alternatives to economic stockpiling should be considered, and the Economic Welfare Model can be used to determine whether or not the alternatives would provide benefits equal to or greater than economic stockpiling,

Findings Regarding Economic Stockpiling in the Context of a Developing National Materials Strategy

Economic stockpiling could have value as a response to certain materials problems; however, it should be considered as one component of a more comprehensive national materials strategy which is developing from its present ad hoc status. Further, such an economic stockpile policy should be developed in coordination with appropriate Government, industrial, and public agencies,

77-119 O -76-2

LEGISLATIVE OPTIONS

Evolution of Current Public and Private Systems Without Enacting New Legislation

The first option is for Congress and the President to forgo establishing an economic stockpile, letting the current market system, with its existing support mechanisms, attempt to prevent or correct the impacts of supply disruptions and price increases,

Congressional Options Without Enacting New Legislation

The second option is for Congress to act without drafting new legislation. It could initiate such action by providing information regarding economic stockpiling within the legislative branch, the executive branch, or the private sector.

Executive Options Without Enacting New Legislation

The third option is for the President to take action, within the limits of his existing authority, without proposing new legislation. Such action could be accomplished in several ways: (a) issue a Presidential proclamation to set overall policy direction, (b) issue an executive or agency order, or (c) make research and development grants available for analysis of materials problems.

Options Through Enacting New Legislation

The fourth option presumes that, for one or more reasons, the first three options will not be sufficiently effective in dealing with current or anticipated materials supply and price problems and that authorizing legislation is required. Such legislation, if required, should entail consideration of the 10 components listed below:

- Definition and distribution of authority,
- Acquisition of information,
- Stockpile management,
- Control of domestic distribution,
- Control of exports,
- Control of imports and access to foreign supplies,
- International trade,
- Domestic economic impact,
- Fiscal incentives, and
- Public access and participation.

INSTITUTIONAL ARRANGEMENTS

Arrangement 1: Economic Stockpile Controlled and Operated by the U.S. Government

A unilateral U.S. economic stockpile might be established as another component of the present strategic stockpile, or it could be established as an independent stockpile whose operations are carefully coordinated with those of the strategic stockpile.

Arrangement 2: Economic Stockpile Controlled by the U.S. Government, but Operated by U.S. industry

The advantage of this arrangement would be twofold: first, it would forgo some of the acquisition and initialization costs required for the Federal Government to establish and operate its own economic stockpile; and second, it would strengthen the working relations between the Federal Government and U.S. industry, thereby demonstrating that an economic stockpile is intended to be an adjunct to, not a replacement of, normal industry operations. A disadvantage of such a policy might be that its operations would give preference to the interests of powerful industry groups.

Arrangement 3:

Establish Unilateral Economic Stockpile Controlled and Operated by a Public-Private Corporation

Such a corporation could be funded by the Federal Government, vested by Congress with a mandate and guidelines on U.S. stockpile purposes, and given independent authority to acquire and maintain national stockpiles without direct Executive control but with provisions for Executive consolation. Since annual appropriations for operating expenses and the stockpile corporation requests for any needed additions to the revolving capital fund would be reviewed only once a year by the President and Congress, the corporation would be able to maintain a certain degree of political independence comparable to the Federal Reserve System on monetary matters.

Arrangement 4:

U.S. Participation in Multinational or International Economic Stockpile

An economic stockpile operated by two or more nations, either multinational or international in nature, could be formed along such existing political or organizational lines as the Organization of American States (OAS), the European Economic Community (Common Market), the United Nations, or just with allied nations having materials requirements similar to those of the United States. At present the United States is conducting several discussions/negotiations which do consider this arrangement: the United Nations Conference on Trade and Development (UNCTAD) discussions within the United Nations and the International Energy Agency. The cost of establishing and maintaining such a collective stockpile would be spread among the participants and would thus be less for any one government. The stockpile would not take as much material out of the world supply as would separate national economic stockpiles. The stockpile might have less effect upon specific materials prices than separate unilateral actions. And, finally, the participating nations would have to work closely together in order to make the stockpile work successfully. The greatest disadvantage would be the possible loss of control and sovereignty over U.S. resources and actions.

Arrangement 5:

U.S. Participation in Producer/Consumer Council Economic Stockpile

Another form of collective stockpiling could be achieved by the creation or expansion of producer/consumer councils like the International Tin Council which is run by both producers and consumers and maintains its own buffer stock to help stabilize the supply and price of tin, The benefits and costs of arrangement 5 are the same as for arrangement 4, but in addition to these there is another important benefit; an economic stockpile operated by a producer/consumer council attacks the basic cause of the materials availability problem and thereby could provide a long-term solution to specific materials problems by developing policies which are acceptable to producers and consumers, exporters and importers, developed countries and lesser developed countries. In this sense, arrangement 5 requires even stronger cooperation among international participants than arrangement 4, Also, like arrangement 4, though, such agreements could take a considerable amount of time to implement,

Arrangement 6:

Economic Stockpile Controlled by U.S. Government, but Operated According to International Guidelines

This arrangement could combine the advantages of the first three arrangements. As with arrangement 1, the only time constraints in implementing this option would be those required to create the legislation and acquire the optimal quantity of materials. Moreover, certain elements of arrangement 2 and 4 could be introduced by specifically defining the use of the economic stockpile in the form of an "international code of operations for economic stockpiles. " This code could be introduced as the announced policy of the United States and expanded on an international basis as needed. Arrangement 6 would recognize the fact that some national economic stockpiles are being created, but that some countries like West Germany have not implemented them because of serious concern regarding their impact on domestic and world market systems. An international code of operations might help reduce this concern, as well as develop effective mechanisms for alleviating U.S. supply problems without increasing the world shortage.

PUBLIC POLICY ISSUES

The public policy issues summarized below, which either have been or should be studied, suggest both the diversity and the intensity of conflict which could be aroused and which would have to be considered if an economic stockpile were implemented, established, and operated.

1. Should an economic stockpile be implemented in concert or in conflict with other U.S. materials policies? For example, how should the planning for an economic stockpile be coordinated with the current discussions regarding whether or not the United States should join the International Tin Council, or with the long-term grain agreements with the U. S. S. R., or with the UNCTAD discussions now underway with the less-developed nations regarding materials supply and prices?

2. What agreements with other industrialized, as well as less-developed nations, will be required in order for an economic stockpile to provide the greatest benefit to U.S. citizens?

3. How can an economic stockpile be designed and operated so that it will not be misused for financial advantage by special-interest groups? How can it be sufficiently insulated from the political process to prevent its misuse, yet insure that it will achieve the public benefits for which it was established?

4. What measures can be taken to insure that an economic stockpile will not be used to accomplish public policy objectives other than those for which it was established?

5. Under what conditions, and to what degree, is it justifiable for the Federal Government to intervene in the marketplace in the form of an economic stockpile? Should such intervention be used to require that industry disclose private, proprietary information to the Federal stockpile managers? And if so, what assurances will be taken to protect the confidentiality of such information?

6. What is the real potential for future supply disruptions and price increases? What is the expected impact (i.e., benefits and costs) of such economic dislocations upon the U.S. economy in general and sectors of U.S. society in particular? What is the cost of insuring against such dislocations? For example, will the acquisition of large amounts of materials like petroleum or chromium reduce such shortages and produce a more healthy economy, or will it stimulate the already spiraling inflationary rate? Second, are the expected benefits of an economic stockpile sufficiently greater than the costs to warrant the expenditure of large amounts of public money, and if so, how will this money be obtained?

7, What measures will be taken to insure public participation in the planning of an economic stockpile? Is such involvement necessary? Further, if the public is involved, what measures will be taken to maintain the confidentiality of U.S. strategic economic information ?

8. What is the long-term outlook for growth in the United States? For example, will the United States maintain, increase, or decrease its present consumption patterns? How will future supply disruptions affect these consumption patterns, and vice versa? How will they affect the environment?

Chapter I

INTRODUCTION

Chapter I

INTRODUCTION

U.S. industry is heavily dependent upon foreign sources for more than a dozen key materials, without which the economy could be severely jeopardized. The lack of manganese, for example, could bring a halt to steel production, with repercussions throughout the United States. Even for materials like petroleum on which the United States is not totally dependent, the loss of even part of the normal supply from abroad has resulted in serious economic disruptions. When drastic price increases by foreign suppliers become an additional element—as in the aftermath of the Organization of Petroleum Exporting Countries (OPEC) embargo—these disruptions are compounded,

U.S. experience with petroleum has dramatically emphasized the dangers of import dependence when political and economic motives are joined as they were in the OPEC embargo and price increases during the winter of 1973–74. These actions contributed not only to the inflationary problems already facing the United States, but they were also factors in the downturn in economic activity in the last half of 1974. For other industrialized countries, most of which are more heavily dependent on OPEC oil than the United States, the impact of the OPEC action was proportionately more serious and far reaching.

The concern over developments in materials supply and price has not been limited to petroleum, of course. A surge in worldwide demand for all types of materials in 1972 and 1973, augmented by a need to build inventories, resulted in tight supply situations in a number of commodities, The lack of productive capacity, plant closures stemming from environmental constraints, and the fact that some raw-material-producing countries took advantage of the high demand situation by raising prices--all these factors contributed to worldwide materials problems.

Although the economic recession which began in late 1974 reduced the immediate pressure, the fundamental concern over the long-term adequacy of raw materials supply has continued unabated. Insofar as domestic supplies are concerned, the price mechanism should provide some corrective action under inadequate supply conditions by dampening demand, encouraging the exploitation of lower grade resources, and creating incentives to develop alternate or substitute materials. Further, long-term outlook for growth in demand should encourage investment in new mining and processing capacity. Technological progress in both production and usage should likewise be a positive factor. Nevertheless, there are limitations to each of these avenues, particularly where they involve declining or inaccessible resources.

The ultimate answer for some raw materials then is directly related to the degree of U.S. dependence on foreign sources for materials and the extent to which U.S. industry can cope with this dependence. The OPEC experience makes it abundantly clear that U.S. industry alone is unable to counteract the operations of foreign countries engaged in deliberate manipulations which affect the national economy. Not only OPEC, but the potential for cartel action in bauxite, the actions of the International Tin Council, the potential for price increases or political intervention in the platinum market by South Africa and Russia, worldwide industrial competition for materials supplies, as well as the shrinking world supply of some material reserves—these are all situations which could have significant adverse effects throughout the U.S. economy.

Furthermore, it is not unreasonable to suggest that the U.S. policy of detente with the U. S. S. R., especially when coupled with the increasing demands expressed by the developing countries in the United Nations Conference on Trade and Development IV (UNCTAD IV) negotiations for more control of their natural resources, has had and will continue to have a significant effect on the U.S. and world economies. It likewise appears evident that since the U.S. strategic stockpile cannot, by law, be used to alleviate economic disruptions caused by cartels and unilateral political actions, analysis of the desirability of stockpiling for economic purposes involves considering a type of institution or capability quite different from the present strategic and supplemental stockpiles,

In addition to problems of foreign origin, several domestic trends and problems in materials supply raise the question as to whether or not economic stockpiling would benefit the public welfare. The need to find new reserves, extract from leaner ores, and invest in new productive capacity require risk taking which might be minimized, or at least shared, by new public policies which might include economic stockpiling as a useful component, Also, the growing public awareness of environmental and social problems highlights such issues as recycling and the development of new technology to improve the overall conditions under which materials are extracted and produced.

Each of the materials problems discussed above—whether actual or potential-an have significant impacts upon the U.S. economy, especially if more than one problem occurs simultaneously. Moreover, each of these problems may be reflected in shortages and hardships upon the American consumer, possibly severe enough to change his basic lifestyle. It is for these reasons that the United States should immediately and carefully reassess economic stockpiling as one component of a national materials strategy.

A. PAST AND CURRENT CONGRESSIONAL ACTIONS

1. Background

The need for an overall materials policy was recognized in 1952 when President Truman appointed a President’s Materials Policy Commission (Paley Commission) which recommended that a Federal agency look at the materials problems as a whole, keeping abreast of the changing situations and the interrelation of policies and programs. The Paley report proposed that the materials agency concern itself with the entire energy and materials field and the relationship of separate programs such as coal, gas, and petroleum to one another; the dimensions of foreign production of materials and its relationship to domestic programs; and the development of a production plan to meet long-term materials requirements. These recommendations were not implemented, and in recent years, materials problems have become widespread and acute.

President Nixon’s Government reorganization plan called for the development of a Department of Natural Resources to include the present Interior and Agriculture Departments and related activities. This proposal was later changed to read that a Department of Energy and Natural Resources should be developed, and the Department of Agriculture’s functions were omitted. Currently, there are a number of bills before the 94th Congress calling for the establishment of a “Department of Natural Resources and Environment” or a “Department of Social, Economic and Natural Resources Planning. ” So far, this legislation has not been acted upon.

Congress established the National Commission on Materials Policy in 1970 and charged it with making recommendations on the supply, use, recovery, and disposal of materials. The Commission's June 1973 report recommended that a comprehensive Cabinet-level agency be established for materials, energy, and the environment. It also called for the creation of a temporary high-level Natural Resources Coordinating Committee for materials policy and the organization of a computerized national minerals inventory system within the Department of the Interior until a new department was formed,

2. The National Commission on Supplies and Shortages

Congress already recognizes the need for coordinated materials planning, having passed in September 1974 Public Law 93–426 establishing the National Commission on Supplies and Shortages and charging it with drafting the "necessary legislative and administrative actions to develop a comprehensive strategic and economic stockpiling and inventories policy which facilitates the availability of essential resources. " Specifically, Congress pinpointed five items in the act which underscore our materials vulnerability and suggest a possible direction of stockpiling policy development:

a. The United States is increasingly dependent on the importation from foreign nations of certain natural resources vital to commerce and the national defense;
b. Nations that export such resources can alone or in association with other nations arbitrarily raise the prices of such resources to levels which are unreasonable and disruptive of domestic and foreign economics;
c. Shortages of resources and commodities are becoming increasingly frequent in the United States, and such shortages cause undue inconvenience and expense to consumers and a burden on interstate commerce and the Nation's economy;
d Existing institutions do not adequately identify and anticipate such shortages and do not adequately monitor, study, and analyze other market adversities involving specific industries and specific sectors of the economy; and
e. Data with respect to such shortages and adversities is collected for various purposes, but is not systematically coordinated and disseminated to the appropriate agencies and to Congress.

3. The Energy Policy and Conservation Act of 1975

The Energy Policy and Conservation Act, Public Law 94–163, which was signed into law on December 22, 1975, has the following purposes:

a. To grant specific standby authority to the President, subject to congressional review, to impose rationing, to reduce demand for energy through the implementation of energy conservation plans, and to fulfill obligations of the United States under the international energy program;
b. To provide for the creation of a Strategic Petroleum Reserve capable of reducing the impact of severe energy supply interruptions;
c. To increase the supply of fossil fuels in the United States, through price incentives and production requirements;
d. To conserve energy supplies through energy conservation programs, and, where necessary, the regulation of certain energy uses;
e. To provide for improved energy efficiency of motor vehicles, major appliances, and certain other consumer products;
f. To reduce the demand for petroleum products and natural gas through programs designed to provide greater availability and use of this Nation's abundant coal resources; and
g. To provide a means for verification of energy data to assure the reliability of energy data.

Each of these purposes is relevant to national stockpiling policy relating to energy materials.

Several of the purposes, together with the authority granted to implement those purposes, directly relate to legal and policy issues discussed in this assessment.

4. Status of Proposed Stockpile Legislation

Congress is presently considering proposed materials legislation for a broad variety of purposes, The issues related to national stockpile policy involve considerations of both military and economic security, as well as other social purposes, Military security has been the major purpose of the Strategic and Critical Stockpile, the Supplemental Stockpile, and the Defense Production Act Inventory. A future war might cause difficulties if it were coupled with concerted actions to cut off U.S. imports of manganese, chromium, cobalt, platinum, and other critical materials. As a result, the strategic stockpile was analyzed to provide the background necessary to understand how it has been operated and the problems which have been encountered. However, no other specific assessment of the current strategic stockpile has been conducted in this study.

The analysis of strategic stockpiles and the current materials problems outlined in chapter II illustrate the fact that stockpiling may also be useful in accomplishing national economic policy. The issue of economic stockpiling is complex and probably should be addressed as a component of the evolving national materials strategy.

The status of bills relating to economic and strategic stockpiling, before the 94th Congress, is listed in table 1–1,

Table 1–1.—Review of pending stockpile-related legislation of the 94th Congress

Bill Identification	Identification No.		Sponsor	Date	(as of Feb 23 , 1976)
	House	Senate			
General					
To amend the Defense Production Act of 1950 to provide for national stockpiles to protect the economic security of the United States		S.1869	Williams	June 4, 1975	Referred to Senate Committee on Banking Housing and Urban Affairs June 4, 1975
To extend by 90 days (until Sept. 30, 1975) the expiration date of the Defense Production Act of 1950,		S.J. Res 94	Proxmire et al.	June 10, 1975	Passed both House and Senate signed by President June 28, 1975. Became law—P. L. 94-42 June 28, 1975,
To extend the Defense Production Act of 1950 until Mar. 31, 1976. (U.S. Congress. House Committee on Armed Services. Subcommittee on Seapower and Strategic and Critical Materials. Hearings on ship transfers, Navy programmings, and stockpiles,)	H.J. Res. 487		Rees	June 5, 1975	
Provides for a 1 -year moratorium on the sale, or other disposition from stockpiles of strategic and critical materials		S.2767	Domenici	Dec. 10, 1975	Pending in Senate Committee on Government Operations.

Table 1–1.—Review of pending stockpile-related legislation of the 94th Congress—continued

Bill Identification	Identification No.		Sponsor	Date	Status (as of Feb. 23, 1976)
	House	Senate			
Amends the Defense Production Act of 1950 to create a National Economic Stockpile Association that shall operate under rules promulgated by the Secretary of the Treasury to facilitate the availability y of essential natural resources and to prevent disruption of the domestic economy.	H.R.9597		Rees	Sept. 15, 1975	Referred to House Committee on Banking, Currency and Housing, Oct. 15, 1975. Receiving executive comments.
Establishes a Strategic Energy Reserve Office in the Federal Energy Administration, and creates strategic energy reserves in storage capable of replacing energy imports for at least 90 days in order to minimize the impact of interruptions or reductions of energy imports. Passed the Senate on July 8, 1975, as amended. Text inserted in S. 622 (see above) on Sept. 26, 1975,		S.677	Jackson	Feb. 12, 1975	S. 622 passed in lieu of S.677 as P.L. 94–163, Dec. 22, 1975
Creates a National Strategic Petroleum Reserve of up to 1,300 million barrels of petroleum consisting of 300 million barrels in the military National Strategic Petroleum Reserve, and up to 1 billion barrels for the civilian National Strategic Petroleum Reserve (as authorized by this act), capable of reducing the impact of disruptions of oil imports.		s. 618	Jackson	Feb. 7, 1975	Referred to Senate Interior and Insular Affairs Committee, Feb. 7. 1975. 1st day Committee hearings, Mar. 11, 1975.
Amends the Strategic and Critical Materials Stockpiling Act in order to establish a fund that shall be used for the procurement of, and the carrying out of other functions related to, such materials.	H.R. 10526		Bennett	Nov. 4, 1975	Referred Armed Services Committee. Nov. 4, 1975,
Disposal of Specific Materials					
Authorizes the release of 1,553,500 pounds of cadmium from national stockpiles.	H.R.129 (H.R.3397)		Broomfield	Jan. 14, 1975	Referred to Subcommittee on Seapower and Strategic and Critical Materials, Mar. 6, 1975.

Table 1-1.—Review of pending stockpile-related legislation of the 94th Congress—continued

Bill Identification	Identification No. House	Identification No. Senate	Sponsor	Date	Status (as of Feb. 23, 1976)
A bill to authorize the disposal of silver from the national stockpiles.	H.R. 306		Conte	Jan. 14, 1975	Referred to Subcommittee on Seapower and Strategic and Critical Materials Mar. 6, 1975. 1st day of hearings, Mar. 25.1975.
A bill to authorize the disposal of beryl ore from the national stockpiles and the supplemental stockpiles.	H.R. 400		Flood	Jan. 14, 1975	Referred to Subcommittee on SSCM* Mar. 6, 1975. 1st day of hearings 3/35/75
Authorizes the disposal by the US. Government of certain Spermoil from the national stockpile and the subsequent regulated commercial disposal.	H.R. 3465		Mosher	Feb. 30, 1975	Referred to Subcommittee on Fisheries and Wildlife, Mar. 27, 1975. 1st day hearings, June 9, 1975.
Authorizes the disposal of tantalus materials from the national stockpile.	H.R. 1598		Drinan	Jan, 17, 1975	Subcommittee on SSCM*, Mar. 6, 1975.
Authorizes the disposal of approximately 100,000 tons of tin from the national and sup plemental stockpiles.	H.R. 4535		Mollohan	Mar. 10, 1975	Subcommittee on SSCM, Mar. 21, 1975. 1st day hearings, Mar. 25, 1975.
Authorizes the disposal of approximately 241,600 tons of c hem ical -grade chromite from the national stockpile.	H.R. 4802		Rose		Subcommittee on SSCM*, Apr. 11, 1975.
Authorizes the release of 9,000 short tons of asbestos chrysotile from the national stockpile.	H.R.5683 (H.R.6663) (H.R.7026) (H.R.691O) (H.R.7927)		Fenwick	Apr. 8, 1975	Subcommittee on SSCM*, Apr. 11, 1975. Favorable excomment from GSA, Aug. 11, 1975.

● Seapower and Strategic and Critical Materials.

B. ASSESSMENT SCOPE AND PURPOSE

While the basic objective of this assessment was to examine the attributes and consequences of economic stockpiling, another primary goal was to develop a generalized methodology which Congress, or any other organization, could use to investigate and provide input in the development of future stockpiling policy. It is in this context, and for this reason, that the step-by-step process used in the assessment is detailed as follows. Prior to describing this methodology, however, it is appropriate to discuss briefly the nature and development of technology assessment, suggesting in that manner a perspective for understanding the nature, scope, and purpose of this assessment.

1. Definition of Economic Stockpiling

For purposes of this assessment, economic stockpiling is defined as the accumulation and storage of materials for the express intention of being able to effect their distribution to accomplish public purposes other than the wartime emergency conditions stipulated in the Strategic Stockpile Act of 1946.[1] While a discussion of economic stockpiling might include an analysis of national, international, private, and public stockpiles, interest centers in this study on those purposes which the American market system does not adequately perform under the constraints, either foreign or domestic, which exist or may be imposed. For this reason, the stockpiling policies studied here concentrate primarily, though not exclusively, on the use of a public (i.e., Federal Government) economic stockpile to achieve various policy objectives. It is possible that an economic stockpile might best be achieved by U.S. participation in an internationally controlled stockpile, or through governmental cooperation with U.S. industry to operate privately held stockpiles, For that matter, how to implement an economic stockpile might be viewed in the final analysis as a choice of the best management system—i,e., not whether or not, but to what extent, the Federal Government should become involved in the operation of the stockpile, Should the U.S. Government, for example, maintain total control of the stockpile, or should that control be shared with industry, with one or more foreign governments, or vested in a public-private corporation? Because of these considerations, an assessment is herein made of the benefits and costs to the United States of stockpiling materials for selected public purposes.

2. Materials Characteristics

An economic stockpile can be composed of raw materials, such as minerals and ores; semiprocessed materials, such as concentrates from mines or metal ingots; or finished materials, such as medicinal or fabricated products ready for use. Stockpiling can also involve food products, but these are specifically excluded from consideration in this assessment. It is recognized that each of the materials which might be stockpiled has special physical geographic, technological, economic, social, and political characteristics which define its modes of production, processing, transportation, marketing, consumption, conservation, storage, and disposal. Nevertheless, for this assessment, stockpiling is viewed initially in terms of a policy objective and only after that policy objective is defined and understood as a matter of national interest is attention given to the materials which might be stockpiled to achieve that policy. It should be noted that “objective” is defined as the goal, or intended use of a stockpiling policy, not the quantity of material to be included in a stockpile.

3. Definition of Technology Assessment

For the purpose of this assessment, technology assessment is defined as a “generalized process for the generation of reliable, comprehensive information about the chain of technical, social, economic, environmental, and political consequences of the substantial

[1] The three definitions listed below reveal much about the evolution of the stockpiling concept in the United States over the past half century:

(a) Webster’s Unabridged—1922: No listing.
(b) Webster’s New Collegiate-1951: Stockpile, n. A storage pile; specifically, a reserve supply of an essential raw material, processed food, or the like accumulated within a country for use during a war-induced shortage.
(c) Webster’s Unabridged—1973: Stockpile, n. a reserve supply of something essential (as processed food or a raw material) accumulated within a country for use during a shortage caused by emergency conditions (as war).

The stockpiling of strategic materials to help meet wartime shortages was discussed in 1921, evidently not in time to make the 1922 edition of Webster.

The 1951 version is the essence of the language in the Stockpiling Act of 1946. Materials must be essential, i.e., critical or strategic, and releasable only to meet shortages generated by war conditions. Even the reference to food seems to be to the civil defense shelter stocking program rather than to the Department of Agriculture program (processed food; war-induced shortage).

The 1973 definition expands the war-induced shortage to one caused by emergency conditions as the reason for acquisition of materials above current needs. This definition covers most of the policy objectives included in the economic stockpiling concepts used in this study. It is interesting to note that the definition was written and adopted before the OPEC oil embargo of 197374.

use of a technology, to enable its effective social management by decisionmakers."[2] In the Working Glossary from which this definition was taken is also a discussion of the development and types of technology assessments. While the development of technology assessment is generally well known, it is important to mention here the four types of assessments, for they bear directly upon understanding the present assessment, The four types identified are:

- Assessments directed to the solution of identified problems of society which are usually amenable to systems analysis for their solution;
- Assessments to enable society to cope with the unfolding chain of cause-and-effect relationships stemming from a new technology;
- Assessments which are policy-oriented studies; and
- Assessments which are studies undertaken (usually in an academic environment) for the purpose of developing an assessment methodology, rather than as a input to decisionmaking.

Whether or not one agrees that all four, or only two, of the types identified above are really assessments, it is fundamental that the process of conducting a technology assessment-or for that matter, the assessment itself—not be equated with the policymaking process, but rather understood as being an input to that process. As the Working Glossary continues, the process of technology assessment is only one of three elements in society's management of technology:

> The first is the process of science and technology, producing innovations as solutions to social problems and needs. These may be economically attractive, or may require public funding; either way, they may become candidate claimants for political decisionmaking. The second element is the assessment of these technologies as solutions. The third element is the political process by which the social benefits and costs are finally judged and appropriate public action decided upon, Technology assessment, then, is the technological information input to the political decision process.

Because it is merely one of the inputs in the decisionmaking process, this assessment has not made any recommendations as to what, if any, policy Congress should consider implementing. It is also for this same reason that one of the primary goals of this assessment was to develop a generalized methodology which could be used in conducting similar policy assessments in the future.

a. Systems Approach to the Assessment of Economic Stockpiling.—The overall approach developed to manage and conduct the research in this assessment differs from the approaches used in the past materials stockpiling projects, The scope and purpose of past studies were limited to specific materials, classes of materials, or the macroeconomic effects of materials shortages on a particular industry or public sector. To date, no materials or stockpiling study has been found which uses a systems approach of first defining the policy objective to be achieved, then investigating materials stockpiling or alternatives to stockpiling as possible means of satisfying the requirements of that policy objective.

These past studies are understandable because the policy objective of stockpiling in the United States has been limited to providing materials for national emergencies, However, when related to the possibility of planned intervention in the United States and world marketplace, the broad spectrum of objectives which could be achieved by the implementation of a stockpiling policy defies consideration of a single material, a group of materials, or even one segment of U.S. society,

b. Definition of Systems Approach.—In general, systems analysis techniques were used to organize and manage this assessment,

[2] *Science Policy*: A Working Glossary, prepared for the Subcommittee on Science, Research, and Development of the Committee on Science and Astronautics, House of Representatives, U.S. Congress, July 1973, This document has served as the working glossary for this technology assessment.

As explained in the Working Glossary, systems analysis can be defined as an—

> inquiry to aid a decisionmaker in choosing a course of action by systematically investigating his proper objectives, and risks associated with the alternative policies or strategies for achieving them, and formulating additional alternatives if those examined are found wanting. Systems analysis represents an approach to, or way of looking at, complex problems of choice under uncertainty . . . In such problems, objectives are usually multiple, and possibly conflicting, and analysis designed to assist the decision maker must necessarily involve a large element of judgment,

4. Seven Steps in the Generalized Assessment Methodology

Using the systems approach, it was possible to organize the assessment requirements into a series of sequential tasks. These seven steps are listed and discussed below. The exact methods to be used in completing each of the seven steps listed will vary as a function of the complexity of the stockpiling policy being assessed. However, certain tasks must be accomplished during each of these steps, as explained below.

Step 1: Identify the Major Issues Related to Economic Stockpiling.—The major issues related to economic stockpiling and associated materials problems which might require some national policy development were examined in a series of literature searches, interviews, case studies, and relevance trees. The major issues identified in this task, which formed the nucleus of information to be used as inputs to the impacts analysis, are discussed in chapter II.

Step 2: Develop Stockpiling Policies to Address the Major Issues.—The stockpiling policies developed here define the policy objectives which are designed to alleviate the national materials problems identified in step 1. In developing these policies, care was taken to insure, with one exception, that each one would achieve only one objective. Selection criteria were developed to identify which materials were directly related to the national materials issues. These materials are then used as proxies in the impacts analysis, This task is discussed in chapter III.

Step 3: Assess the Impacts (Benefits and Costs) of Implementing the Stockpiling Policies.—The impacts related to implementing specific stockpiling policies are assessed in relation to the sectors of U.S. society which they could affect, As a minimum, consideration is given to the possible economic, political, and social impacts, These impacts are analyzed in chapters IV and V.

Economic stockpiling policies are considered in two categories: those relating to foreign actions and those relating to domestic actions. An example of the former would be one whose objective is to cushion temporary import disruptions, while an example of the latter would stabilize the long-term trend of fluctuating domestic materials prices. In either event, it is necessary to construct a probable future in which the stockpile would be operated. The complexity of the probable future could vary from the creation of a straightforward set of scenarios, based upon “what if” types of questions, to the extrapolation of the environment using sophisticated forecasting techniques, The nature of the future to be used should be determined as a function of the stockpiling objective and in anticipation of the impacts related to its implementation.

Step 4: Identify Alternatives to Economic Stockpiling. —A stockpiling policy may be only one of several means to satisfy the requirements of the national materials objectives. Accordingly, possible alternatives to economic stockpiling which may achieve the same or similar policy objectives have been identified. These alternatives are presented in chapter VII.

Step 5: Assess the Impacts (Benefits and Costs) of Implementing Alternatives to Economic Stockpiling.—In order to ascertain the true value of economic stockpiling policies, it is necessary to evaluate the impacts of alternatives in much the same way as was done for the stockpiling policies. It should be pointed out, however, that such a quantitative

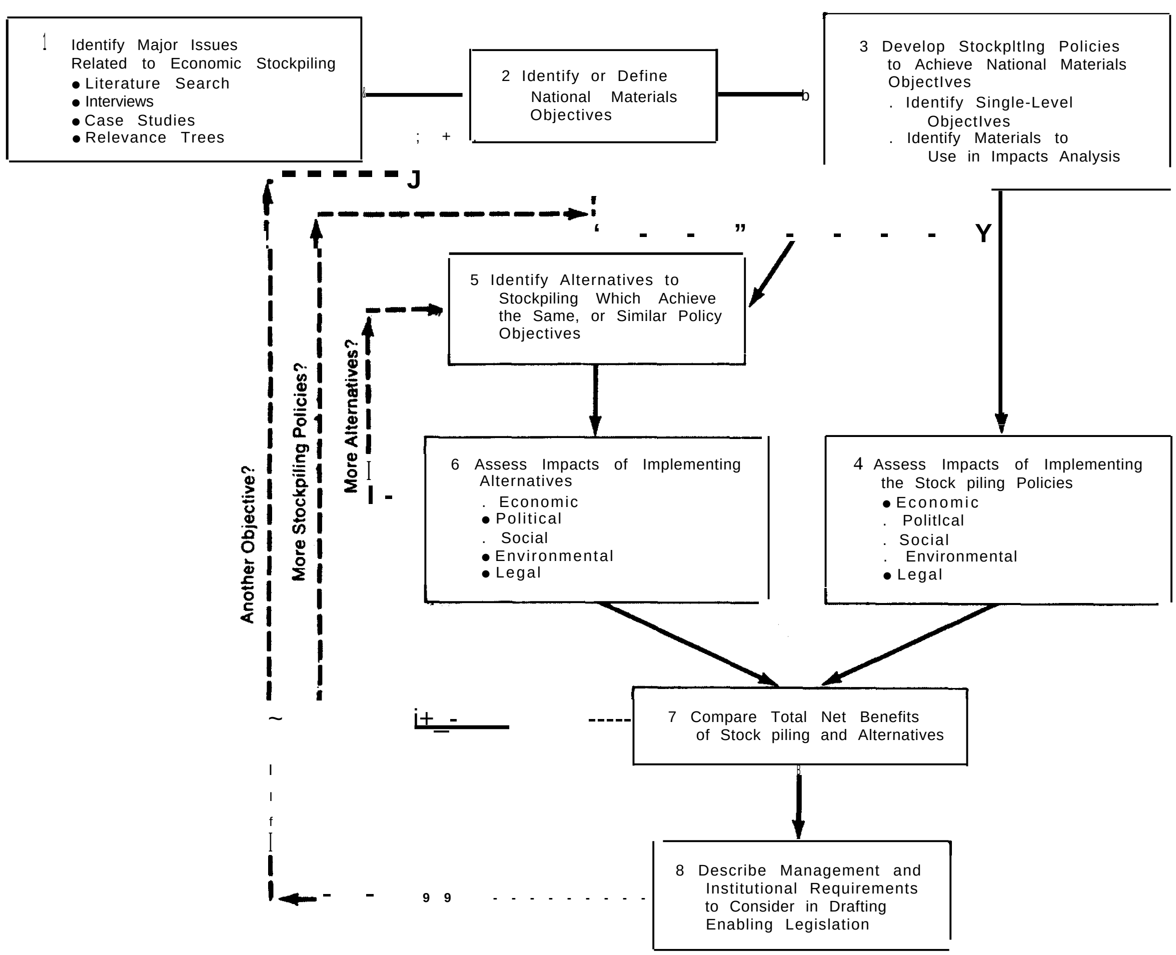
77-119 0 -76-3

cost/benefit analysis was beyond the scope of this assessment and was therefore not performed. What was accomplished is a qualitative analysis of the alternatives in terms of their possible impacts, advantages, and disadvantages.

Step 6: Compare the Impacts (Benefits and Costs) of Economic Stockpiling With Those of Alternatives.-Once the information is collected and the analysis related to the first five steps has been completed, it should be possible to arrive at supportable conclusions regarding whether or not economic stockpiling is sufficiently worthy for the Congress to consider in drafting enabling legislation. However, this detailed cost/benefit analysis was beyond the scope of this assessment and was not performed.

Step 7: Legislative Considerations Regarding Economic Stockpiling.—Because no analysis other than qualitative judgments is offered regarding whether stockpiling offers greater net benefits than alternatives, and because no recommendation is offered regarding whether or not an economic stockpiling policy should be implemented, the final step of

Figure 1-1.
Functional Logic of Generalized Assessment of Methodology



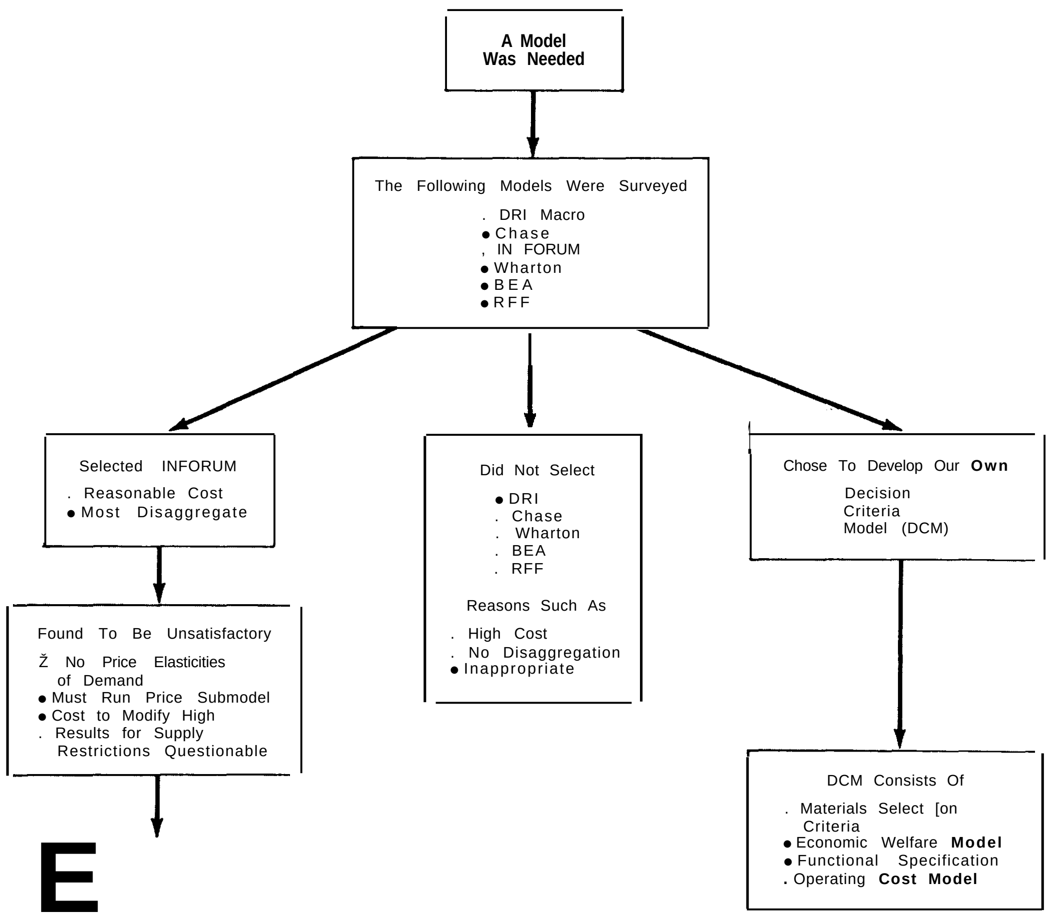
this generalized methodology is to identify the possible legislative options and institutional arrangements which are available in considering possible legislation. These considerations are included in chapters VI and VIII.

5. Functional Logic of Assessment Methodology

Figure 1-1 is a graphic display of the functional logic of the generalized methodology developed and generally used to assess economic stockpiling, While the steps in the methodology as outlined in the previous section are presented as a sequential process, in actual practice the assessment process is iterative and requires a constant feedback of information from one task to another.

a. Discussion of Decision Criteria Model Development.—Figure I-2 is a display of the development of the decision and computer models surveyed and developed during this assessment. Several existing models were surveyed; one was selected, used, and found to be unsatisfactory. Therefore another model (Decision Criteria) was developed to assess the benefits and costs to society of implementing

Figure 1-2.
Decision Criteria Model Development



an economic stockpiling policy. It was with the four components of this Decision Criteria Model that the basic assessment was made and the findings were drawn.

b. Discussion of Decision Criteria Model.—The Decision Criteria Model, which is discussed in chapter 111 consists of four components:

- A Set of Materials Selection Criteria,
- An Economic Welfare Model,
- A Functional Specification Checklist, and
- An Operating Cost Model.

The Economic Welfare Model and the Operating Cost Model were completely implemented for five stockpile policies using a computer program developed in the study.

Chapter II

NATIONAL MATERIALS ISSUES RELATED TO ECONOMIC STOCKPILING

Chapter II

NATIONAL MATERIALS ISSUES RELATED TO ECONOMIC STOCKPILING

Chapter II addresses the question, "Should the United States consider implementing an economic stockpile?" The major issues which necessitate such consideration are discussed from five vantage points:

- Increasing U.S. import dependence,
- International cartel actions,
- Response of U.S. market system to materials problems,
- Use of U.S. stockpiles for economic purposes, and
- Economic stockpiling in selected foreign countries.

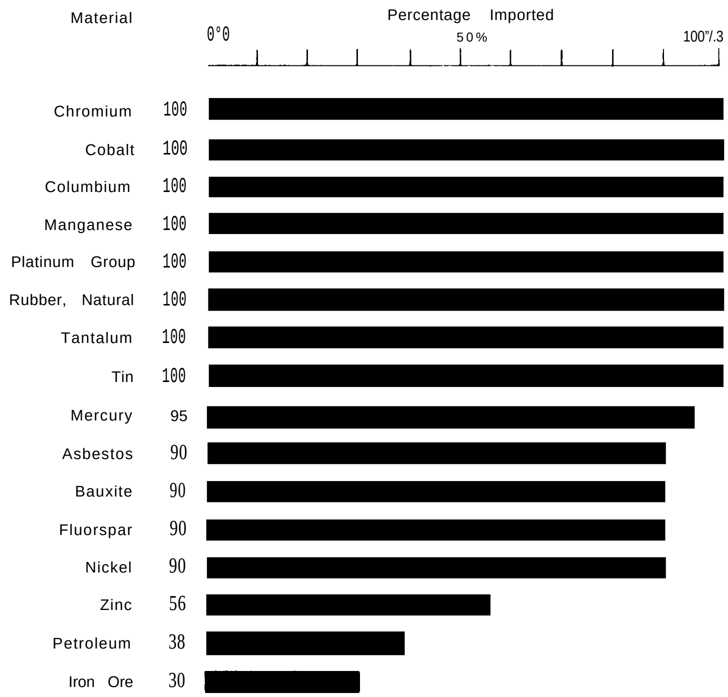
A. INCREASING U.S. IMPORT DEPENDENCE

In 1970, the United States, which has only one-twentieth of the world's population, consumed approximately one-third of the world's raw material supply. Although the United States is a major producer of both energy and raw materials, it has become increasingly dependent on imports from other countries to supply its industrial economy. As a result, the country is vulnerable to supply cutoffs or price increases, particularly for several key materials. Figure II–1 dramatizes this import dependence for 16 selected materials. Although the percent import dependence for zinc, petroleum, and iron ore is reasonably small, three factors alone—the degree of dependence, the importance of these materials in the U.S. economy, and the existence of a potent cartel in the case of petroleum—are cause enough for concern about the future supply and price of these materials.

The dependence on imports is increasing either because such supplies are cheaper than using indigenous U.S. sources (e.g., bauxite ore), or the material is not indigenous to the United States but has performance characteristics uniquely suited to specific and desired technological needs (e.g., platinum for use as a catalyst in chemical reactions and chromium for resistance to corrosion and oxidation). Most of the other industrialized nations are even more dependent on importing raw materials than the United States and are therefore more vulnerable to future supply disruptions and price increases, Furthermore, many of these nations depend upon the United States as a reliable source of major commodities essential to their economies, a dependence recognized in bilateral or multilateral agreements. As a result, the economies of the United States, and its allies, the less-developed countries, and the Communist countries are mutually interdependent upon each other for continuing prosperity. For those countries like Japan and West Germany which rely almost totally upon imported raw materials, the situation is even more precarious. While freedom from dependence on imports may be desirable for the United States, it may not be a practical reality.

Figure 11-1.

U.S. Import Dependence for Selected Materials



Source Derived by comparison between U S imports and usage over a number of years (Import data from Department of Commerce usage data from Bureau of Mines and Rubber Manufacturers Association)

In addition to concern regarding price and supply of imports over the next several decades, there is an immediate and serious problem of the present actual shortages in many processed materials such as steel, aluminum, and copper. These particular shortages appear to be the result of an undercapacity in the United States and world materials producing industries which occurred for several reasons: (1) a long period of underinvestment in new capacity, (2) unprecedented period of high rate of economic growth which has occurred simultaneously in most of the developed countries, (3) large reductions of inventories, and (4) the recent economic slump. The resulting higher prices for materials, which are also impacted by energy price increases, are stimulating some cautious expansion in production capacity and some improved efficiency of materials use or substitution in the materials and manufacturing industries. While such changes can be expected to alleviate this particular source of shortages, they will not resolve the questions of vulnerability due to U.S. dependence on imported raw materials.

B. INTERNATIONAL CARTEL ACTIONS

The emergence of the Organization of Petroleum Exporting Countries (OPEC) cartel as a force powerful enough to manipulate the normal flow of petroleum to the international economy has made the world painfully aware of the potential which this type of organization can have on both producing and consuming countries. Although OPEC has been in existence since 1960, its action in October 1973 was the first instance in which its members used their joint strength as a political weapon against petroleum-consuming countries, many of which are completely dependent on imports for this indispensable material. While the United States is far from being completely dependent on OPEC's oil, the effects of the temporary embargo and the quadrupling of prices have been of the most serious nature, Whatever may come of a long-range program for energy independence in this country, the more immediate concern requires, among other approaches, the consideration of an economic stockpile for materials other than petroleum included in the new strategic petroleum reserve to avert or counteract future cartel actions which may either restrict supply or impose monopolistic prices to the detriment of the U.S. economy. It should be emphasized, too, that because of the interdependence of the economies of the world industrial nations, U.S. policy in this important area will also have repercussions on nations other than the members of a cartel,

1. Conditions Necessary for Successful Cartelization

OPEC's example has undoubtedly stirred the hopes of other producers of raw materials, especially where the "climate" for successful cartels is favorable. If such a cartel action is to be successful, however, several conditions must exist:

- The supply of materials must be concentrated in a relatively small number of countries;
- The material must be traded internationally on a fairly large scale;
- c. Substitute materials must not be too readily available to the consumer, forcing him to continue paying higher prices for a period of time before seeking a substitute;
- . The material must be one in which U.S. Government stocks do not exist in significant quantity;
- The producers, or at least their organ i z a t ion, must be able to simultaneously forgo export earnings from sale of the material for some period of time, and withstand retaliatory import restrictions on other economic fronts, as well as overcome the possible internal labor problems which deprivation would cause;
- . Consumer demand must be somewhat unresponsive to price changes; and
- The members of the producer group must have compatible objectives which could be either political or economic.

Even though all of these conditions were not present in the OPEC action, the political advantage was the deciding factor in that organization's determination to act as it did.

2. Materials Cartels

Given these conditions, one question dominates the analysis of materials planning: Is there a probability of a materials cartel like the petroleum OPEC, and if so what can be done about it? To the first part of the question, one can respond only with informed judgment. To the second, however, there is a history of scientific and technological solutions which can be assessed and--contingent upon their economic, social, and political ramifications—applied in an effort to avert or counteract cartel action.

Many producing countries are showing increasing interest in changing present terms of trade to their benefit.[1] Hence, many of these countries have either discussed or attempted market intervention to raise or at least influence raw materials prices. First, seven major bauxite-exporting countries met in March 1974 and formed an organization to coordinate their future policies. while some of the members opposed using the International Bauxite Association (IBA) as a cartel, Jamaica in-

[1] *International Economic* Report *of* the President, transmitted to the Congress March 1975.

creased its taxes and royalties on bauxite by 500 percent in June 1974. Second, the four countries which make up the International Council of Copper Exporting Countries (CIPEC) met several times throughout 1974 to discuss setting minimum copper prices. They finally agreed to reduce exports of copper in all forms by 10 percent in an attempt to stop the downward price movement. Third, Morocco raised the price of phosphate rock by nearly 60 percent during 1974. Finally, a number of iron-ore-exporting countries—mostly less-developed countries are currently discussing plans to create a formal collective organization.

In general, it must be pointed out that the price multiplication of raw materials should affect product prices much less than has been the case for energy. Bauxite, for example, has been close to $12 per ton, whereas the price of aluminum ingot is about $600 per ton. Although it takes about 4 tons of bauxite to produce 1 ton of aluminum, it is clear that doubling the bauxite price should not influence the price of aluminum as strongly as the changes in crude oil prices increased the resulting prices for energy fuels and petrochemical products, However, there is a trend for the producing countries to seek price increases for their raw materials, as well as to develop their own industries for materials processing and fabrication rather than simply exporting raw materials. Such changes in industrial emphasis could not only result in significant changes in the economic development of producing countries, but it could also damage the U.S. materials processing industry,

The prospect of a “Materials OPEC” is currently the subject of serious examination, both inside and outside the Federal Government, and such consideration has already changed the character of discussions in international trade relations from the focus of the past several decades on “access to markets” toward one of “access to supply, ” The statement by U.S. Ambassador William Eberle (Special Representative for Trade Negotiation) at the recent Hearings on Materials Shortages before the Joint Economic Committee of Congress pointed to such an administration view on the development of a stable and equitable framework for international trade in raw materials.

Further, developments in the negotiations recently concluded in the United Nations Conference on Trade and Development (UNCTAD IV) suggest new considerations for U.S. materials policy, A group of 77 countries have been pressing for the creation of a $3 billion Common Fund to finance buffer stocks as a means of stabilizing world prices for various raw materials, Buying and selling these buffer stocks would permit countries, they argue, to keep prices within specified ranges and thus avoid price fluctuations. Initially, the U. S., Japan, West Germany, France, and Britain opposed this suggestion, offering instead to negotiate commodity agreements on a case-by-case basis, then at some future date to discuss the issue of stockpile financing, A compromise was reached during the last week of the conference which would permit negotiations to begin on certain commodities before the end of 1976, Moreover, the conference urged quick review of the debts of 20 very poor nations, and authorized various studies on world economic problems, [2]

The second part of the question regarding a materials cartel is concerned with what might be done if the threat of an OPEC-like action becomes reality. Both increases in price and uncertainty of supply are likely to stimulate the following technical responses:

- Materials substitution (i.e., the use of a different material, to perform the same function, such as copper or aluminum in conductors);
- Process substitution (i.e., the use of a different raw material, such as other alumina clays in place of bauxite);
- System modification or substitution (i.e., reduce or avoid the need for a specific material by changing the

[2] Washington Post, June 1, 1976.

engineering system, such as the use of a magnetic circuit breaker in a car ignition system in place of the conventional electrical circuit breaker); and

- Stockpiling either of materials or of technology.[3]

The first three of these responses will require relatively long leadtimes to develop the substitute technologies and will be very expensive if heavy investments in new facilities are required. For example, the substantial substitution of natural fibers by sythetic fibers has taken some 40 years; the replacement of open-hearth steelmaking technology by the basic-oxygen process, some 10 years. Historical experience indicates that the substitution of a material or a new process for another generally takes about 20 years. While it is true that crash programs like the development of the atomic bomb or the manned spacecraft program can result in unusually rapid change, the investment in resources to achieve such change is extremely large.

Table II–1 sets forth the cartel outlook for 16 materials, along with related information on U.S. imports, major import sources, the U.S. Government stockpile situation, and the trend of U.S. demand over the next 5 years. Further details on cartels and potential cartels are contained in appendix B.[4]

[3] *Requirements for Fulfilling a National Materials Policy*, Proceedings of an Engineering Foundation Conference held at Henniker, N.H., August 1974. Note.—All other references to articles from these proceedings will be cited as the *Henniker* Report.

[4] See also the Council on International Economic Policy *Special* Report: Critical Imported Materials for an analysis of the potential for materials cartelization, and Eight Mineral Cartels; The New Challenge To Industrialized Nations, published by *Metals Week*, 1975.

a. Copper Cartel.—The International Council of Copper Exporting Countries (CIPEC) has been less successful than OPEC, due in part to the fact that the four countries in CIPEC control only about one-third of the world production. In any event, CIPEC poses little threat in terms of supply disruptions to the United States, which is almost independent of foreign sources for copper. However, a successful action by CIPEC will certainly affect domestic copper prices.

b. Bauxite Cartel.--Other than OPEC, this is probably the most serious cartel threat to the United States. Ten countries which produce over 65 percent of the world's output and account for 80 percent of the bauxite/alumina trade are members of the International Bauxite Association. The IBA's purposes are to coordinate information on bauxite production and increase revenues from bauxite operations in member countries. Unilateral action by Jamaica, which accounts for about 20 percent of world production, increased revenue from the sale of bauxite through higher taxes. Although that country may press other members of the IBA to attempt joint restrictions of supply, no firm pricing and taxing policies have yet been established. The U.S. response to supply or further price actions could be a shift to substitute materials and, in the long run, the domestic development of aluminum-bearing clays and other aluminum bearing materials,

c. Mercury Cartel.—A mercury cartel has had an intermittent existence over the last 50 years. During the early 1970's a group of mercury producers met informally to exchange market views and try to formulate a price policy. A producers' organization, formed in May 1974 to maintain high prices, has been unsuccessful and is likely to remain so because of the existing U.S. mercury stockpile and the decrease in world demand.

Table II–1.—U.S. import situation for selected materials

Material U.S. consumption price per unit[1]	Percent of U.S. consumption imported[2]	Major import sources and percent of total (1974)[3]	U.S. Government stockpile (9-30-75)[4]	Annual U.S. demand growth through 1980 (percent)[5]	Cartel outlook
Chromite 1,438,000 short tons $33-$58/short ton, Turkish ore	100	U.S.S.R. (50%) South Africa (18%) Turkey (17%) Rhodesia (13%) (metallurgical grade)	22 months' supply	2.1	Possible, if South Africa and Rhodesia find tacit cooperation of U.S.S.R.
Cobalt 9,400 short tons $6,920/short ton	100	Zaire (50%) Belgium	38 months' supply	2.6	Unlikely; cobalt is byproduct of other mineral production.
Columbium 3,250,000 pounds $1.45–$1.80/lb. Columbite (ore)	100	Brazil (75%)	[illegible] months' supply	5	Unlikely; variety of close substitutes.
Manganese 1,645,000 short tons, ore $71–$85/short ton, metallurgical ore	100	Brazil (39%) Gabon (25%) Australia (16%) (ore)	2[illegible] months' supply	2	Unlikely; large world reserves and potential seabed recovery.
Platinum Group 1,981,000 troy ounces Platinum—$184.98/troy ounce Palladium—$136.67/troy ounce	100	U.S.S.R. (35%) South Africa (34%) United Kingdom (21%)	11 months' supply	2, except in automobile emissions control catalysts which could be much higher	Potential for collusive pricing fairly high but this may have reached its limits; development of alternate materials should restrict cartel supply/price actions.
Rubber, natural 719,000 metric tons $868 per metric ton		Indonesia (45%) Malaysia (32%)	5 months' supply	2-3	Unlikely; disruptive to local employment and overall producers; limited by potential switch to synthetic rubber; International Rubber Study Group has not acted to control supply or price.
Tantalum 2,425,000 pounds $15 per pound, tantalite (ore)		Canada (42%) Brazil (8%) Malaysia (7%)	15 months' supply	3	Unlikely.
Tin 51,611 long tons, primary 13,131 long tons, secondary $8,865/long ton, primary		Malaysia (52%) Thailand (15%)	45 months' supply	Less than 1	Unlikely; International Tin Agreement with producer and consumer members is not apt to restrict supplies.

Mercury 59,479 flasks (78 pounds) $282 per flask	95	Canada (33%) Algeria (20%) Mexico (20%)	42 months' supply	Less than 1	Producers' efforts to restrict supplies to raise prices have been unsuccessful.
Asbestos 849,000 short tons $122 per short ton	90	Canada (98%)	Less than 1 month's supply	2	Unlikely.
Bauxite (aluminum ore 16,904,000 long tons $11.37 per long ton, import value, f.o.b. export port	90	Jamaica (53%) Surinam (21%)	10 months' supply	6	Highly possible; potential structure exists in International Bauxite Association (10 producing countries).
Fluorspar 1,325,000 short tons $71 per short ton	90	Mexico (80%)	11 months' supply	1	Unlikely; large number of producer countries.
Nickel 193,000 short tons, primary $3,060–$4,020 per short ton	90	(68%)	None	3	Unlikely; potential seabed recovery.
Zinc 1,288,000 short tons $719 per short ton, Prime Western	56	Canada (56%) Mexico (6%) Peru (6%)	3 months' supply	3.1	Unlikely; would require close cooperation of highly disparate private sector entities.
Petroleum 6,070,000 barrels, products U.S. $6.74 per barrel, crude, wellhead $11.20 per barrel, import value, f.o.b. export port	38	Venezuela (20%) Canada (18%) Nigeria (12%) Iran (9%) Saudi Arabia (7%)	None	3.3	OPEC controls supply and price.
Iron ore 140,500,000 long tons $13.85–$15.75 per long ton	30	Canada (41%) Venezuela (32%) Brazil (14%)	None	2	Unlikely; iron ore abundant and widely distributed.

Sources: (1) Bureau of Mines, Census Bureau, Rubber Manufacturers Association, and trade press.
(2) Percent of U.S. consumption imported—derived from import and usage data over a number of recent years.
(3) Major import sources and percent of total (1974)—Department of Commerce.
(4) U.S. Government stockpile—derived by Ultrasystems from stockpile and usage data. Stockpile relationship to supply is based on average consumption 1973–74.
(5) Annual U.S. demand growth through 1980—Commodity Data Summary, Bureau of Mines 1975; Special Report—Critical Imported Materials, Council on International Economic Policy, December 1974.

C. RESPONSE OF US MARKET SYSTEM TO MATERIAL PROBLEMS

In mid-1973, the Secretary of the Interior issued his "Second Annual Report Under the Mining and Minerals Policy Act of **1970.** **"** Stating that "development of domestic mineral resources is not keeping pace with domestic demand, " he cited nine major problem areas confronting the mining, minerals, metal, mineral reclamation, and energy industries. Of the nine areas cited, two are of particular importance in relation to how the U.S. market system responds to materials problems;

- Expropriate ions, confiscations, and forced modifications of agreements have severely modified the flow to the United States of some foreign mineral materials produced by U.S. firms operating abroad, and have made other materials more costly; and
- U.S. industry is encountering greater competition 'from foreign nations and supranational groups in developing new foreign mineral supplies and in assuring the long-term flow of minerals to the United States.

The Secretary made a number of corrective legislative recommendations, including the creation of a Department of Energy and Natural Resources, provision of an organic act for the Bureau of Land Management, revision of the mineral leasing laws, regulation of surface mining activities, amendment of the Natural Gas Act, construction of deepwater ports, and modifications of right-of-way limitations. Only the latter recommendation, defined as the Alaska pipeline bill, was enacted into law in 1973; the other recommendations were carried forward as considerations for the 94th Congress.

Also in mid-1973, the National Commission on Materials Policy (NCMP) issued its Final Report which made 177 detailed recommendations, those affecting minerals being in close agreement with the Interior Minerals Policy Report. Perhaps the most significant recommendation of the NCMP was that

> it should be the policy of the United States to rely on market forces as a prime determinant of the mix of imports and domestic production in the field of materials but at the same time decrease and prevent wherever necessary a dangerous or costly dependence on imports.[5]

Under the extraordinary conditions now facing the United States, however, the American market system may be unable to respond quickly and effectively to the variety of supply problems now occurring. One major reason is the system's dependence for much of its raw materials upon purchases in international markets which are undergoing rapid changes and do not operate in the same manner as the U.S. system. Whereas in the past many U.S. firms had subsidiaries abroad which provided much of their raw materials, now the situation is complicated by direct foreign government involvement in many industrial phases of raw materials supply. In the United States the political and social ramifications involving raw materials producers or consumers may override economic factors. Furthermore, legal and constitutional barriers may be deterrents to the production and flow of raw materials. Aside from the significant impact of the raw materials problems stemming from import dependence, the U.S. economy is faced with problems of quick and effective response to domestic supply/demand changes.

For these reasons, analysis of a certain limited form of Government action to complement the market may be necessary. It must be clearly recognized, however, that an economic stockpile is subject to political as well as economic manipulation. Its mere existence constitutes a threat overhanging the market,

[5] National Commission on Materials Policy, Material Needs and the Environment, June 1973,

unless acquisitions, holdings, and disposals are carefully disciplined with respect to the potential dangers of market management. It is therefore the purpose of this assessment to examine how national stockpiling policy can be used to assist, not replace, private industry's management and operations in the American market system.

D. USE OF U.S. STOCKPILES FOR ECONOMIC PURPOSES

The only direct U.S. experience with stockpiling has been the handling of materials in the agricultural and strategic stockpiles and Defense Production Act inventories.[6] Despite their statutory limitation to military purposes, these stockpiles have in actual practive been used as a de facto economic stockpile, especially through disposals after the termination of national emergencies. Moreover, recent disposals from both the strategic stockpile and Defense Production Act inventories have depleted U.S. materials resources to the extent that our capabilities to discourage or counteract foreign disruptions of materials required by the economy have been seriously compromised.

1. Economic Use of the Strategic Stockpile

The Stockpiling Act of 1946 specifically, albeit unintentionally, included some aspects of an economic stockpile when it provided in section 3 that purchases of strategic and critical materials be made, so far as practicable, from supplies of materials in excess of the current industrial demand. In the same Section, the matter of disposals provides for the protection of producers, processors, and consumers against avoidable disruption of their usual markets.

Acquisition and sale of materials from the strategic stockpile were governed by the imbalance between objectives and inventories.[7] The objectives were governed by an ever-changing set of assumptions relating to the length of war, accessibility of foreign supply, size of the Armed Forces, degree of civilian austerity, and similar considerations which had a profound effect on either demand or supply or both, and consequently on the size of the stockpile objective, This, in turn, determined whether or not Congress could be asked for money to buy or authorization to sell. Not surprisingly, the record shows that when there was a disposition toward acquisition of materials, for whatever reason, the assumptions tended to result in reduced supply estimates and/or increased demand estimates. When disposal became a policy objective, whether to fight inflation or simply to add to Treasury receipts, changes in the assumption produced a totally opposite supply/demand effect.

Evidence of the foregoing abounds in the case studies and other materials developed from the literature search conducted during this assessment. Specifically, the post-Korean war acquisition period in the fifties, the disposals during the peak of the Vietnam war production effort in the sixties, and the inflation fight of the early seventies provide highlights over a period of several decades. One item of interest is the total independence of the stockpile program and actions from political-party persuasion. Managing a stockpile has many political aspects, but orientation to one party or the other has not been one of them.

In addition to the effect of changing assumptions or objectives, one other aspect of the management of the strategic stockpile should be mentioned. Under section 5a of the

[6]For further elaboration of the events discussed here, see app. A.

[7]As explained in ch, I. stockpiling objective in this study refers to the goal (or use) of a given stockpiling policy, not to the amount of material to be stockpiled, as defined here by the strategic stockpile.

Stockpiling Act, the President can order releases of material when, in his judgment, such release is "required for purposes of the common defense. " Thus, the released material was allocated by the Commerce Department largely to contractors and subcontractors based on their defense-rated orders for programs of the Department of Defense, the Energy Research and Development Administration, the Nuclear Regulatory Commission, and the National Aeronautics and Space Administration. The rules were followed to the letter and beyond in the sense that "common defense" was given the broadest possible interpretation.

The net effect, however, was essentially the opposite of what appeared on the surface. As pointed out earlier, defense production and construction operated under the rules of the Defense Materials System (DMS). Under those rules, purchase orders of defense contractors had an absolute priority over purchase orders of nondefense contractors. After defense needs were met from available supply, the remainder was sold to meet nondefense needs. To the extent that defense needs were met by a stockpile release, an equivalent amount of material was made available from regular supply for sale to nondefense users.

2. Defense Production Act Inventory

The above discussion relates primarily to the strategic and critical materials stockpile, for which statutory language was relatively tight. However, purchasing and disposal actions under the Defense Production Act (DPA) inventory took place under a much more flexible set of rules.

Under the Defense Production Act of 1950, congressional approval of individual actions was not required. As a matter of fact, the program was managed by the Director of Emergency Preparedness and predecessor agencies. He could accept deliveries into the DPA inventory, divert them to private industry, or accept them and transfer them to the strategic stockpile to remove the threat of their sale from the market.

The DPA inventory was not originally envisaged as a stockpile. As is pointed out several times in the literature search, floor price purchase contracts represented an inducement to help persuade private investors to expand productive capacity. e In some cases deliveries were small in relation to the potential expectations (or fears) of the DPA program managers of the 1950's. As time went on, the huge amounts of materials made it possible to use the DPA inventory as an economic balance wheel, and it was so used.

Table II–2 presents a summary of stockpile disposals (as of March 31, 1975) from the various types of inventories, comparing sales values with acquisition costs. Total sales value of all disposals is about 3 percent above acquisition costs. A somewhat different comparison between national stockpile inventory acquisition costs and market values (which do not necessarily reflect the amount that would be realized at time of sale) shows the result of inflationary rises, especially in 1973 and 1974. At the end of 1966, these two figures were fairly close—$4.7 billion in inventory, against a market value of $4.8 billion. By June 30, 1975, as a result of large amounts of disposals, inventories had been reduced to $2.6 billion, while their market value was calculated at more than $5.4 billion.

In these program actions, there is not the slightest suggestion that any law was violated or any action of questionable legality taken. Nevertheless, the history of U.S. stockpiling makes it abundantly clear that any legislation establishing an economic stockpile and delegating operational authority to the executive branch should be designed to include congressional review and approval.[9] In March 1975, the General Accounting Office (GAO) recommended in a report to Congress that "until the Nation's critical resource requirements are clarified, the Congress may" wish to consider halting future disposals currently

Wee the case study, "Releases of Copper from the Stockpile, " App. B.

[9]See, for example, S. 1869, a bill to provide for national stockpiles to protect the economic security of the United States.

Table II–2.—Summary of stockpile disposals as of Mar. 31, 1975

Nature of disposal	Saks commitments	
	Sales value	Acquisition cost
Cumulative to date:		
National and supplemental stockpiles	$4,823,872,570	$4450,789,238
Defense Production Act	1,347,293,393	1,589,238,982
Other inventories	212,170,670	94,007,911
Presidential releases	487,955,000	389,119,000
Total disposals	6,871,291,633	6,523,155,131
Purchase and resale: Defense Production Act	1,749,646,112	1,808,406,671
Grand total	8,620,937,745	8,331,561,802

NOTE:-Acquisition cost is based on the average unit price of inventory on hand at time of sale. This unit price is established without regard for (1) the grade, type, or quality of the commodity in inventory, and (2) the varying purchase prices or appraisal value that have accumulated in inventory records since the inception of the program.

Source: General Services Administration DM-80 Quarterly Report, Mar. 31.1975.

authorized under specific legislation and grant no further requests to dispose of strategic and critical materials. ”[10] The report also suggested that Congress might want to “study the advisability of broadening the strategic and critical materials stockpile concept to release material to meet short-term economic as well as national defense emergencies. ” In addition to the GAO report, the House Armed Services Committee has requested a complete reevaluation of the requirements of the strategic stockpile in terms of materials and the length of a potential conflict requiring their use. Further, Senator Domenici introduced a bill, S.2767, which calls for a moratorium of 1 year on all sales from the strategic stockpile, including those previously authorized but not sold. This bill was introduced to enable a reevaluation of the strategic stockpile, permit the question of an economic stockpile to be resolved, and insure that no materials would be sold which might have to be purchased in the future at an increased price.

3. Interaction Among Federal Agencies

Another useful product of the literature search is the insight provided into the actions and interactions among Congress, the executive branch, private industry, and persons responsible for other Government programs such as national security, economic stabilization, industrial growth, and budget deficits.

On the one hand, no amount of literature can ever adequately convey the strength of the pressures, the degree of abrasion, or the intensity of program conflicts. These are not committed to paper. Yet the literature search did illustrate that powerful forces and pressures were commonplace for many stockpile transactions. The significance of this is simply that if a defense-oriented stockpile is susceptible to external forces, it can certainly be expected that similar pressures will rise exponentially for an economic stockpile.

Given these pressures and potential conflicts, any piece of economic stockpiling legislation will have to be both more flexible and less flexible than the strategic stockpiling legislation: more flexible in the sense that disposals under present legislation take so long that the optimal selling time frequently disappears by the time action can be taken, and less flexible in addressing the question of the policy assumptions which underlie individual actions. Perhaps the process could be speeded up by having the President submit a proposed transaction to Congress which would have a 10-day period for disapproval.

[10] General Accounting office, “Stockpile Objectives of Strategic and Critical Materials Should Be Reconsidered Because of Shortages,” March 1975.

77-119 0 -76-4

E. ECONOMIC STOCKPILING IN FOREIGN COUNTRIES

The same threats of supply disruptions which could seriously affect the United States could also damage the economies of other nations, many of which are more import dependent than the United States. Several of these countries have established or are planning to establish economic stockpiles as a form of self-protection against supply disruptions or price increases, It is extremely important for the United States to pay close attention to the materials which these countries may stockpile. Inherently, economic stockpiling is a process of market intervention and will create economic as well as social and political impacts,

One country which maintains both a government-owned stockpile and grants incentives to private industry to insure supply and price stability is Sweden. Sweden is now ranked fourth in the world in the production of iron ore and is still discovering new deposits. The major importers of Swedish iron ore are West Germany, the United Kingdom, and Belgium-Luxembourg. If Sweden decided to cut back on its exportation of iron ore, for either price or strategic reasons, the importing nations could be adversely affected, creating foreign policy implications for the United States. For example, if West Germany were unable to receive its needed iron ore supply, it might very well turn to the United States to supply some of its needs. These stockpiling programs are summarized in the following sections; a more detailed analysis is included in appendix C,

1. Japan

The Japanese Government is considering several forms of economic stockpiling. In 1974, the Mining Industry Council, an advisory group to the Ministry of International Trade in Industry (MITI), recommended that the Japanese Government immediately subsidize the stockpiling of nine nonferrous metals:

- Immediate stockpiling of copper, nickel, chromium, and tungsten;
- Stockpiling held desirable but not currently appropriate for zinc, cobalt, and molybdenum; and
- Supplies considered stable but in need of continuing observation for tin and antimony.

The stockpiling program will be carried out by a private corporation financed by Government-guaranteed funds and partially subsidized by the Government. The corporation—Japan Metal Mining Public Corporation-controlled by MITI is supervising the issuance of bonds.

"Scrap Steel Stockpiling" was created in 1975 by MITI with the formation of a nonprofit foundation composed of steel manufacturers, scrap wholesalers, and scrap collectors. It will stockpile steel to stabilize domestic prices of scrap and to encourage recycling of steel. In addition to this, a special recycling association was created to promote utilization of iron resources, It will generate loans for new equipment and develop new technology for utilization of scrap.

2. France

In 1972, the French Government decided to establish a natural stockpile of critical materials to meet economic rather than strategic supply crises. The French economic stockpile has four purposes:

- Serve political and economic defense needs,
- Reduce the excessive vulnerability of certain processing industries,
- Allow France to participate in international agreements to stabilize prices of raw materials, and
- Provide a basis for regulating prices of materials.

The stockpile management is under the "Groupment d'Importation et de Repartition des Meteoux" (GIRM). GIRM specifically will assist French mining companies beyond their traditional efforts in French Africa and oversea territories. It will help French companies extend endeavors into developed countries with mineral resources such as Canada and Australia and oil-rich countries such as Iran, Indonesia, Zaire, Yugoslavia, and Brazil.

The economic stockpile will contain 2 months' average input supply of each category of materials. One hundred million francs (approximately $23 million) were provided for 1975. Appropriations are expected to double in 1976 and remain there for the level build up of 3 to 4 years.

3. Sweden

The Swedish inventory management system provides incentives to private industry to maintain stockpiles. This is done through taxation of corporate income in three areas:

- Inventory valuation,
- Depreciation, and
- Reserves for future investment.

In reality these will not create a national stockpile but rather a healthy industry with inventories large enough to meet emergency situations.

4. European Common Market (EEC)

The Common Market Study currently underway is oriented toward a policy/ management system. The policy objectives include the growth and stabilization of the economics of less-developed countries now dependent on revenue from exports of particular materials.

To support these objectives, the EEC nations would enter long-term agreements for purchase of such materials and agree upon prices. This would presumably work independently of the world market prices being either higher or lower. West Germany is very concerned about any EEC program which could interfere with the operation of the free enterprise system.

The EEC study consideration is an alternative to economic stockpiling. A big question is how it could work without affecting world market prices and/or other nations.

5. Other Countries

The United Kingdom is also creating an economic stockpile, and unconfirmed reports indicate that this is the case in several other countries, including Brazil. Of considerable importance is the question of how various national economic stockpiles will relate to one another, and of their tremendous potential for abuse and use beyond the intended policy objectives.

Chapter III

SPECIFIC PURPOSES OF ECONOMIC STOCKPILING

Chapter III

SPECIFIC PURPOSES OF ECONOMIC STOCKPILING

This chapter is a discussion of the overall operation of an economic stockpile and the rationale used in selecting specific policies and materials for detailed assessment. The following information is presented:

- Conceptual logic of economic stockpiling;
- Development of economic stockpiling policies for initial consideration;
- Interviews with U.S. business, labor, government, and civic action groups;
- Classification of stockpiling policies for detailed analysis; and
- Decision Criteria—a model for developing and implementing economic stockpiling.

A. CONCEPTUAL LOGIC OF ECONOMIC STOCKPILING

From the point of view of economic policy, any materials stockpile involves three basic considerations: first, the possible national purposes which the stockpile might achieve; second, the economic trends and cycles anticipated during the overall stockpiling operation of buying, holding, and selling to achieve the policy objective; and third, the types of benefits and costs which accrue to the country in general as a result of stockpiling.

1. Possible Functions of an Economic Stockpile

A stockpile is an inventory of supplies whether maintained by private individuals and business enterprises or by the Federal Government. Inventories maintained for private purposes are held for convenience, for continuity of supply under a variety of conditions of supply disruptions, for anticipation of price increases, and for several other reasons. Stockpiles maintained by the Federal Government can also serve a variety of purposes, as the following list indicates:

- Provide source of supply for short-term national shortages,
- Deter monopolistic control of supply,
- Stabilize supply/demand through buffer stock, and
- Provide support to price support programs,

a. Provide Source of Supply for Short-Term National Short ages.—National stockpiles have been established to provide the supply of critical materials for use during wartime and other national emergencies. Stockpiles established under the Strategic Stockpile Act of 1946 still exist, but are limited to use during wartime emergency conditions.

Economic stockpiles can serve similar roles in providing continuity of supply for foreign source materials; for other emergency disruptions of supply such as natural disasters, prolonged labor strikes in the source country, or transportation bottlenecks; and for embargoes as in the recent petroleum restriction by the OPEC countries.

Inventories are customarily maintained by the private sector to provide continuity of supply between orders and are based on cost considerations which could include potential disruptions. However, industrial and commercial users may not individually account for remote possibilities or may not have information to adequately guard against the possibilities. The function of a national economic stockpile would be to serve as insurance against remote, but disastrous occurrences, and the stock would supplement the protection customarily maintained by the private sector.

b. Deter Monopolistic Control of Supply.—Where material producers might form cartels to impose monopolistic pricing and where the United States is a major consumer, the existence of an adequate stockpile could provide the competitive source to restrain monopolistic control. This stockpile would be most effective where the producer countries' economics are highly dependent upon the production of the material, as the economies may not be able to sustain reduced production while attempting to organize and impose monopolistic controls. Many of the source countries in which cartelization is possible are developing countries whose economies are dependent upon their mineral resources. Thus, where cartelization is a significant threat, the formation of a U.S. economic stockpile could serve as an effective counterthreat. The size of the economic stockpile would be an important element in the effectiveness of this stockpile function, as the stockpile must exceed the committed resources of the potential cartel.

c. Stabilize Supply or Demand Through Buffer Stock.—Many raw materials are subject to wide variations in demand which are nonseasonal, resulting in wide variations in both prices and production of raw material. These variations in production disrupt revenues and employment and can create major social hardships, if not inefficiencies in production, due to idle capacities during low production periods and use of inefficient facilities and equipment during periods of peak production. Wide variations in prices and availabilities of raw materials also create inefficiencies in the consuming industries for similar reasons. A national economic stockpile could serve as a buffer stock to cushion these impacts by absorbing some of the production during periods of low demand and dispensing stocks during times of unusually high demand, Such use of the stockpile could help stabilize production and material availability, and result in more efficient resources utilization for both the producers and the consumers. For internationally traded commodities, a stockpile serving this function in the principal consuming and producing countries could result in a more equitable distribution of stockpile resources and could probably result in more effective moderation of price and production variations.

More specialized versions of this buffer stock function can be served by a stockpile which is designed to accommodate special needs. For example, a "stockpile" for recycled materials generated by municipal waste management programs could provide a constant market so that municipal waste recycling programs would not be subject to widely fluctuating revenues. The purpose of this "'stockpile" would not be to influence market prices for scrap material, but rather to stabilize the revenue for public interest ventures,

d. Provide Support to Price Support Programs.—Government price-support programs to encourage marginal and submarginal producers of critical materials can result in stockpiling if the program involves outright purchase by the Government. There are many reasons why the Government might provide support to marginal and submarginal producers: maintain minimal domestic production, support the development of new technology such as the production of synthetic fuel, achieve welfare purposes such as maintaining employment levels in economically depressed areas. Government purchases leading to a stockpile may have certain advantages over direct production subsidies, depending upon the particular circumstances. A stockpile generated through a price-support program can be used for any of the functions served by a stockpile created from direct market purchases of commodities of equivalent specification,

2. Economic Trends and Cycles of Stockpiling

Any stockpiling operation has three phases: (1) buying, or otherwise acquiring, commodities; (2) holding these commodities; and (3) selling or threatening to sell these commodities to achieve some benefit.[1] Because holding costs may continue throughout all three of these phases in the operation of a stockpile, the decision to continue holding stocks, or to buy or sell, must be periodically reviewed in terms of an assumed future time of operation, and the net benefits (i. e., benefits minus costs, which may be either positive or negative) must be estimated by assuming a particular economic scenario.

Within these operational phases, it is useful to consider stockpiling in terms of the factors of anticipated economic conditions during a cycle of use, and the purpose of stockpiling under these conditions. Over the anticipated lifetime of a stockpile, the policy can be designed in anticipation of (1) fluctuating commodity prices superimposed on a long-time, constant average price; (2) a general trend toward increasing prices; or (3) a general trend toward decreasing prices. For each of these conditions, a stockpile might conceivably be designed either to minimize the deviation from a constant price or accept the deviations and attempt to use them to benefit some segment of producers or consumers. Five types of economic stockpiles for these conditions are discussed as follows:

a. Stockpile: Type 1.—A stockpile designed to minimize the extent of these fluctuations is the case usually considered in discussions of economic stockpiling. Such fluctuations include the situation in which a cartel is formed to raise the price of a mineral product—not only to the price of potential production from alternate, undeveloped sources, but above this price in the expectation that the high price can be maintained until the alternate sources are brought into production and the latter can then be slightly undercut. A stockpile could provide a deterrent to this action by forcing the cartel to sustain a loss of sales until the stockpile is exhausted, Using a stockpile to deter market fluctuation is the most commonly considered example; however, cartels are not the only cause of relatively sudden changes in commodity prices. Other causes and the resulting stockpile possibilities can be considered as well.

b. Stockpile: Type 2.—In contrast to Type 1, this stockpile could involve accepting the fluctuation price for the general market but providing a stockpile to shelter a particular group of producers or consumers from the full extent of fluctuations. For example, scrap prices may undergo wide variations. A recycling facility for urban waste which depends on the sale of scrap at near-average prices for economic feasibility y might be greatly benefited by a stockpile which bought only the recycled output during times of low prices and sold scrap during times of high price. This stockpile would be intended not to reduce price fluctuations, but to minimize adverse loss (or even extract net benefit) for a particular industry in the public interest. Such a stockpile would require much less investment than one which would require a sufficient volume of stocks to affect market prices.

c. Stockpile: Type 3.—A generally rising price might eventually bring presently marginal sources into production. It may

[1] See chs. IV and V for a discussion of how the conceptual logic of economic stockpiling provides the framework for the economic impact a nalys is,

therefore be in the public interest to hasten production from such sources through a third type of stockpile—a publicly supported stockpile which purchases only from such marginal sources. For example, oil prices seem likely to rise as world supplies are slowly exhausted. The desirability of a U.S. oil stockpile to discourage another oil embargo is therefore being implemented, Purchasing oil for this stockpile on the open market may tend to increase the already high prices. If instead, the stockpile were slowly built up by purchasing only U.S. made synthetic oil, double purposes would be served of creating a synthetic fuel and of deterring cartel actions. The alternative of direct subsidy for the synthetic-fuel industry and direct purchase of petroleum for the stockpile may be preferable, but the policy of stockpiling synthetic oil needs to be examined. If carried out successfully, it might actually reduce the rate of price increase through the development of a synthetic-fuel industry,

d. Stockpile: Type 4.—This stockpile offers the potential for making money by holding commodities in anticipation of higher prices. There may be reason to take measures, including stockpiling of selected materials or commodities, for which one may be able to anticipate a future technology and use or demand that may be difficult or inefficient to fulfill in the future in the absence of present preparation, Stockpiling in the present to meet a future use or demand may be compared with saving or, more importantly, if it stimulates technology and the economy, with investment, A federally-supported stockpile for this purpose would be in competition with private speculators and would achieve any profits at the expense of producers and consumers. This type of stockpile does not appear likely to be in the public interest on first examination,

e. Stockpile: Type 5.—A fifth type of stockpile could sustain otherwise declining prices for a while through massive purchases but would eventually suffer heavy losses. Like type 4, this stockpile was not considered further because it does not appear to offer any net benefits.

3. Types of Benefits and Costs Involved in Economic Stockpiling

There are four types of benefits and costs involved in the life-cycle operation of an economic stockpile, These include:

- The direct benefits and costs to materials producers,
- The direct benefits and costs to materials consumers,
- The benefits and costs borne by the stockpile investor, and
- The external benefits and costs to the economy in general.

The first two types of benefits and costs cited above are directly related to the two general interest groups impacted by economic stockpiling: materials producers and materials consumers. To assess the real impact of a public policy on economic stockpiling, one must identify the relative benefits and costs which accrue to each of these interest groups as a result of stockpiling. Other parties which are impacted must also be considered, but an analysis can begin with these two directly impacted groups. In special situations, an economic stockpile might benefit only one party and produce a cost (loss) to the other party. Even so, however, stockpiling might still be considered in the national interest if the benefits are large, or if political considerations override economic costs.

The two parties concerned with stockpiling a particular commodity can be further divided into three categories, depending on whether the impacted party is predominantly domestic, foreign, or mixed to a significant extent, In considering benefits and losses expected to accrue to the United States from a particular stockpiling policy, this distinction is important, Benefits or costs to parties outside the United States may be omitted from an estimate of the benefits to the United States, but should still be considered as an aspect of foreign policy.

In addition to the parties directly impacted, an economic stockpile will also have indirect economic impacts upon the stockpile investor and create external benefits or costs to the economy in general. The investor might be the Federal Government which would be responsible for allocating the funds required to initiate and operate the stockpile. External costs or benefits would not be to direct consumers of the commodity, but to consumers of products made from the commodity. These indirect impacts on the general economy must be addressed separately from the gains or losses of the principal interest groups so that the relative economic impacts of a materials stockpile can be determined.

4. Rationale for Federal Government Support of Economic Stockpiling

The justification for strategic stockpiles to provide materials critical to national survival during wartime is evident. Under less critical conditions, the question of whether the public interest will be served by an economic stockpile must be carefully assessed. The private-sector producers and consumers maintain their own inventory to serve their particular needs. Since continuity of their own operations is a major motivation for their stockpiling practices, self-interest compels their action to include consideration of the functions which a Government economic stockpile might serve. Clearly, however, the adequacy of the protection provided will depend upon the perceived threats, availability of capital and allocation to competitive uses, and the management attitudes and policies concerning risks.

There are a number of reasons why private inventories will not be adequate. Industrial and commercial inventories are generally based on “normal” uncertainties arising from past experiences, while potential supply disruptions due to politically motivated embargoes, natural disasters, and other reasons for which a national stockpile might be maintained are long-shot risks and are highly erratic occurrences, Even if industrial managers do foresee possible supply disruptions due to these occurrences, their assessment of the risks may be inaccurate with respect to the timing or the magnitude. Furthermore, and perhaps most important, private investments do not account for the secondary costs or negative externalities arising from a shortage—possible unemployment in both the consuming industry and their customers, as well as the impact of higher prices on the material and its products. A further consideration includes the fact that, even though some private inventories may be adequate to accommodate the disruptions, the smaller firms and the marginal firms may be severely handicapped.

It is unlikely that private inventories. however conscious of potential cartelization of the material supply, will be adequate to deter the formation of cartels and their consequent monopolistic controls for most materials. Private resources and efforts for combating cartelization are unlikely to be successful without the support of the Federal Government. Should the threat of monopolistic control be great enough, there appears to be justification for considering a national economic stockpile as one means of deterring such possibilities. This point of view is supported by the overwhelming approval given to an economic stockpile for insuring materials supply by industry representatives interviewed for this assessment.

The justification of Federal Government maintenance of buffer stocks to stabilize material supply and demand is much more controversial and depends upon the extent and nature of governmental involvement. The case for governmental involvement depends upon whether or not it can be demonstrated that the Government can impartially and equitably moderate market forces without impairing the American market mechanisms and whether the achievable stabilization is worth the costs of the Government enterprise. Buffer stocks maintained in support of international commodity agreements constitute a form of Government involvement which may be beneficial. Also, the justification for a specialized stockpile—like that, for example, in support of a waste material recycle program where the intent is to assist municipal governments without attempting to influence the general market—is a worthwhile consideration.

The justification for an economic stockpile developed as an integral part of price-support programs will depend upon the feasibility of the price-support program and upon the function to be served by the stockpile.

5. Total **Net Benefits of Economic Stockpiling**

The task of this assessment is to ascertain whether or not an economic stockpile will yield total net benefits to society. The total net benefits to society of an economic stockpile can be determined as a function of separate economic, political, and social, net benefits. If these separate benefits could be quantified in dollars, the total net benefits to society could then be determined. However, this is not easily accomplished, since only the economic net benefits (in dollars) can be fully determined using quantitative methods, and even these conta in qualitative variables. The remaining political and social benefits can only be determined using qualitative methods. For a further analysis of these benefits see chapters IV and V.

B. DEVELOPMENT OF ECONOMIC STOCKPILING POLICIES FOR INITIAL CONSIDERATION

The socio-politico-economic system in which the materials production and distribution activities exist is a complex mechanism which is difficult to understand. Often good solutions to problems turn out to be poor ones in the light of broader overviews, and attempts to institute controls in one sector can produce unwanted impacts in other sectors because of unknown and unanticipated relationships among the system elements. Because critical materials, almost by definition, have many trails into the economic system, investigation of problems for which stockpiling might be a suitable option requires a systematic, problem-oriented analysis. In general, this means embedding the problem within the largest tractable network of influences, constraints, and controls; consideration of all reasonable alternatives; and careful assessment of the impacts of potential actions under clearly defined criteria.

1. **National Policy Objectives**

It is especially important to select for analysis stockpiling policies which can be related to a set of higher national objectives, such as those listed below from the National Commission on Materials Policy:

- Provide adequate energy and materials supplies to satisfy not only the basic needs of nutrition, shelter, and health, but a dynamic economy, without indulgence in waste;
- Rely on market forces as a prime determinant of the mix of imports and domestic production in the field of materials but at the same time decrease and prevent wherever necessary a dangerous and costly dependence on imports;
- Accomplish the foregoing objectives while protecting or enhancing the environment in which we live;
- Conserve our natural resources and environment by treating waste materials as resources and returning them either to use or, in a harmless condition, to the eco-system; and
- Institute coordinated resource policy planning which recognizes the inter-

relationships among materials, energy, and the environment. z

The identification of such national policies, however directly or indirectly stated, should be considered in order to assess, first, whether or not a set of stockpiling policies is sufficiently comprehensive to address today's materials problems, and second, to allow identification of alternatives to stockpiling in relation to a higher level policy objective.

For practical purposes, this assessment considered the multitude of various impacts and issues surrounding each stockpiling policy as separate and independent from the complexities of any other policy. It is possible, however, that several policies could be implemented simultaneously. This suggests that stockpiling policies can be considered in terms of their interrelationships. The simultaneous operation of two or more stockpiling policies would not necessarily add further difficulty, since there may be a great degree of commonality between them. One stockpiling policy may, for example, achieve objectives similar to those of other policies, or two different policies may require the same materials.

2. Eleven Stockpiling Policies (SP) Studied

The various functions which might be served by economic stockpiling can be further specified to achieve particular policy objectives. Eleven such purposes have been identified and are defined below.

a. Discourage or Counteract Cartel or Unilateral Political Actions Affecting Price or Supply .—This stockpiling policy would be directed to a foreign country or combination of countries with the power to affect the price and supply of materials to the United States. The recent multiplying of prices by the oil cartel is an example of the type of situation to which this stockpiling policy could be directed. Recent actions on bauxite, copper, and iron ore are other examples of such concerns.

b. Cushion the Impact of Nonpolitical Import Disruption.—This stockpiling policy would support the maintenance of operations which depend on foreign source materials. Disruption of imports could result from strikes, shipping problems, disasters, business actions, or any number of nonpolitical events which could not be overcome by the adjustment of prices.

c. Assist in International Materials Market Stabilization.—This stockpiling policy is designed to help stabilize world prices. Since many prices are more volatile abroad than in the United States and have a secondary effect on U.S. prices, it would be advisable to counteract such wide price movements when they first gain impetus. This could include stockpiling in cooperation with other nations or international organizations.

d. Conserve Scarce Domestic Materials.—This stockpiling policy would discourage current consumption of a scarce material by raising the price of the material through stockpile purchases. This policy is worth considering only if a scarce material is thought to have a greater social value in the future.

e. Provide a Market for Temporary Surpluses and Ease Temporary Shortages.—This stockpiling policy would reduce the undesirable economic and societal consequences of temporary surpluses or shortages of selected materials. Dampening wide swings in prices, reducing or eliminating the shortage/surplus caused by unemployment stoppages, and reducing the necessity for increased capital outlays are possible benefits from implementation.

f. Support Domestic Production of Selected Foreign Source Materials.—This stockpiling policy would provide a market to encourage domestic production of materials not competitive with foreign sources regardless of price. It could also be used to decrease and prevent, whenever possible, a dangerous

[2] NCMP, *Material Needs and the Environment*. The National Commission on Materials Policy, June 1973.

and costly dependence of the United States upon foreign nations for supplies of these materials in times of national emergency. Purchases in the 1950's of chrome, manganese, and tungsten are examples of maintaining or encouraging domestic production of foreign source material.

g. Support Friendly Nations in the Event of Temporary Materials Shortages in Those Countries.—This stockpiling policy would supply friendly nations in the event of materials shortages.

h. Increase and/or Maintain Foreign Country Production of Materials.—This stockpiling policy would maintain the flow of materials from foreign countries, espe cially during depressed economic times when purchases by U.S. industry might be m inimal or even cut off completely,

i. Commodity Trading Between the United States and Foreign Countries.—This stockpiling policy would implement barter arrangements between the United States and foreign countries. Barter arrangements could include the trading of perishable commodities, usually expensive to store, for nonperishable industrial materials, An example of this was the United States' trading of wheat to India for manganese. An attempt might also be made to obtain a quid pro quo in terms of needed materials for military or economic aid to foreign countries. A possibility might be the exchange of wheat for chromite ore or petroleum from the U.S.S.R.

j. Advance New Technology for Materials Supply.—This stockpiling policy would provide an assured market to stimulate the private development of new technology for materials production which might otherwise lie dormant for lack of urgency or financial support, The purchase of titanium sponge in recent times is a prime example, Purchase contracts utilizing such technologies could provide materials for the stockpile without interfering with industrial demands for raw materials, enhance domestic capacity for continued production, and reduce dependency on foreign sources of supply.

k. Encourage Recycling.—This stockpiling policy would support the domestic recycling of selected materials by providing a temporary market pending the development of a continuous market based on new technology or improved economics.

C. INTERVIEWS WITH U.S. BUSINESS, LABOR, GOVERNMENT, AND CIVIC ACTION GROUPS

Selected interviews were conducted with individuals in American business, labor, government, and civic action agencies. The objectives of the interviews were twofold: (1) to ascertain the views of people with materials expertise regarding the feasibility of the 11 stockpiling policies and the criteria by which one decides what materials should be included in an economic stockpile; and (2) to obtain information relative to the impacts and issues which bear directly upon implementing one or more of the stockpiling policies. The findings of the interviews are grouped below in seven categories.

(1) Use of an economic stockpile by the Government to support prices or ease price pressure is considered risk laden, susceptible to powerful political pressure, and likely to cause substantial disruption in domestic and international markets, s

(2) There is general support among the interviewees of the policies which deal with cartels and nonpolitical import disruptions,

[3] This includes the political actions affecting price included in the first stockpiling policy to deter or counteract cartels.

although some individuals did express reservations about price elements. There were also reservations with regard to the SP's which directly imply market and price intervention. Where it existed, the intensity of feeling expressed in opposition to other SP's was much less than it was toward price-directed Government actions, As a matter of fact, reservations made to policy objectives other than price manipulation tend to be less philosophic and more pragmatic, with reservations frequently based upon the contention that an economic stockpiling program is not the best method of attaining stated policy objective.

(3) In only three cases out of 18 was the concept of an economic stockpile rejected categorically as unsuitable for any of the 11 policy objectives. In two other cases, acceptance was limited and hedged. In each of the remaining 13 interviews, there was complete acceptance of an economic stockpiling program as a feasible means for achieving one or more of the 11 policy objectives.

(4) Except for those interviewed who expressed a fundamental philosophical objection to economic stockpiling, a stockpile to lessen the impact of a supply interruption (whether politically inspired or not) received wide support. To those who have been heavily involved in stockpiling problems over a period of years, the foregoing conclusions are significant. If the same people had been queried prior to the" OPEC oil embargo in the fall of 1973, the maximum number of affirmative responses might not have exceeded two, and might well have been zero instead of 13.

(5) The interviews make it quite clear that over the past 2 years a radical change has occurred in the way informed people think about economic stockpiling. Now only a small number oppose the concept on philosophical grounds. While the use of a stockpiling program to manipulate prices has virtually no support, expressions regarding the remaining policies are mixed. Much of the negative response reflects a belief that some alternative approaches (e.g., Government loans or loan guarantees, direct subsidies, tax incentives, and the like) represent a more direct and effective way to achieve the objective of the stockpiling policy.

With respect to the feasibility of an economic stockpile, the implication of the interviews is self-evident. The creation of a stockpile to reduce the impact of supply interruption would tend to be well received by virtually all segments of our economic structure and social institutions. This presumes, of course, a high degree of dependence on a material critical to U.S. economic welfare for which a supply interruption, whether for political or nonpolitical reasons, is a significant possibility. Conversely, creation of a stockpile to manage prices is likely to face an opposite reception. For the remaining policies, reception would be mixed, depending in the final analysis upon a comparison with alternative means to achieving the same objective.

(6) A final word with respect to the interviews should be mentioned. Everyone addressing the subject stressed the degree of import dependence as a factor of domestic supply and availability. Consequently, it is clear that the greater the dependence, the greater the impact of a supply interruption and the more serious the economic injury to the Nation.

On the other hand, the actual distribution of a given shortage between the household/commercial sector and the industrial sectors can have a profound effect on the severity of the economic impact of a supply interruption. This raises two questions: (1) Is it possible to effect a degree of redistribution? and (2) Does the Government have the authority and the means to effect the distribution?

Both points were well illustrated in the 1973–74 OPEC oil embargo. It was possible to alter the distribution between the household/commercial sector and the industrial sectors; the Government had the authority to do so and an agency was available to do it. Through the oil allocation program, a disproportionate share of the shortage was distributed among the final consumers. Reduced gasoline supply resulted in long lines at service stations, some increase in carpooling, some increased use of public transportation, some decrease in pleasure driving, and a substantial rise in public indignation. The economic effects of the OPEC embargo were discernible in reduced sales of large cars, lower demand for motel rooms, curtailed markets for recreational vehicles, and similar economic activities associated with automotive travel. While those effects may not be negligible and were especially severe to the businesses directly involved, they represent but a fraction of the economic injury which could have been anticipated if a greater share of the shortage had to be borne by the petrochemical industry, or any other industry for which the (energy) input-output ratio is relatively rigid, at least in the short term.

At any rate, it is clear that in some cases the degree-of-dependence rule has to be modified to reflect the responsibility of reducing adverse economic effects by Government allocation actions, This would contemplate a tradeoff between reduced unemployment and loss in GNP, on the one hand, and public indignation and/or rationing at the consumer level, on the other,

(7) Great concern was expressed in the interviews about the possible political use of an economic stockpile and the need to insulate the management of an economic stockpile from political pressure.

D. CLASSIFICATION OF STOCKPILING POLICIES FOR DETAILED ANALYSIS

The 11 stockpiling policies developed above were analyzed further to determine which ones should be treated in depth. While some degree of judgment is inherent in such a procedure, the technological and economic information background does exist and permitted a reasoned choice without undertaking a lengthy analysis of alternatives.

1. Problem Origin, Function, and Principal Impact Mode of Eleven Policies

Based upon the problem origin, function, and principal impact mode, the 11 policies defined earlier were organized in five categories, One stockpiling policy judged most important from each of the categories was selected for detailed analysis, Those policies, which are marked with an asterisk, have been numbered SP 1–5 and given an abbreviated title for easy reference,

a. Foreign—Cartel Response

* SP–1: Discourage or Counteract Cartel or Unilateral Political Actions Affecting Price or Supply (Political Disruptions).

b. Foreign—Nonpolitical Interruption

* SP–2: Cushion the impact of Nonpolitical Import Disruptions (Nonpolitical Disruptions).

c. Foreign-General

* SP–3: Assist in International Materials Market Stabilization (International Market),

Support Friendly Nations in the Event of Temporary Materials Shortages in Those Countries.

Increase and/or Maintain Foreign Country Production of Materials,

Commodity Trading Between the United States and Foreign Countries.

d. Domestic—Supply Oriented

* SP–4: Conserve Scarce Domestic Materials by Reducing Current Consumption (Conservation).

Support Domestic Production of

Selected Foreign Source Materials.

Advance New Technology for Materials Supply.

Encourage Recycling.

e. Domestic–Price Oriented

* SP–5: Provide a Market for Temporary Surpluses and Ease Temporary Shortages (Domestic Market).

2. Five Stockpiling Policies Selected for Detailed Analysis

The five selected policies can be considered in two main categories: (1) those dealing with problems of foreign origin, and (2) those dealing with domestic situations which might aggravate problems of foreign origin,

a. Category 1.—Stockpiling options in this category have three purposes: (1) discourage or counteract cartels; (2) insure temporary supply to U.S. consumers during nonpolitical, foreign supply interruptions; and (3) assist in international materials market stabilization. An additional, secondary stockpiling function associated with the third option would be to assist other countries by providing supply during temporary shortages, by maintaining foreign production during temporary surpluses, or by using stocks in commodity trading.

b. Category 2.—Stockpiling options in this category include (1) conserving scarce domestic materials, and (2) reducing domestic price variations through transactions only with domestic producer and producers. Additional functions which could be associated with the first option are stockpiling to support substantially uneconomic domestic sources of imported materials at a minimal level to provide standby capacity, to provide a market for promising new production technologies during early development, and to develop or stabilize the market for production from a recycling center.

Table III–1 is a conceptual display of how the policies in these two categories might be used over the lifetime of an economic stockpile.

Em DECISION CRITERIA—A MODEL FOR DEVELOPING AND IMPLEMENTING ECONOMIC STOCKPILING POLICY

A fundamental proposition of this assessment is that the materials to be stockpiled must be directly related to the problem which the stockpiling policy is designed to alleviate. It is also clear that the materials will vary from one stockpile to another, both in number and in kind. For example, relatively few materials of certain types may be needed for a stockpile designed to overcome cartel actions which are limited in potential scope. On the other hand, a considerably larger number of materials of various kinds may be required for a stockpile aimed at compensating for temporary surpluses and temporary shortages in the economy as a whole.

Since there is no direct U.S. experience with stockpiling to achieve economic goals, there is a need to consider the entire decision making process related to developing, implementing, and operating an economic stockpile. The decisionmaking model developed in the assessment (hereafter termed “Decision Criteria Model”) provides guidelines for determining, first, whether or not to stockpile for economic reasons and, second, how to determine the optimal quantity of materials to acquire and disperse from the stockpile once it is established.

1. Components of the Decision Criteria Model

The Decision Criteria Model is composed of four components: (1) Materials Selection Criteria, (2) Economic Welfare Model, (3) Specification of Functional Nature of

77-119 0 -76-5

Table 111–1.—Matrix of stockpiling policies and possible operational actions

"Stockpilig Policies	Operational actions		
	Acquisition	Holding	Disposal
SP–1: Discourage or Counteract Cartel or Unilateral Political Actions Affecting Price or Supply.	Buy primarily from foreign sources, preferably in periods of excess supply; or transfer from strategic/critical stockpile if available; or barter for surplus agricultural products.	For purposes of discouraging actions, hold indefinitely.	Sell or threaten to sell when supply restriction or price increase action occurs or appears imminent,
SP–2: Cushion the Impact of Nonpolitical Import Disruptions.	Buy from domestic and foreign sources or transfer from strategic/critical stockpile if available; or barter for surplus agricultural products	Hold until emergency conditions occur.	Sell to overcome temporary shortage conditions, for current use or addition to depleted industry inventory,
SP–3: Assist in International Materials Market Stabilization.	Buy from domestic or foreign producers in periods of low world demand.	Hold during period of normal world demand, until shortages develop.	Sell to domestic or foreign consumers during periods of high world demand.
SP–4: Conserve Scarce Materials by Reducing Current Consumption.	Buy from domestic sources even when no excess supply exists; to raise prices in order to discourage consumption and possibly to encourage domestic output from low-grade resources.	Hold until disposal is appropriate as shown.	Sell when future social value exceeds current value.
SP-5: Provide a Market for Temporary Surpluses and Ease Temporary Shortages,	Buy from domestic producers in periods of low domestic demand.	Hold during period of normal domestic demand, until shortages develop,	Sell to domestic consumers in periods of high domestic demand,

Stockpile, and (4) Operating Cost Model. The Materials Selection Criteria, which are developed and explained in this chapter, are basic considerations or guidelines to use in identifying the materials most directly related to the supply or price problem which the stockpiling policy is designed to alleviate. The Economic Welfare Model is a set of econometric equations which are based on the theory of welfare economics and which can be used to determine the benefits and costs to the United States of implementing an economic stockpile. The Functional Specification is a set of guidelines which can be followed in determining such factors as stockpile location and storage, the form of the materials, and the time factors implicit in stockpiling decisions. Finally, the Operating Cost Model is a means of quantitatively estimating the direct, out-of-pocket costs to the U.S. Government of operating an economic stockpile. The Materials Selection Criteria are developed and explained immediately below; the Economic Welfare Model, in chapters IV and V; and the Functional Specification and the Operating Cost Model, in chapter VI.

2. Materials Selection Criteria

The selection of materials for each stockpiling policy involves a series of criteria directly related to the particular policy under consideration. Some of these criteria are common to more than one policy. In fact, one criterion may be considered as common to all policies, i.e., the consideration as to whether the material is significant to the U.S. economy as a whole or technologically significant in the manufacture of components important to the U.S. economy. Petroleum and iron ore could qualify for the former, while platinum used in antipollution control devices in automobiles could qualify for the latter. It is apparent that definitions of "significant," "important," and the other terms mentioned will be needed, preferably in quantitative terms to the extent possible. This would be a proper function for the agency involved in stockpiling and would require a considerable amount of statistical computations and measurements. For the present assessment, selections were based on judgmental decisions by a limited group of persons knowledgeable in the materials field. These selections will therefore be illustrative rather than definitive.

Having determined that a material meets the first criterion applicable to each of the policies, one must then consider whether or not it also meets other criteria related to the policy under review. These Materials Selection Criteria are listed below, with brief descriptions of how each one is applicable to the five stockpiling policies considered in detail,

a. SP–1: Discourage or Counteract Cartel or Unilateral Political Actions Affecting Price or Supply.

(1) Economic or technological significance: Materials of economic significance are those which are basic to manufacturing, construction, and ancillary industries, and without which these industries would be unable to operate. Petroleum and iron ore are examples. Materials of technological significance are those possessing specific inherent qualities or properties (often unique) which are critical to insure the functioning of industrial operations or technological processes. Platinum used in antipollution control devices in automobiles is an example.

(2) High degree of import dependence: This criterion need not refer to total or almost total dependence on imports. For petroleum, for example, the 30- to 40-percent import dependence is high enough to create supply and price concern. On the other hand, setting the degree of dependence too low would tend to blanket in an inordinate number of materials. The potential for substitution should be taken into account in measuring import dependence, but this becomes a difficult problem from at least two standpoints: the extent to which substitute materials can meet the performance standards of the original material, and the new intermaterial supply effects resulting from the substitution.

(3) High potential for political control of supply and price: This is the basic screening criterion for this stockpile, Materials with little or no potential for cartel or unilateral actions could be excluded from consideration at the time the stockpile is established, regardless of the other two elements described above. However, since the creation and effectiveness of cartels are subject to change, a continuing review of developments would be essential.

b. SP–2: Cushion the Impact of Nonpolitical Import Disruptions.

(1) Economic or technological significance: Same as (1) under a, above.

(2) High degree of import dependence: Same as (2) under a, above.

(3) High degree of concentration of supply: This is the basic screening criterion for this stockpile. The total uncertainty of physical disasters, such as earthquakes, fires, explosions, and shipwrecks, could make every material vulnerable to nonpolitical import disruptions. Strikes either at producing installations or on shipping or distribution lines may be partially anticipated and must be monitored continually where periodic labor negotiations are involved, although wildcat strikes are wholly unpredictable. In any event, the seriousness of disruptions would follow from the degree to which supply is concentrated

geographically, through industrial combinations, or because of labor union relationships,

c. SP–3: Assist in International Materials Market Stabilization.

(I) Economic or technological significance: Same as (I) under a, above.

(2) High degree of international trade: International materials market stabilization involves those commodities in which international trade is a significant enough factor to influence stability in foreign markets and therefore in U.S. domestic markets.

(3) Significant volatility of international prices: Significant price volatility of commodities which are traded on an international basis often show wide degrees of fluctuation over short periods of time. As in the case of domestic price volatility, the degree and frequency of fluctuation provide indications of the extent to which stability is needed. These variations can be measured in import and export values or in such markets as the London Metal Exchange, in terms of departures from average price levels in a base period or of spreads between high and low prices over time.

d. **SP–4:** Conserve Scarce Domestic Materials.

(1) Economic or technological significance: Same as (1) under a, above.

(2) High degree of import dependence: Same as (2) under a, above.

(3) Significant lack of domestic availability: This is the basic screening criterion for this stockpile. The relative unavailability of domestic resources from which production can be pursued without recourse to governmental assistance will determine the extent to which a stockpile is necessary to achieve the policy objective set forth. The elements to be considered include the quality of the resources, present and future, their accessibility, and the potential for technological breakthroughs.

e. SP–5: Provide a Market for Temporary Surpluses and Ease Temporary Shortages.

(1) Economic or technological significance: Same as (1) under a, above.

(2) Significant volatility of domestic prices: Since domestic price stability is the basic objective of this stockpile, estimates of price volatility as a measure of instability provide indications of the extent to which stability needs to be achieved. Price volatility as a reflection of supply/demand relationships during various phases of the business cycle could be measured, for example, in terms of variations from average price levels or of spreads between high and low prices for each material,

(3) Wide fluctuations in domestic demand/supply: This criterion supplements the price volatility measurements under (2). It could help delineate the extent to which supply surpluses or shortages are responsible for price variations and thus help determine those materials in which governmental intervention in the market place is likely to be most effective.

3. Modified Delphi Technique Used To Identify Problem-Related Materials

For the present assessment, materials have been selected based upon the judgments of a small group of people knowledgeable in the materials field. The primary goal “of these experts was to identify those materials which are directly related to the national problems which the stockpiling policies are designed to alleviate, In this way, a list of Problem-Related Materials was constructed: first, as a means of testing the economic and noneconomic impacts of implementing a stockpile to achieve economic purposes; and second, as illustrations of classes of materials which should be analyzed in more depth by the agency responsible for economic stockpiling. For these reasons, the materials selected in the assessment should be considered illustrative, rather than exhaustive, The starting point for the materials experts in selecting materials for each of the five stockpiling policies was the list of materials from Material Needs and the Environment (table 111–2). From this list, which is not intended to be a comprehensive catalog of all materials,

Table III–2.—Classifications of materials

MINERALS

Iron and Ferroalloy Ores

Iron	Cobalt
Manganese	Molybdenum
Tungsten	Nickel
Chromium	

Other Metal Ores

Gold	Antimony
Silver	Cadmium
Copper	Magnesium
Lead	Platinum-group metals
Zinc	Selenium
Bauxite	Tellurium
Titanium	Tin
Uranium-radium-vanadium	

Mineral Fuels

Anthracite	Natural gas
Bituminous coal and lignite	Natural gasoline
Crude petroleum	Liquefied petroleum gases

Construction Minerals

Dimension stone:	Sand and gravel:
Limestone	Construction sand
Granite	Gravel
Slate	Glass sand
Marble	Other industrial sand except for abrasives
Basalt	
Sandstone	
Miscellaneous stone	Fire clay
Crushed and broken stone:	Magnesite
For cement manufacture	Common clay and shale
For lime manufacture	Gypsum
Other limestone	Native asphalt and bitumens
Granite	Asbestos
Slate	Perlite
Marble	Shell
Basalt	
Sandstone	

Chemical and Fertilizer Minerals

Barite	Bromine
Fluorspar	Calcium and calcium-magnesium chloride
Potash	Magnesium compounds
Berates	Sodium carbonate
Phosphate rock	Sodium sulfate
Sodium chloride	Iodine
Sulfur and pyrites	
Arsenious oxide	

Abrasives and Miscellaneous Minerals

Fuller's earth	Grinding pebbles and tube-mill liners
High-grade clay:	Grindstone, pulpstones, and other special silica stone products
Bantonite	
Kaolin	
Ball clay	
Miscellaneous high-grade clay	Quartz, ground sand, and sandstone for abrasive purposes
Feldspar	
Mica sheet	Tripoli and rottenstone
Mica scrap	Peat
Pumice and pumicite	Diatomite
Talc and soapstone	Graphite
Emery and garnet	Greensand
Vermiculite	

FOREST PRODUCTS

saw logs	Pulpwood
Veneer logs	Miscellaneous products
Fuel wood	

PAPER MATERIALS

Paper	Paperboard

NONFOOD AGRICULTURAL PRODUCTS

Cotton	Oil crops and others
wool	Rubber
Fish products	

PLASTICS

Polymers	Synthetic fibers
Elastomers	Other plastic materials

CERAMICS

Construction Ceramics

Glass	Cement
Brick	Tile
Clay products	Mineral wool

Consumer Ceramics

Glass containers	Pressed glass
China	Earthenware
Pottery	Porcelain materials

industrial Ceramics

Pigments	Oxides
Refractories	Asbestos products
Abrasive products	

Electronic Ceramics

Transistors	Semiconductors
Capacitors	Ferrites and magnets

Source: "Material Needs and the Environment Today and Tomorrow, " The National Commission on Materials Policy, June 1973.

two other lists were developed: first, a Key Materials List (table III–3) to be used in the computer simulations; and second, (table III-4), a list of identified materials which directly relate to the problems which the stockpiling policies are designed to alleviate.

Having determined that a material meets the first criterion of economic significance, the materials experts then considered whether or not it met the other selection criteria directly related to each of the five stockpiling policies being analyzed. To be included in the set of Problem-Related Materials for a particular policy, a commodity had to meet all of the selection criteria for that policy. Table III-4 displays the Problem-Related Materials for each of the five policies considered in detail.

One material for each of the five policies being studied was then selected from the list of Problem-Related Materials for use in the impacts analysis. These materials are:

SP-1: Discourage or counteract cartels—petroleum;

SP-2: Cushion the impact of nonpolitical import disruptions—zinc;

SP-3: Assist in international materials market stabilization—tin;

SP4: Conserve scarce domestic material— . tungsten;

SP-5: Provide a market for temporary surplus and ease temporary shortages--copper.

Table III-3.—Key materials

Energy materials:
- Fossil fuels:
  - Petroleum
  - coal
  - Natural gas
- Uranium-thorium

Ferrous metals and minerals:
- Iron ore-steel
- Chromium
- cobalt
- Manganese
- Nickel
- Tungsten

Nonferrous metals and minerals:
- Bauxite-alumina-aluminum
- Copper
- Lead
- Platinum
- Tin
- Zinc

Nonmetallic minerals:
- Asbestos
- Fluorspar
- Helium
- Industrial Diamond
- Potash

Fibers:
- cotton
- wool

Petrochemicals--Plastics
Forest Products
Rubber
Pharmaceuticals

Table III–4.—Problem-related materials for Stockpile Policies 1–5

Material	SP-1	SP-2	SP-3	SP-4	SP-5
Aluminum	....	x	....	....	x
Antimony	....	....	...	....	x
Asbestos	....	x	....	....	....
Bauxite	x	x	x	....	....
Chromate	x	x	....	....	x
Cobalt	x	..	....	....	....
Columbium	....	x		....	x
Copper	....	....		....	x
Fluorspar	x	x		x	...
Calcium	....	x		....	....
Ilmenite	....	x		....	....
Lead	....	....	x	....	x
Manganese	....	...	x	....	x
Mercury	x	...	....	....	x
Natural gas	....	....	....	x	....
Nickel	....	x	....	x	....
Petroleum	x	....	....	x	....
Platinum group	x		....	....	x
Potash	....	x	...	....	....
Futile	....	x	....	....	....
Selenium	....	x	....	....	....
Sliver	....	..	....	....	x
Sulfur	....	x	....	....	x
Tantalum	....	....	....	....	x
Tellurium	....	x	....	....	....
Tin	x	x	k	....	....
Titanium	....	x	....	....	....
Tungsten	....	....	x	x	x
Uranium	....	x	....	....	....
Vanadium	....	....	....	....	x
Zinc	....	x	x	....	....
Zirconium	....	x	....	....	..
Natural rubber	x	x	x	..	x

Chapter IV

APPROACHES USED TO ASSESS IMPACTS OF ECONOMIC STOCKPILING

Chapter IV

APPROACHES USED TO ASSESS IMPACTS OF ECONOMIC STOCKPILING

The approaches used to assess the impacts of implementing five selected economic stockpile policies encompass both economic and noneconomic considerations. While a distinction has been drawn between economic and noneconomic impacts in order to simplify the analysis, it should be understood that such a precise distinction is not possible. Most of the impacts discussed in this assessment cannot in fact readily be expressed in dollar costs and require a type of analysis other than economic. Therefore, the noneconomic impacts include political, social, and market operation considerations as separate and distinct from the economic impacts analysis.

The possible impacts identified and analyzed with these approaches are presented in detail in chapter V as (1) impacts general to all five stockpile policies, and (2) as particular impacts associated with individual policies. In this chapter the methods used in the impacts analysis are presented for two categories:

- Methods of analyzing noneconomic impacts.
- Methods of analyzing economic impacts,

A. METHODS OF ANALYZING ECONOMIC IMPACTS

Economic impacts have been analyzed in two ways: (1) using a model developing and based on welfare economical to determine the gains or losses in domestic economic welfare, and (2) using an existing input-output model to determine the economic sector impacts created during the acquisition phase of stockpiling.

In the welfare model, economic impacts are estimated by developing generalized cost functions applicable to all five stockpiling policies and separate benefit functions particular to each of the five policies. Once the benefits and costs are ascertained with these two functions, the overall net benefits of an economic stockpile—which may be either positive or negative--can be determined. The estimates of economic impacts provided by input-output calculations were not entirely successful, primarily because there was no method to restrain supply in the selected model; however, the calculations did point the way to more extensive use of input-output modeling in the assessment of economic stockpile policy.

[1]Here "welfare economics' is used in the strict sense of economic theory and should not be confused with the popular use of the term "welfare,"

1. General Description of Economic Welfare Model

The Economic Welfare Model developed in this study proposes that a country such as the

United States should stockpile or continue to stockpile (i. e., continue to increase the size of the stockpile of any particular material) as long as the additional benefits derived by the country from adding one more unit of the material to the stockpile exceed the costs. These benefits and costs which accrue to the public should be differentiated from the private benefits and costs which accrue to firms or individuals which might motivate them, rather than the Government, to hold stocks. This distinction implies that the level of stocks which should be held is that quantity which maximizes the total net benefits to the country, as explained in chapter 111. It also follows that the Government need hold only sufficient stocks in excess of the private buffer stocks (if any) to make up the optimum quantity, provided coordination of actions can be arranged.

The Economic Welfare Model does not explicitly incorporate the change in economic welfare which may result from a distribution of income within the economy. The optimal stockpile size is that which maximizes the total net benefits to the country, even though this may involve a substantial redistribution of income among groups within the country. In theory, the effects of such a redistribution could either be alleviated or eliminated altogether by countervailing fiscal policies. In practice, however, history indicates this rarely happens. An estimate has been made of the benefits and costs to two general interest groups, materials producers and materials consumers, as well as to the stockpile investor; however, no attempt has been made to estimate the private stockpile as it would affect the public stockpile.

The economic net benefits of stockpiling do not change linearly with the amount of material stockpiled. In principle, the Economic Welfare Model allows calculation of the optimal size of an economic stockpile. In the study, however, economic net benefits—which are a function of stockpile size—were calculated for only three quantities so that the optimal size for the conditions used was not precisely determined. The Economic Welfare Model specifies a period of time for which calculations are made and requires estimates for various quantities such as prices, elasticities, and probabilities of actions affecting supply during this time interval. Estimation of economic net benefits over an assumed lifetime of the stockpile would require repetition of this calculation for a sufficient number of time intervals to cover the assumed lifetime. In the present report, however, attention is focused on calculations for a single time interval to illustrate the decision process and give typical results.

It should be clearly recognized (1) that these results are only estimates based on an approximation, (2) that the illustrative process here is necessarily simpler than the complex combination of real events, and (3) that this approximation requires input data which are based partly on judgment. Nevertheless, the results are believed to be valuable in indicating the nature (benefits and costs) and magnitude of the economic impacts for the circumstances assumed.

Other models for estimating economic impacts could probably be developed to give somewhat different numerical results. And while other calculations might differ in detail from those performed here, they must build upon the same basic requirements to consider the impacts of stockpiling on various parties, as well as estimate probabilities and price elasticities. Their general conclusions should therefore be similar. In any case, the Economic Welfare Model is one tool which the stockpile operator could use in making decisions regarding whether or not to increase, hold, or decrease the stock of each material.

The Economic Welfare Model estimates the economic benefits and costs of stockpiling which may be either positive or negative. It is important that not only the overall economic benefits and cost be estimated, but also that the degree to which different parties are impacted be identified. The terms making up the Economic Welfare Model have accordingly been structured into two categories to provide separate estimates of benefits and costs to materials producers and materials consumers. Two additional categories of benefits and costs borne ultimately by producers and consumers but not to either alone are also separately estimated. These are the direct benefits and costs to the stockpile operator and the external costs borne by the economy in general. It is also important to recognize that impacts on various. parties vary depending on whether the stockpile is acquiring. holding, or disposing of materials. The terms in the Economic Welfare Model have thus been structured to provide separate estimates of economic impacts associated with acquisition, holding, and disposal for each of the four categories of benefits and costs discussed above. These estimates are called partial benefits and costs.

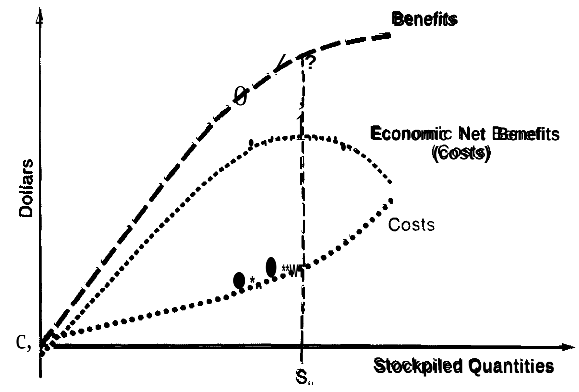
In order to determine the optimal quantity of a material to be stockpiled, two functions within the Economic Welfare Model should be determined for a specified period of time:

- The benefit function, which shows how public benefits increase with the quantity of material stockpiled; and
- The cost function, which shows how public costs increase with the quantity of material stockpiled.

Figure IV–1 conceptually illustrates how to determine the optimal stockpile size using the benefit and cost functions. The optimal quantity of stocks occurs at the point where the difference between the benefit and cost functions is maximum, i.e., the economic net benefit curve is at the maximum positive value. Economic net benefits are only positive, of course, when the benefit function is above (or greater than) the cost function. If this is not the case, then the particular material in question should not be stockpiled unless other, overriding noneconomic reasons exist.

In certain cases, it is readily apparent that the public benefits of stockpiling are zero or close to zero. For example, if an economic stockpile were established by the United States for the sole purpose of counteracting possible cartel actions, the benefits to the country of stockpiling materials which the

Figure IV-1.
Economic Net Benefits



C_f = Fixed initialization cost
S_o = Optimal stockpile size

United States does not import (such as molybdenum or coal) or which are highly unlikely to be cartelized (such as iron ore) are obviously nil. This is the theoretical justification for the set of Materials Selection Criteria outlined in chapter III which were used to determine the Problem-Related Materials which should be acquired to achieve the stockpiling policy objective.

In figure IV–1 the benefit function is shown passing through the origin, since the benefits associated with a stockpile of zero size are zero. It then rises with the quantity of material stockpiled but at a decreasing rate, on the assumption that those needs which generate the largest public benefits would have priority in the allocation of stockpiled material, Those needs which contribute little in the way of public benefits would receive stockpiled material only if stocks were still available after other, higher priority needs were met.

The cost function is assumed to intersect the vertical axis above the origin since there are certain fixed costs (equal to C_f in figure IV–1) associated with stockpiling which do not vary with the size of the stockpile. As the cost function is drawn in figure IV–1, the variable costs increase with the size of the stockpile. The rate of this increase is greater as the quantity becomes larger due to the effects of stockpile acquisition, a point discussed in the following section concerning the generalized cost function.

The Economic Welfare Model has two time dimensions. The first concerns the time period over which the economic net benefits of stockpiling action should be estimated. If, for example, the benefits and costs associated with a particular stockpiling program are reassessed once a year and changes in the desired level of stocks made, the coming time period is 1 year. It could, of course, be a month, 6 months, or 5 years. The review period is dependent upon the leadtime to establish a stockpile, the frequency with which an event is expected to occur, and the perishability of the material to be stockpiled.

The other time dimension concerns the period over which costs and benefits are estimated. It may be, for example, that the analysis of a prospective stockpiling action indicates that no action should be taken next year, but that a stockpile of a certain size should be established in 5 years. In such cases, both costs and benefits should be discounted to their present value. Also, with a longer time horizon, alternative rates of stock acquisition can be considered. The costs of acquiring all of this material in the year just before it is needed may be higher than if the stocks were accumulated more slowly over a longer period of time. Associated with each time path of accumulation is a stream of costs. The optimal timing of accumulation is that which has the stream of costs with the lowest present value.

The disposal of stocks can also be timed using the Economic Welfare Model. A stockpile will be accumulated to solve a specific problem such as an import disruption. When such an interruption occurs, the Economic Welfare Model can be calculated to determine, based on the probability of continued or more severe disruptions, the amount ,of stocks to be released to counteract the disruption. Likewise, after an interruption the level of the stockpile can be reevaluated and its effectiveness reexamined. The continual review of costs and benefits accrued through stockpiling can further refine the timing factors influencing accumulation and disposal of optimal quantities of materials.

2. Three Steps in Using the Economic Welfare Model

The Economic Welfare Model is a tool developed for use in quantitatively analyzing the economic impacts of stockpiling. The Economic Welfare Model provides a guide for determining actions to be taken by an economic stockpile: first, by estimating the net benefits to the country of stockpiling a particular material which is or should be stockpiled; second, by providing guidance on the timing of acquisition and disposal of that material; and third, by identifying the benefits and costs to particular impacted sectors of the country,

There are three steps involved in using the Economic Welfare Model, each of which is discussed immediately following the general description of the model:

- Step I—Estimate the costs of stockpiling;
- Step 2—Estimate the benefits of stockpiling as a function of the quantity for material stockpiled; and
- Step 3—Determine the net benefits as a result of stockpiling, net benefits being benefits minus costs.

Development of the Economic Welfare Model in terms of cost/benefit relationships has required the use of parameters for which, in some cases, materials information is not available, This, in turn, has required using a panel of experts to provide subjective estimates for these parameters. While estimates provided by experts are sufficient to ascertain the feasibility of stockpiling, implementation of one or more of the stockpiling options by an agency of the Federal Government would require establishing, a materials information system to supply inputs for use in calculating the economic welfare parameters. z

a. Step 1: Estimate the Costs of Economic Stockpiling. —In order to apply the Economic Welfare Model, the benefits and costs of stockpiling a particular material as a function of the quantity put into the stockpile must be estimated, It should be emphasized that there are two distinct types of costs associated with economic stockpiling: (1) the costs to various impacted interest groups and to the economy in general which accrue as a result of implementing a stockpile and which are derived using the Economic Welfare Model (impact costs); and (2) the direct costs, including acquisition, for a stockpile operator to run the stockpile (operating costs). Since the derivation of the impact costs in the first category will not change significantly with the different stockpiling policies, a general discussion of the cost function as it applies to all five stockpiling policies is presented here. Analysis of the operating cost function is presented in chapter VI.

The costs of an economic stockpile occur during the entire operation of the economic stockpile: the acquisition phase, the holding phase, and the disposal phase. During acquisition, the costs of a stockpile are incurred through initialization of the stockpile and through acquisition of the commodity. The holding phase of the economic stockpile's operation generates storage, administrative, and interest costs for stockpiling operations, while costs for releasing stockpiled materials accrue in the disposal phase. These costs are discussed as follows in three categories.

(1) Acquisition phase costs.—The capital required to acquire stocks—as opposed to the interest on that capital—should not be counted as a cost of economic stockpiling, since the purchase of materials merely involves exchanging one type of asset for another. It does not generate real costs for society in the sense that resources are consumed or lost.

While acquisition costs are not considered economic costs, they are nevertheless real costs to those who must consider outlays from the U.. budget. The Semiannual Stockpile Reports of the General Services Administration (GSA) to the Congress, covering all types of stockpiles of strategic and critical materials, show accumulated acquisition costs upward of $6 billion through 1962,f which more than $2.5 billion at acquisition costs (valued at about $6 billion at market prices) remained in these stockpiles at the end of 1974 after a long period of accumulation. The costs of acquiring and keeping materials for an economic stockpile are therefore of some importance in deciding whether or not such a stockpile should be established. Even if the calculations of economic benefits and costs indicate positive economic net benefits for a stockpile of a certain quantity of material, and even if the stockpile may be otherwise considered desirable from a policy standpoint, the overall costs of implementing such a stockpile may be so large as to be judged prohibitive in terms of the U.S. budget. The financing of acquisition costs and other budget costs to the stockpile operator are discussed in chapter VII. Acquisition costs are considered here to the extent of determining interest costs in the economic net benefits.

Acquisition costs are dependent upon the size of the stockpile and the unit costs of commodity purchase, so that:

$$AC = C_U Q \qquad (1)$$

where
AC = acquisition cost
C_u = unit cost of stocks
Q = stockpile size

Initialization of an econmic stockpile requires the development or acquisition of storage facilities, the establishment or augmentation of a cognizant stockpiling authority, and the implementation of systems for monitoring the stockpile activities. Initialization costs may vary with stockpile size and in-

[2] "Critical Materials: Commodity Action Analysis," [J, S, Department of Interior, May 1975. See also a recently completed OTA assessment. "Materials Information Systems" for a more definitive treatment of this point,

elude the fixed costs incurred in establishing the stockpile, so that:

$$IC = c_f + c_i Q \quad (2)$$

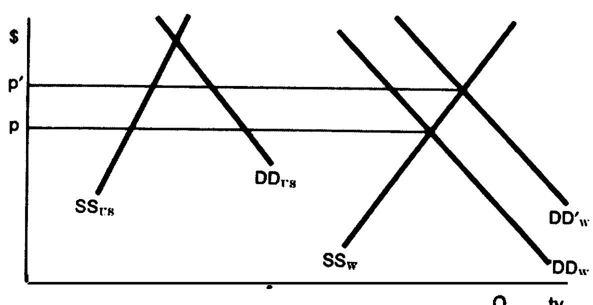
where
IC = initialization cost
c_f = fixed cost of initialization
c_i = variable unit cost of initialization
Q = stockpile size

The act of accumulating stocks increases the relevant demand for a commodity, and the increased demand will tend to raise the equilibrium price for the commodity. When the acquisition of stocks shifts the relevant (world) demand curve for a material rightward and the relevant (world) supply curve is not infinitely elastic, a rise in price on the world market will occur, as illustrated in figure IV–Z which also shows the effect this price increase has on the U.S. market. This price increase will generate two costs: (1) a net loss in domestic consumer surplus, and (2) external or second-order costs. Each of these costs is discussed in the following paragraphs.

The loss in domestic economic welfare resulting from the acquisition of materials for a stockpile introduces a net cost in that the loss in domestic consumer surplus is not offset by the increase in domestic producer surplus. [3] This net cost is indicated in figure IV-3 by the trapezoid abcf and is composed of the following three elements:

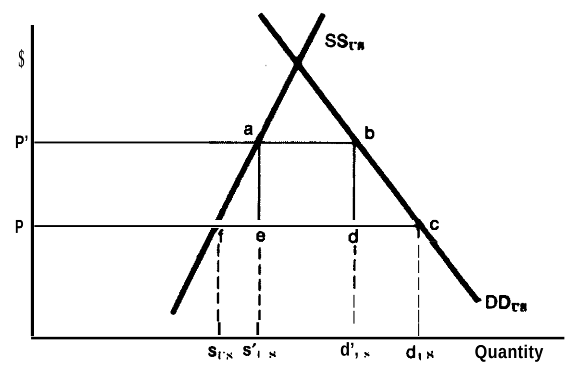
- The loss in consumer surplus which arises because the higher price drives some consumers out of the market—represented by the triangle bed;
- The loss caused by the incremental increase in real resources required to expand domestic production from s_{us} to s'_{us}—represented by the triangle aef; and
- The loss of real income by domestic consumers because they must pay higher prices for imported materials—represented by the rectangle abde. Some of this latter loss merely represents a transfer payment reflecting an increase in foreign producer surplus. From the U.S. point of view, however,

Figure IV-2.



TERMS:
DD_W = World Demand Curve
DD'_W = New World Demand Curve
SS_W World Supply Curve
DD_{US} = U.S. Demand Curve
SS_{US} = U.S. Supply Curve
p = Equilibrium Price (World)
p' = New Equilibrium Price (World)

Figure IV-3.



TERMS:
s_{US} = U.S. supply at price p
s'_{US} = U.S. supply at price p'
d_{US} = U.S. demand at price p
d'_{US} = U.S. demand at price p'

[3] There is a loss of domestic consumer surplus accompanied by the increase in domestic producer surplus—represented by the trapezoid p'afp, Since this is merely a transfer payment from one group within the United States to another, it does not represent a loss to the country as a whole. It is, however, a good illustration of how stockpiling can effect a redistribution of income.

it is a loss in control over real resources and should be considered a cost of stockpiling.

Figure IV–3 demonstrates that the net loss in domestic economic welfare can be estimated from the loss in domestic consumer surplus and the gain in domestic producer surplus, so that:

$$LEW = CL - PG \qquad (3)$$

where

LEW= net loss in economic welfare
CL = loss in domestic consumer surplus
PG = gain in domestic producer surplus

The terms in equation (3) are derived from—

$$CL = (d'_{US})(p'-p) + 1/2(d_{US} - d'_{US})(p'-p) \qquad \textbf{(4a)}$$
$$PG = (s'_{US})(p'-p) - 1/2\ (s'_{US} - s_{US})(p'-p) \qquad \textbf{(4b)}$$

yielding:

$$LEW = 1/2\,(s'_{US} - s_{US})(p'-p) + 1/2(d_{US} - d'_{US})(p'-p) + (d'_{US} - s'_{US})(p'-p) \qquad \textbf{(4C)}$$

where

s_{US} = U.S. supply at price p
s'_{US} = U.S. supply at price p'
d_{US} = U.S. demand at price p
d'_{US} = U.S. demand at price p'
p = Equilibrium price (world)
p'= New equilibrium price (world)

Equation (4) assumes that the U.S. supply and demand curves are approximately linear in the price range p to p', thus the coefficient of I/2 is used.

External or second-order costs to society may be generated by the net loss in domestic consumer surplus which occurs because some consumers are driven out of the market by the higher price. Firms may find it unprofitable to continue producing certain products and lay off workers. If alternative employment is not readily available for such workers and if other factors of production are idled, there are external costs (EC) imposed on society which must be added to the net loss in domestic consumer surplus.

It is important to note that these costs—the net loss in domestic economic welfare and the associated external costs-arise only when stockpiles are being accumulated, since the mere maintenance of an existing stockpile does not shift the demand curve and raise prices, Thus, the cost function will be steeper during acquisition periods than during holding periods. The rise in prices will be a function of the size of the stocks acquired during a given time period. That is, the greater the shift in the demand curve due to stockpiling, the larger the impact on market prices and the greater the loss in domestic consumer surplus and the external costs.

(2) Holding phase costs.—The budget for stockpiling operations will have to cover storage and administrative cost. According to the GSA, storage of the materials in the strategic stockpile fell overall from about 27 to 18 cents per ton per year between 1960 and 1964, and has remained in the range of 14 to 16 cents since then.

Reports from GSA to Congress indicate that annual administrative costs for the strategic stockpile are currently equivalent to under 3 percent of the acquisition cost of materials in the stockpile during the year; however, administrative costs will vary widely according to the materials and the kinds of activities (buying, selling, holding) required to administer the stockpile. An important cost component during the holding phase is the interest cost associated with the value of stocks originally acquired. For the cost function, this interest rate should be equivalent to the opportunity cost of capital.

In addition to storage and administrative costs and the interest costs on the capital required to acquire and hold stocks, a third holding cost of a materials stockpile is the loss arising from damage and spoilage of stocks in storage.

The costs of holding a material are a function of the size of the stockpile and the unit value of the material stored. For the present development of the cost function, it has been

77-119 0- 76-6

assumed that these holding costs vary linearly with the stockpile size, so that:

(5)

where

s = storage and administrative cost in $/unit
d = quantity of stock loss
i = interest rate
C_u = unit cost of stocks
Q = stockpile size

(3) Disposal phase costs. -costs will be incurred for disposing of materials from an economic stockpile. For example, the use of a petroleum stockpile to counteract an OPEC cartel action will require the lifting of oil from storage (e.g., salt domes or capped wells) and into bulk terminals or refineries. The disposal costs will be dependent upon the quantity of material disposed and the expense of the disposal operation, so that:

$$DC = d_d Q_d \qquad (6)$$

where

DC = disposal cost
C_d = unit cost of disposal
Q_d = stockpile disposal

In sum, the cost function of the Economic Welfare Model for stockpiling developed above can be expressed as—

$$C = IC + LEW + EC + HC + DC \qquad (7)$$

where

IC = calculated from equation (2)
LEW = calculated from equation (3)
EC = the external cost
HC = calculated from equation (5)
DC = calculated from equation (6)

This basic cost function is applicable to all five stockpile policies studied in this assessment, though minor modifications have been made in subsequent descriptions of three of the policies.

b. Step 2: Estimate the Benefits of Economic Stockpiling.—The form of the cost function does not depend on the objective for which stockpiling is undertaken, and so is similar for each stockpiling policy. However, the benefit functions do vary with the objective of each stockpiling policy and are developed based solely on the purpose (or policy objective) of the five stockpiling policies in chapter V.

(1) Definition of benefits of economic stockpiling.—The benefits of an economic stockpile are equal to the expected damages which are either averted or counteracted through the operation of the stockpile. The benefits thus consist of the possible damage which could result from a disruption (change) in the normal materials supply or price, times the probability that such a disruption will occur.

The benefits of economic stockpiling will not be realized only through the utilization of the stockpile. On the one hand, holding materials will produce benefits for the U.S. economy by discouraging cartel or unilateral actions, On the other hand, the benefits of either counteracting a cartel or unilateral action or cushioning an import disruption will be realized only through the disposal of materials from the stockpile.

Calculation of the benefits of economic stockpiling thus assumes that a given quantity of materials will either be held or disposed at a particular point in time. Knowledge of the disposal price enables the determination of capital gains or losses resulting from stockpile disposal. The expected capital gains or losses, which are included in the benefits of the stockpile, serve to decrease or increase the cost of the stockpile to the operator.

(2) Interest groups.—Disposal from a stockpile directly influences two general interest groups: materials producers and materials consumers. The difference between the loss in domestic producer surplus and the gain in domestic consumer surplus yields the net gain in domestic consumer surplus, a benefit of economic stockpiling. There are also benefits and costs to third parties in the form of external costs which are offset or avoided through stockpiling holding and disposal.

c. Step 3: Determine the Economic Net Benefits of Stockpiling.—The difference between the benefits and costs yields the economic net benefits (ENB) derived from a stockpile, so that:

$$ENB = B - C \tag{8}$$

where
- B = the benefits calculated from the benefit function
- C = the costs calculated from the cost function

The Economic Welfare Model, thus used, can provide the tool by which the optimal stockpile size is calculated and the timing of stockpile acquisition and disposal are determined, Specific estimates of the economic impacts are presented in chapter V,

3. Discussion of Computer Program Developed To Estimate Economic Impacts of Stockpiling

The Economic Welfare Model has been developed specifically to estimate the economic net benefits of implementing SP-1, –2, –3, -4, and –5. To facilitate calculations, the model has been developed into a computer program.

Inputs to the program include stockpile sizes, unit costs, fixed initialization costs, interest rates, etc. Output from the program consists of the economic costs, benefits, and net benefits for various stockpile sizes.

The advantage of the program is that it permits the rapid calculation and analysis of a large number of stockpiling policies and the perturbation of variables with their resultant impacts on the costs and benefits. A range of optimal stockpile sizes can be estimated, then the sensitivity to parametric variations can be assessed.

The Operating Cost Model, which can be used to estimate the direct operating costs of an economic stockpile, has also been included in the computer program. For a discussion of the operating cost model, see the appropriate section of chapter VI.

The calculated results using the equations in the Economic Welfare Model and the Operating Cost Model are dependent on the magnitude and the relationship (relative magnitude) of all the input (independent) variables chosen for the calculations. These input variables are chosen from a variety of sources (e.g., graphs, tables, subjective reasoning, projections, etc.) by persons possessing the knowledge and training to allow this process to be accomplished with an acceptable probability of success.

The Economic Welfare Model and the Operating Cost Model have been used to calculate a "baseline" case, where the set of input variables have been carefully chosen as the most accurate and probable values. For each stockpiling policy (SP–1, –2, –3, –4, –5), one baseline case has been calculated for one material, The results are presented in chapter V under the sections dealing with each policy,

Whenever an analysis like that described above is performed, certain questions related to the validity of the calculated results always arise. Two primary questions can be listed: (1) what input variables are the most sensitive? (e.g., for small changes in input, the output changes are large); and (2) what input variables are the least sensitive? (e.g., for small changes in input, the output changes are small or zero).

It is important that an analysis be performed which seeks to answer these questions to permit validation of the models and to gain insight into the validity of the results. In doing this, it is important for the stockpile analyst to attempt answering certain corollary questions such as the ones listed below:

- For the sensitive input variables, what is the degree of certainty in the data which have been used?
- If these input data have an unacceptable degree of uncertainty, what additional data or analysis is required to narrow this range of uncertainty?

- What is the cost of obtaining the additional information required?
- What is the tradeoff (break even) between the increased cost to improve the certainty and the cost of the impact of the uncertain y remaining?
- Conversely, are we spending too much time and money to determine the values of the least sensitive input variables?

The scope of this assessment did not allow for exhaustive analysis of the type discussed above, as the primary intent was the development of the methodology and not the analysis of all specific cases. The development of the computer program did, however, allow for some first-order sensitivity analyses to be performed using the digital computer to save time and money over manual analyses.

The sensitivity analysis chosen for this study consisted of determining the relative importance of each input variable in the benefit, cost, and net benefit functions. The sensitivity of the cost and benefit functions to changes in the formulation parameters was computed. The sensitivity of the net benefits and optimal stockpile size to changes in the cost function and the benefit function was also computed. These sensitivity y computations were made for each stockpile policy.

To effect this sensitivity analysis, the computer program automatically modifies an input parameter by a specified percentage (+10 percent in this study) and recalculates the output parameters. Each input parameter is individually modified and the program repeats the output calculations for all parameters. Each stockpiling policy is then recalculated using this automatic feature.

4. Economic Damage Not Averted

The establishment and use of an economic stockpile is intended to ameliorate the economic damage which particular events—import interruptions, price fluctuations, etc,—would cause, However, the optimal stockpile as estimated with the Economic Welfare Model will seldom, if ever, be large enough to completely offset the damage inflicted on the economy. The difference between the total economic damage and that portion offset by the stockpile is defined as damage not averted. Estimation of damage not averted becomes important when policy makers assess the tradeoffs between incurring some damage which the optimal stockpile cannot offset and the additional costs incurred for a larger stockpile size. The Economic Welfare Model incorporates equations to estimate the economic damage not averted,

5. Economic Impact of Not Establishing a Stockpile

Even under conditions when the economic net benefits for a particular stockpile are positive, policy makers may not want to establish the stockpile, or at minimum may want to know what the costs and benefits of not establishing a stockpile would be. The economic costs of no stockpile are obviously zero, but at the same time the economy will incur the expected damage which the optimal stockpile would offset if it were established. Or put differently, the economy will forgo benefits which it otherwise would have. Hence, the adverse economic impact of not establishing a stockpile is equivalent to the benefits calculated with the benefit function,

B. METHODS OF ANALYZING NONECONOMIC IMPACTS

The range of possible political and social impacts was derived through the use of relevance trees. These impacts were then examined to identify those which promised to be the most important and therefore worthy of further analysis, A discussion of the relevance tree and impact relevance matrix are presented as follows, and specific political and social impacts are discussed in chapter V.

1. Discussion of Relevance Tree

In concept, a relevance tree is a hierarchic structure in which the entries at each successive level, in the aggregate, describe completely the next immediate level above. A relevance tree describes a domain and, theoretically at least, describes it completely. In this study, four relevance trees were constructed in order to synthesize material collected during the interviews and literature search tasks. The relevance trees were then used to subdivide particular stockpiling subjects into their constituent building blocks in order to identify important areas which would later be included in analyses of stockpiling impacts and alternatives to stockpiling.

There are two advantages in using a relevance tree to examine the fine-grained structure of a problem. First, it provides a means of systematically searching for omissions. For example, insights about possible impacts of the stockpiling policies were discussed during the interviews and foreshadowed by experiences described in the case studies. However, even after tabulating the impacts derived from these sources, the question remained: What other impacts might occur in the future? While there is no absolute assurance that a relevance-tree analysis will provide the entire universe of impacts, the systematic approach required provides a higher degree of assurance that important impacts are indeed discovered. Second, since the organization of a relevance tree is hierarchic, the researcher must ask at each level whether or not his description is complete. This induces a process of self-learning and discovery, which further insures that the field under study will be effectively described,

As might be expected, the relevance trees themselves underwent an evolution during the study. The content of the four trees is illustrated below, and the complete trees are included as appendix D.

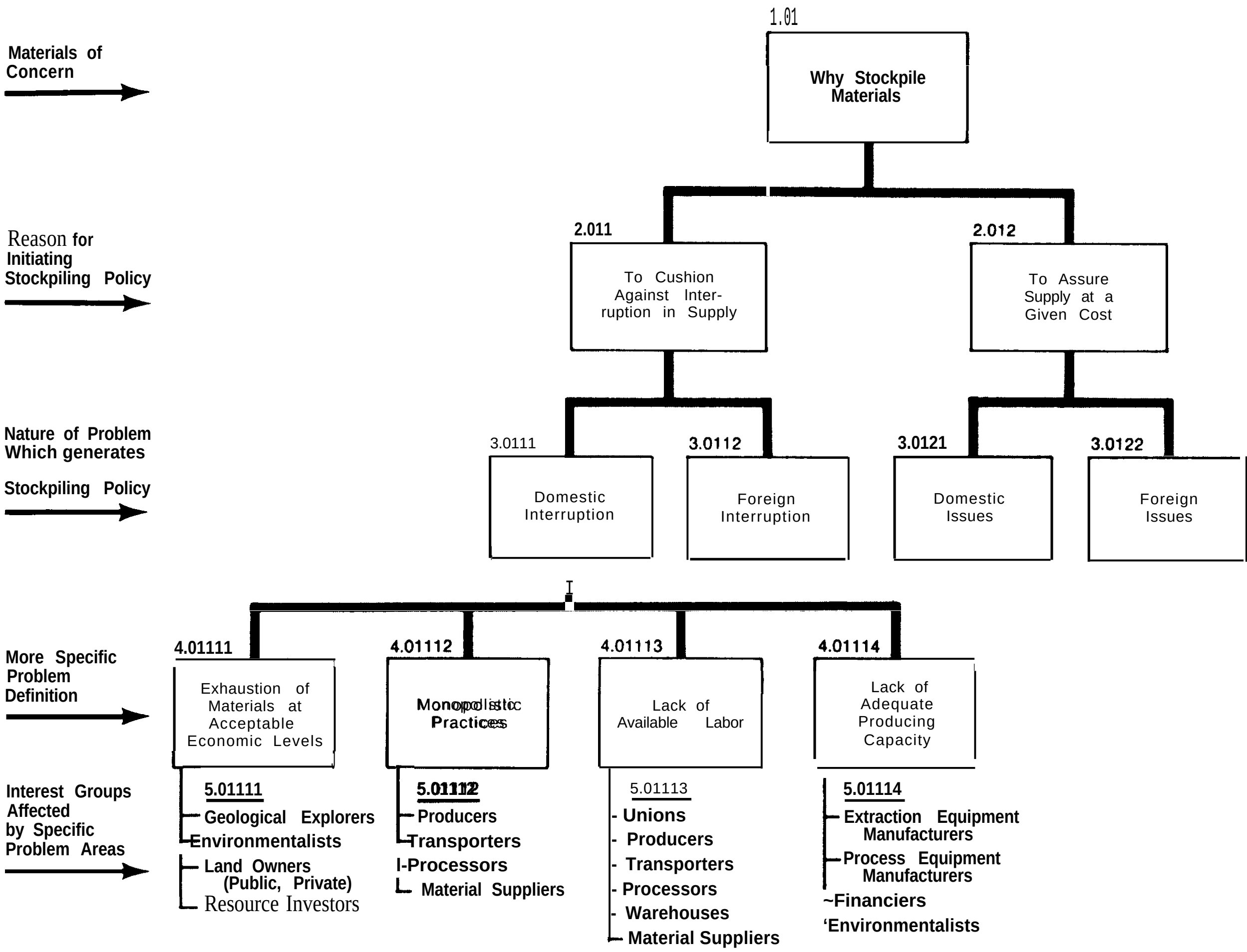
a. Stockpiling Policy Tree.—The stockpiling policy tree (Level 1) begins with the question: Why stockpile? Level 2 shows two general reasons for initiating stockpiling: to maintain a supply in case of cutoff from primary sources, and to provide protection against economic pressures. Level 3 identifies that material resource problem area as being either domestic or foreign. The problems which may be alleviated by stockpiling are detailed in Level 4 (e.g., increasing labor and production costs in producer countries, sociopolitical disruptions, etc.). The lowest level (Level 5) shows the interest groups which are likely to be affected by the problems. An illustrative segment of this relevance tree is shown in figure IV-4,

b. Stockpiling Procedure Tree.—The stockpiling procedure tree (Level 1) deals with the question: "How can stockpiling be accomplished?" Level 2 shows the two areas of concern: domestic and foreign. On Level 3, general stockpiling approaches are identified (e.g., stockpile in proven reserves, stockpile as raw ore, etc.). Specific storage procedures are shown on Level 4 (e.g., purchases of land and mineral rights, etc.). Level 5 (the lowest level) again identifies the interest groups which may be affected by the stockpiling procedures.

c. Alternatives to Stockpiling Tree.—The alternative to stockpiling tree (Level 1) derives from the question: "What alternatives to stockpiling exist?" The general policies which may be identified as a result of stockpiling are given on Level 2 (e.g., influence consumption, encourage recycling, etc.), Level 3 specifies policies sufficiently (e.g., limit production, materials R&D, etc.) so that the programs derived from these policies can be identified on Level 4 (e.g., taxation, incentives, etc.), The lowest level (Level 5) shows interest groups which would be directly affected by those programs.

d. Stockpiling Impact Tree.—The stockpiling impact tree (Level 1) begins asking where, throughout the world, the impacts might be felt. The major divisions recognized

Figure IV-4.
Illustrative Segment of Relevance Tree



are the United States, other countries which import the material, countries which export the material, countries which could export the material or substitutes, and countries which have secondary dependence on the material (e.g., countries which import products manufactured from the material). At Level 2, the relevance tree centers on the question: "How might the impact be felt?" Here, the divisions are social, economic, political, legal, and other. The domain of the impact is next addressed at Level 3: the impacts can be felt internally, or in relations between the country and others. Level 4 consists of a further subdivision of the domain, and Level 5 addressed the impacts themselves (e.g., institutional feasibility, political stability between nations, and trade alliances).

2. Impacts Relevance Matrix

After the five stockpiling policies were designated, the most important social, political, and legal impacts for each policy were identified. A matrix was constructed to accomplish this task. The five policies were deployed on one axis; the potential impact areas (derived from the fourth relevance tree) were deployed on the other. Figure IV–5 is a sample of the political impacts portion of this matrix.

The numbers entered into the matrix depict judgments as to the relevance and weight (importance) of a particular impact of a stated policy, Judgments about weight were made first. Here, the task was to identify those impacts which, in and of themselves, appeared to be most important to the future of the United States. Looking at figure IV–5, for example, one sees impact area No. 66 (Political Stability Between Nations) was given a weight of 5—much higher than the weight of 2 given impact No. 62 (Cultural Alliances and Agreements). Second, judgments were made about how relevant each impact was within the context of the assumed stockpiling policies, i.e., whether the stated impacts were relevant to the stated policies. These judgments are depicted in figure IV–5 as the numbers entered in the matrix cells. Finally, the data contained in the matrix were used to rank-order the impacts in terms of their importance for each stockpiling policy. The rank order was determined by taking the product of the weight and the relevance number contained in the matrix cell. Thus, for SP–1, impact No. 53 (Internal Political Stability) rated a "score" of 25.

Using the above technique, it was possible to rank-order the impacts for each of the policies, and to designate a subset of impact area for further study. The impacts designated by this weighting matrix operation served as the basis for the detailed discussion of political and social impacts in chapter V. A further discussion of impacts evaluation matrices can be found in appendix D.

Figure IV-5.

Political Impacts Portion of Impacts Relevance Matrix

Impact Areas	1	2	3	4	5	Weight
52 Levels of Satisfaction with Government	5	3 1	5 1	3 1	4 1	4
53 Internal Political Stability	5	2	4	2	2	5
54 Laws and Regulations	4	i	4(4		4	4
55 Regulatory Structure	5	4	5	4	4	3
56 Institutional Viability	5	4	5	4	4	3
57 Int'l Relations Trade Agreements & Alliances	5	5	5	4	4	4
58 Buyers' and Sellers' Consortia	5	2	5	2	2	5
59 Aspirations of Other Potential Consortia Members	5	2	5	2	2	4
60 Aspirations of Consortia in Other–Materials	5	2	4	2	2	5
61 perception About U.S. Intent	5	3	5	3	3	4
62 *Cultural* Alliances and Agreements	3	0	3	0	0	2
63 U.N. Effects	4	0	4	0	0	3
64 impacts on Other International institutions	4	0	4	o	0	3
65 Military Alliances and Agreements	5	O	4	t"	o 0	4
68 Political Stability Between Nations	5	1	4	2	1	5
67 Political Aspirations of Others	5	1	4	1	1	4
68 National Boundaries	1	0	1	0	0	5
69 Political Pressures on Third Parties	3	2	3	2	2	4

Relevance Key

5 = Great Relevance
3 = Moderate Relevance
1 = Little Relevance
O = No Relevance

Weight Key

5 = Extremely Important Impact Area
3 = Important Impact Area
1 = **Of** Little Importance
O = No Importance

Chapter V

POSSIBLE IMPACTS OF ECONOMIC STOCKPILING

Chapter V

POSSIBLE IMPACTS OF ECONOMIC STOCKPILING

The impact analysis encompasses both economic and noneconomic considerations. Under the latter category, the political, social, and market-operations impacts which might result from implementing an economic stockpile are considered. It should be emphasized, however, that because the economic factors associated with an economic stockpile are far more important than the noneconomic factors, the analysis concentrates on economic impacts. Two distinct techniques were used to examine the economic impacts: the University of Maryland's INFORUM model, and the Economic Welfare Model developed in the assessment.

For purposes of this assessment, economic impacts have been separated into two types; first, the benefits and costs which accrue to the United States, either directly or indirectly, as a result of the impact which stockpiling has on the domestic economic welfare; and second, the direct, out-of-pocket costs to the stockpile investor for operating the stockpile, costs which include the acquisition and disposal of materials.

The term impacts defines changes in the circumstances of individuals, groups, or nations which occur as the result of implementing a particular stockpile policy. Impacts may occur as a result of the activity associated with building a stockpile, as a result of operating it, or as a result of dispersing from it. Impacts may be real (changes in employment levels) or perceived (fear that an economic stockpile would be used to reduce the power of a strike); local (environmental effects of mining marginal ores) or global (creation of new trading alliances); social (improvement in the choice of products or range of lifestyles available); political (frustration of cartel action); or economic (stabilization of prices). In short, impacts encompass a vast range of consequences which maybe of significance to the United States and its citizens.

The impact analysis here is organized into two basic categories: (1) first, the general impacts considered applicable to all five stockpiling policies (the political, social, and market operations impacts); (2) the impacts specifically applicable to each of the five stockpiling policies (the economic impacts), Accordingly, the following sections are included in chapter V:

- General impacts of economic stockpiling;
- SP–1: Economic impacts of stockpiling to discourage or counteract cartel or unilateral political actions affecting price or supply;
- SP–2: Economic impacts of stockpiling to cushion the impacts of nonpolitical import disruptions;
- SP–3: Economic impacts of stockpiling to assist ing international materials market stabilization;
- SP-4: Economic impacts of stockpiling to conserve scarce domestic materials; and
- SP–5: Economic impacts of stockpiling to provide a market for temporary surpluses and ease temporary shortages,

A. GENERAL IMPACTS OF ECONOMIC STOCKPILING

The general impacts which may result from implementing any form of an economic stockpile can be considered in three areas: political, social, and market operations, Each of these general impact areas will be discussed in this section, followed by an analysis of the economic impacts which may result from implementing stockpile policies (SP) 1–5.

1. Political Impacts of Economic Stockpiling

Building a stockpile to guard against supply interruptions or to help stabilize prices can have important political significance. Both exporting and importing nations can be affected. Internally, many organizations will be politically involved in supporting or opposing the creation of stockpiles.

a. Effects on International Relations, Trade Alliances, and Agreements.—Economic stockpiling will influence international relations, creating an environment for new alliances and new means of demonstrating support and solidarity among nations. Even when an economic stockpile is designed primarily for domestic reasons, it will have international implications. There are at least three ways international relations might be affected:

(1) Exporting nations might call on allies to support their action to raise prices or divert or withhold supplies from the United States;

(2) The creation of an economic stockpile within the United States might deter the formation of cartels in other materials or affect aspirations of other potential consortia members; and

(3) An economic stockpile could reduce the risk of serious confrontation between the United States and materials controlling nations.

The International Energy Agency (IEA) is an example of a defensive stockpile formed among importing nations with a common need for a material controlled by a cartel. The program of IEA is designed to allocate supplies to member nations and to reduce competitive bidding for scarce supplies of petroleum. The program is enacted when there is a general supply emergency or when an embargo is aimed selectively at one or more of the member nations. Shortages are shared among the nations when they exceed 7 percent of previous consumption. Less severe shortages are managed by conservation. Rules for using stockpiles enable countries to share the risk of supply shortfalls. These rules avoid the “self-targeting” problem which arises when only one member, e.g., the United States, has and releases large stockpiles. Thus, under the IEA the United States does not become a “prime target" for an embargo because it possesses stockpiles.[1]

The size of an economic stockpile like SP-1, which is designed to withstand a politically inspired embargo, might well be based on the contribution which the material makes to the economy of the exporting nation. For example, an exporting nation which relies heavily on revenues derived from the export of a particular material could itself survive only a relatively short interruption; therefore, a stockpile designed to guard against this interruption could be small. However, third-party nations, allied with the exporting nation, could change this balance by offering the exporting nation loans, subsidies, or alternate markets,

A stockpiling policy like SP–3, which is aimed toward regularizing the international flow of materials, might be viewed as defensive (guarding against the eventuality of high prices) or offensive (forcing prices down when market conditions would dictate otherwise). Thus, the political impacts of SP–3 depend on how the policy is conceived, perceived, and implemented. As in the case of SP–1, this policy could well result in consuming nations' forming joint stockpiling arrangements other than the IEA so that the collective risk to any member is sharply reduced. To the degree that such an effort is successful in stabilizing markets, long-range policies based on the interests of both producing and importing nations may well be easier to arrange. For many commodities, the existence of a stockpile would be a modest guarantee of stability, both of the international market, and through this leverage, the capital flow to the producers. Thus, if a stockpile is not seen as a threat which induces immediate, negative reaction from producer nations, it may well enhance the possibility for cooperation among nations with common interests in stabilizing material flows.

lsee Federal Energy Administration, Project Independence Report (Washington, D. C., U.S. Government Printing Office, 1974), pp. 369-377.

The creation of an economic stockpile within the United States might also deter the formation of cartels in the material being stockpiled or in other materials. The increasing dependence of the United States on imported materials, discussed in chapter II, suggests that by the year 2000 imports may account for more than 90 percent of all chromium, tin, titanium, platinum, beryllium, aluminum, and fluorine which the U.S. consumes. In this situation, supply interruptions may become increasingly common, To the extent that stockpiles of important materials exist, potential cartels will see them as a deterrent, an obstacle which would have to be overcome before their actions could be effective. Hence, the formation of cartels and/or the effectiveness of their actions could be constrained by the creation of a U.S. stockpile.

An economic stockpile could also reduce the risk of serious confrontation between the United States and materials-controlling nations during an embargo or a trade action. If, during an embargo, serious economic dislocations occurred in the United States due to scarce supplies, the pressure to give up previous foreign policy objectives or to take aggressive action could be substantial. The tension created by possible confrontation of world powers could thereby be increased. The difficulty of the situation is compounded by the need for quick a&ion. If there were no stockpile, or if only a token amount of material existed in the stockpile, the acquisition of additional material could become an issue in itself. If an essential ingredient in diplomacy is time, then the existence of the stockpile may be politically valuable insofar as it helps provide that time.

On the other hand, the creation of an economic stockpile might bring about counterproductive results. It could, for example, be viewed as a threat by foreign producer countries, triggering the imposition of embargoes or adverse pricing policies. Indeed, stockpiling may be perceived by exporting nations as an implicit act of aggression, since it suggests distrust of those foreign nations who control needed U.S. materials. While the timing of stockpile implementation may provide the leverage to weaken a cartel at a moment when the relations between the members are strained, it could likewise coalesce the cartel and elicit threatening responses in terms of price escalations.

The involvement of third-party nations in a manner which could be adverse to U.S. interests is also a possibility, particularly in the case of SP–1. In general two possibilities appear plausible: (1) third-party nations might intervene by supporting exporting nations through direct subsidies, grants, favorable trade arrangements, or the provision of new markets; or (2) other importing nations could become involved by entering into agreements with the United States to form a cooperative effort for emergency sharing of reserves.

The success of the Organization of Petroleum Exporting Countries (OPEC) has been instructive to other producer groups and may affect the formation of other materials cartels. Jamaica, for example, recently took the step of raising the bauxite ore tax by 700 percent, despite its exceptionally vulnerable economic position. Jamaica has an adverse (and worsening) balance of trade, and could benefit from foreign-aid program assistance provided by nations such as the United States. However, Jamaica was convinced that its interests were better served by actions which in no sense appeased or accommodated the United States or other consumer nations. An important, perhaps crucial, factor in such situations may be the willingness of OPEC nations to abet other nations in these desires, z The existence of a stockpile within the United States could have an effect on such activities and could probably affect the creation and operation of consortia in materials being stockpiled, The stockpile would set the minimum level of embargo which a consortium would have to impose to be effective, If the exporters' economies were not strong enough to endure the embargo period implied by the stockpile size, the stockpile would clearly be a deterrent to the formation or operation of a new consortium.

b. Effects on U.S. Domestic Politics.— Economic stockpiling designed to keep the economy strong will probably be welcomed by labor and business in general, because both benefit from high levels of economic activity. However, business or labor directly involved in primary materials production or consumption are more strongly connected to materials supply and price and therefore may have specific, short-term interests which may conflict with each other or with the broader business or labor community. In general, a stockpile may be seen by labor as a means of maintaining jobs in the presence of a supply interruption. In general, a stockpile may be seen by business as a means of stabilizing international price fluctuations. However, labor, business, and other groups will be concerned over the eventual or potential use of the stockpile, regardless of its announced purpose. For labor in the materials production sector, the possibility exists that a stockpile could blunt the threat of strikes. For business in the materials production sector, a stockpile could represent an intervention into the marketplace and the possibility of governmental action adverse to its interest. For these reasons, some sectors of labor and the business community are likely to be wary of the Government's efforts to build and operate an economic stockpile. The interviews conducted in this assessment certainly corroborate such a watchful point of view, and were used as inputs to this impact analysis.

To the extent that the operation of an economic stockpile tends to stabilize cyclic market performance, opposition may be anticipated from producers and consumers who see cyclic market performance contrary to their interests, whereas support may be anticipated from those who find cyclic performance useful. The intended purpose of a stockpile like SP–5, for example, is to insure that materials flows are adequate. This means that the price of the stocked commodity will not be

[2] *Wall Street Journal*, Aug. 13, 1975, p. 9.

influenced by "panic" buying or hoarding when supplies appear short. As price and supply fluctuate, so do employment, loading of transportation resources, capital investment in new plants and facilities, and consumer product prices.

Raw material consumption and prices are cyclic, closely following general economic trends, The cycle is evidenced more significantly in some extractive and production industries than others, in which increasing demand can lead to the construction of new capacity which, when available, provides excessive capacity. Prices then fall and new capacity additions become infrequent. When these facilities are taxed because of rising demand, prices again rise and the cycle reestablishes itself,

Public attitudes with respect to a stockpile like SP–5 could be expected to vary, depending on the phase of the stockpile cycle involved. In general, a stockpile used to alleviate shortages in materials which are produced domestically may be resisted by domestic producers, who could expect to benefit from such shortages. But the stockpile would also, through purchases during periods of oversupply, protect domestic producers from the effects of declining prices. Producers would presumably favor such protection, considered by itself, while consumers would worry about subsidized production resulting in artificially high price levels. The stockpile could be used to prevent unhealthy surges to nonmaintainable price levels during periods of shortage and declines in production during periods of surplus, thereby protecting both consumers and producers in the long run. Nevertheless, many producers and consumers would fear that inadequate information, administrative lethargy and inefficiency, and political pressures would all combine to make an economic stockpile less attractive. On principle, some would also object to the paternalistic and controlled-market aspects of the stockpile.

To implement SP–5, data on materials supply and demand would probably be required from industry in even greater detail than might be required for some of the other four stockpiling policies analyzed. Industry may object to the Government's gathering of such data. A comprehensive stockpiling system could be politically sensitive in this way and could generate strong opposition,

On the other hand, U.S. Government purchases of scarce raw materials (SP-4) could stimulate resource development by minimizing the unsettling effects of temporary declines in discovery rates or variations in prices. Sales from the stockpile at the stabilized higher price might protect domestic industry from the eroding effects of price fluctuations of foreign imports. The stockpile would provide a constant market which could encourage capital formation to support domestic extraction industries and insure minimum and continuing production levels, The assured high price level could encourage the development of new technology, both to enhance production of scarce domestic materials through mining or processing breakthroughs and to provide lower cost and more plentiful substitute materials. It could also be a strategy for preserving within the United States a minimal amount of technical expertise concerning the extraction and production of such scarce materials. For all of these reasons, a stockpile like SP-4 might be favorably received by the relevant producing industries, However, unless a clear, overriding national need were demonstrated for such favored governmental treatment, individual consumers and consuming industries could be expected to object strongly to this market interference which, conceivably, could restrict supply and raise prices.

2. Social Impacts of Economic Stockpiling

Social impacts are difficult to analyze because they are diffuse and vague. These impacts can affect the individual (e.g., mobility and leisure) or society as a whole (perceptions about the world role of the United States); they can relate to institutional or regulatory changes (rationing or allocation programs); or they can bring about social changes of world scope (new patterns of migration and changing social aspirations of other nations),

It is assumed that the United States would remain a consuming society, heavily dependent on the use of resources to achieve what most of its citizens now consider to be a desirable standard of living. This premise naturally leads to policies which help assure uninterrupted flows of materials. Stockpiling may be seen, for example, as an instrument not only for maintaining economic stability, but for encouraging such desirable actions as energy conservation and the development of new material technologies. Yet, the situation leading to the need for an economic stockpile, and the discussions surrounding the implementation and use of such a stockpile, may ultimately contribute to a much more profound impact than any considered explicitly here—i.e., a change in values and expectations with respect to consumption in the United States and around the world.

It is also important to note that some social impacts vary with each phase of stockpiling operation. For example, if petroleum were diverted from imports in significant quantities to help provide a stockpile inventory, mobility could be adversely affected; however if a stockpile were already in place, it could help assure mobility in the presence of an embargo. Social impacts, in particular, have a quality of requiring adverse current or near-term impacts in order to reduce risk or uncertainty in the future.

Of the five stockpiling policies considered, SP–1 could have the most important social impacts. This is true for four reasons:

- The need for, and effort to build, a stockpile is apt to gain national attention, and thus stimulate debate because the quantity of material required for this stockpile policy could be massive;
- The amount of material which would have to be diverted into the stockpile could affect consumption patterns and may require establishing new laws and regulations to allocate or ration materials;
- The stockpiling action itself could change national and international perceptions about the role of the United States on the world scene; and
- The stockpile may be seen either as a valuable concrete action in an otherwise frustrating world situation, or as an attempt to preserve an inefficient lifestyle.

In particular, SP–1 demonstrates the need to weigh potential short-term adverse effects during the stockpile acquisition period against the potential long-term beneficial effects after acquisition has been completed, Acquisition of sufficient stocks to discourage or counteract politically motivated supply interruptions may require temporary domestic allocation or rationing and thereby result in diminished mobility and restricted patterns of leisure activity. However, such acquisition is intended precisely to avoid adverse consequences in the long-term future. Used in anticipation of a unilateral political action or cartel, this policy would divert imported materials or domestically produced materials into a stockpile. The effect of this diversion during the acquisition period could be to raise prices of products utilizing the material and perhaps to limit the availability of the material in some applications. But assurance of the future availability of essential resources could result in stabilized supplies of fabricated goods, so that anticipation of the security offered by the stockpile may be accepted as the justification for diverting material from current consumption. Moreover, as discussed above, the adverse impacts incurred during the acquisition stage can be mitigated or even eliminated by implementing a gradual, rather than a one-shot, acquisition program or by filling the stockpile needs from nonmarket sources, such as existing excess stocks in the strategic stockpile or in defense reserves.

Since the stockpile required by SP–1 would have to be quite large to have a deterrent effect, its operation would probably result in appreciable public discussion and possibly economic dislocations, The question which would naturally follow would be: “Why are consumption and dependency on foreign supplies so high?” Discussions about desirability of growth, utilization of economically marginal domestic supplies, and manipulation of our destiny by foreign powers would be stimulated, The response to such discussions is difficult to forecast and depends on other factors which exist at the time, including in particular the stance of the media, economic conditions, as well as domestic and international political stability.

a. Effects on Prices and Consumer Choice of Products.—The range of choice of products available to the public could be affected as a result of price changes and the differential effect of these changes on various socioeconomic groups. During the creation of a stockpile, the flow of material into the market could be restricted, and its price would probably rise. If this occurred, the price of certain products would also increase, making it more difficult for people in lower socioeconomic levels to purchase the more expensive products. During the disposal phase of the stockpile, however, the effect could be reversed. Of course, it is possible to introduce compensatory legislation which would minimize the regressive effects of stockpiling acquisition.

The major social impact of SP–5, for example, would be to reduce the regressive effects of price changes in society. As pointed out earlier, when prices rise, certain sectors of society are least able to afford more expensive goods and services; therefore, as prices rise, there is a regressive effect on lower socioeconomic groups. This stockpiling policy would help minimize that effect. Furthermore, consumers in general would have a more stable supply of goods, both from the standpoints of price and availability.

However, as mentioned previously in the discussion of political impacts, inadequate information, lethargic or inefficient administration, and political pressure may result in the stockpile’s exacerbating problems rather than solving them. Price-support actions during periods of surplus might result in artificially high prices being maintained over the long-run, Conversely, sales from the stockpile during periods of shortage might be excessive and damage the productive capacity and competitive posture of the producing industry. The potential for intentional or unintentional misuse of a stockpile for SP–5 seems appreciable.

Furthermore, if the stockpile were large enough, diversion of materials into the stockpile could cause temporary shortages and price changes. Such a diversion could have direct adverse impacts on the consumption and personal lifestyles of U.S. citizens for the duration of the acquisition program. However, the temporary adverse impacts potentially attributable to stockpile acquisition could be mitigated or even eliminated by a planned, phased program of acquisition which purposely avoids a large immediate impact on the market. Furthermore, for at least some of the materials considered for stockpiling, nonmarket sources for acquiring materials exist, although it may be desirable to open these sources to the market rather than funneling them directly to a stockpile.

In the case of oil, for example, one plan calls for using the Elk Hills Naval Petroleum Reserve for stockpile purposes.[3] Elk Hills is estimated to contain close to 1 billion barrels of reserves, which can be produced at the rate of approximately 400,000 barrels per day, Similarly, the zinc required for an economic stockpile could be obtained from the 171,955 short tons currently held in excess of the stated objective of the strategic stockpile administered by the General Services Administration (GSA).[4]

[3] Senate Report 327, 94th Cong., 1st sess. 2–4 (1975). Naval Petroleum Reserve No. 4 in Alaska is estimated to contain 10 to 33 billion barrels of oil, but unlike Elk Hills the capability for immediate production does not exist in NPR 4.

[4] Inventory of Stockpile Material as of Oct. 31, 1975, Office of Stockpile Disposal, GSA.

77-119 0- 7'6 -7

b. Effects on Perceptions of United States in World Affairs.--One subtle social impact of SP–3, which concerns international materials market stabilization, would be to promote changes in perceptions about the abilities and role of the United States on the world scene. This policy would likely be part of an international commodity agreement; however, in some instances, it could be implemented as a unilateral stockpile. Ideally, it would involve both producing and consuming countries, and the stockpile would serve as a buffer stock to be built when prices are low and supply is high and utilized in the reverse circumstances. The exact nature of this impact will depend on many external factors which exist at the time, including in particular foreign nations' perceptions of the intent of the stockpile. Within the United States, if the stockpile is seen as a responsible and effective means of exerting control over national policy, it could help promote political cohesiveness.

3. Market Operations Impacts

Economic stockpiling entails acquisition and disposal of materials in excess of normal demand and supply at the time of purchase and sales. At the very least, an economic stockpile overhangs the market as a force in being which cannot but affect market behavior. Insofar as its object is to prevent or counteract supply interruptions, the stockpile alters the risks and rewards of normal market actors. Insofar as its object is to alter terms between buyers and sellers, it constitutes direct, purposeful intervention to change the consequences of normal market operations to bring about results more compatible with the policy objectives.

Stockpiling operations are likely to be invoked in circumstances of shortage or threat of shortage, surplus or threat of surplus, or wide price fluctuations. These are the very circumstances in which the normal actors in the marketplace are most likely to be big gainers or big losers. This inherent ability of the stockpile to affect winnings and losings not only alters the patterns of private risk decisions (to invest, produce, buy, sell, inventory, etc.); it makes the stockpile administration the object of extreme pressures from private risk-takers to influence the buy/sell decisions. Stockpiling may also have an adverse effect on investment, insofar as the overhanging stocks threaten to truncate the upper end of the price range and thereby add arbitrary, nonmarket risks to investment.

Discouraging investment is one consequence of the unpredictability of market behavior which, in the presence of relatively large stocks subject to administrative control, can result in "excessive accumulation in the first instance and subsequent massive dismantling in the second, disrupting the minerals economy in both phases. "[5] Of course, what is "excessive" or "massive" depends on the purposes to be served and the quantities to be bought, sold, or held to achieve them. What is suitable as the amount of material to be stockpiled may be "excessive" to those who are dealing commercially in the market for materials. Indeed, such stockpile amounts, which are themselves often a matter of dispute within the Government, may change with circumstances (or administrations), leaving the market to cope with run-up or liquidation of stocks, which may be sudden by market standards.[6] The American Mining Congress contends that an economic stockpile should be surrounded by strict safeguards to avoid effects which will "obstruct the natural function of a free market. "[7]

The markets for stockpiled materials are generally worldwide. For many, the demand fluctuates cyclically, as do the corresponding price fluctuations. Market intervention in the form of stockpiling might either moderate or exaggerate the market behavior, depending on the purpose, the timing, and the management of the stockpile, In any case, the overhanging stockpile could depress the price level

[5] *American Mining* Congress journal, "A- Declaration of Policy, 1974-1975" (Oct. 6, 1974), p. 7.
[6] See Case Study, "Release of Copper from the Stockpile" Appendix B.
[7] American Mining Congress.

throughout the market cycle even where that was not its intent.

These market impacts obviously affect the distribution of risks and rewards between producers and consumers, both intra- and international. The impacts on less-developed countries can be particularly felt. In many cases, such countries have seen themselves as exploited suppliers of raw materials at low prices and importers of high-priced manufactured goods.[8] They perceive the periods of high prices as their only opportunities for equitable treatment, and in this view, a U.S. economic stockpile would appear as a threat which would diminish their market power in periods of heavy demand or interruptions in supply. But in many countries and materials, time and events have overtaken this view: the growing demands and diminishing supplies of certain minerals are changing the terms of trade and have led to demands from less-developed countries for a more positive role in the decisions governing supply and price. The United States is now having to reckon with these changing relationships.[9]

The growth of world demand, coupled with the spectacular success of OPEC, has encouraged the less-developed countries to demand both higher prices for their exports and protection against continued inflation of the prices for their imports. While it has traditionally resisted these demands, the United States appears to be moderating somewhat in the direction of accommodation with the positions of the less-developed countries.[10]

The economically weak suppliers of mineral raw materials in the past have pressed for international "stabilization" agreements which would have the effect of regulating supply and setting floor and ceiling prices. As a principal importer, the United States has been reluctant to enter into such agreements, professing a preference for competitive markets and in any case resisting output restrictions which it regards as too high, However, the United States has recently signed the Fifth International Tin Agreement (ITA) which is now before the U.S. Senate awaiting consent and ratification. The ITA is the only operational international commodity agreement for a metal.

Many of the materials which are candidates for stockpiling are actively traded in nationwide or worldwide markets which mediate between producers and users. Stockpiling, as an explicit mode of government intervention in the market for public purposes, can markedly affect market and price behavior by upsetting the expectations of buyers and sellers.[11] Sometimes, in cases where markets are sensitive and prices volatile, these effects can be quite out of proportion to the quantities acquired or sold,

When current or forward market prices are built into production or pricing decisions of suppliers or users of important materials, as may be the case with aluminum or copper, market intervention may have a destabilizing effect. One such effect may be felt if the result of the stockpiling is to activate high-cost domestic suppliers who may find themselves unable to compete commercially when the stockpiling objective is achieved. This can happen in the commercial market also, of course, but it is then the result of market forces and market risks, not necessarily public policy decisions. These actions add to uncertainties and may upset competitive relationships, perhaps even the locus of production and employment.

On the other hand, successfully executed stockpiling operations in support of public ob-

---

[8] This view was formulated systematically by Raoul Prebisch in a series of papers issued by the U.N. Economic Commission for Latin America, and is currently being voiced at the UNCTAD IV discussions in Nairobi.

[9] See, for instance, the speeches of the U.S. Secretary of State to the Kansas City international Relations Council, May 18, 1975, and to the U.N. General Assembly, Sept. 1, 1975.

[10] See *New* York Times (Aug. 27, 1975), p. 1.

[11] For example, the decision of the International Monetary Fund to dispose of so million ounces (about $7.5 billion) of the gold from its "stockpile" drove down not only the price of gold but sympathetically the price of silver. New York Times, Sept. 3, 1975, p. 49.

jectives could, if pursued steadfastly and consistently over time, reduce uncertainty by bounding risks and the consequent market behavior. In this respect, stockpiling might have an effect analogous to that of the currency support operations of central banks in a system of floating exchange rates, by putting all parties on notice that the permissible range of fluctuations would be limited by government action. A comparatively small stockpile of raw sugar, for example, might have moderated the runaway sugar market in the latter part of 1974. Once suppliers, users, and intermediaries become convinced and accustomed to the stockpiling operations, such operations could reduce the risks on all sides and permit production and consumption decisions on the basis of efficiency within those bounds.

Under these conditions, the operators of the stockpile undertake the burden of performing the functions of the market in allocating scarce resources, many of which are becoming scarcer and more costly, as well as differentiating between market manipulation and real changes in the supply prices for the quantities demanded. This is far more difficult than short-term supply or price stabilization. Because public policy objectives may be incompatible with economic efficiency, public management may have adverse and difficult-to-forecast economic effects on the allocation and use of resources. The history of regulation of natural gas is perhaps an inexact but nevertheless useful analogy. These incompatibilities can generate both economic and political impacts: the economic impacts arising from the changes in the burden of risks/rewards and the distortion of the normal market incentive effects on supply/demand; the political impacts of interests, regions; and nations trying to influence management decisions to their advantage.

SP-4, for example, could have a significant impact on the evolution of domestic industry since it would, in effect, establish a "floor" price for various materials in short supply. Known economic objectives for development of substitute materials would be set. In addition, as cost levels change, the economic incentive to develop indigenous marginal resources and substitute materials could also change.

A U.S. economic stockpile could provide a floor price for a particular material as a means of stimulating industries which are now economically "submarginal" but which have a potential for becoming stable industries in the near future. Furthermore, providing a floor price would encourage investment in research to develop substitute materials, since the federally backed price would provide an economic goal for the new technological development. Within the social domain, the consequences of shaping technology in this way include reducing dependency on imports, losing other technological opportunities as a result of diversion of manpower and skills, changing future product mix and costs, stimulating opportunities for spinoff technologies, and creating technologies which may be well suited for export.

In achieving these policy objectives, SP–4 could also affect the domestic environment. Extractive industries would be encouraged to develop marginal resources so that the materials extracted could be used at a later date. Planning for this policy must therefore include careful consideration of such environmental factors as land use (including questions relating to the use of Federal lands), availability of water, and land restoration and runoff.

The impacts of an economic stockpile on market operations can be summarized in four major points:

(1) The operation of an economic stockpile is an intervention into the market and as such it could obstruct the natural functioning of the market. This interference could pose certain elements of risk to consumers, producers, and stockpile investors;

(2) If the stockpiling objectives were pursued in a constant and consistent fashion, the market uncertainty and risk

created could be bounded, most likely within acceptable levels;

(3) Some of the possible problems which may occur could be short-run and transitory in nature and do not appear to be significant impediments to policy implementation; and

(4) There may well arise possible conflicts between economic efficiency and policy objectives due to political objectives in a spacific stockpiling situation. This could be a crucial issue in ultimate acceptance of stockpiling as a policy alternative.

B. ECONOMIC IMPACTS OF STOCKPILING TO DISCOURAGE OR COUNTERACT CARTEL OR UNILATERAL POLITICAL ACTIONS AFFECTING PRICE OR SUPPLY (SP-1)

The Economic Welfare Model as presented in chapter IV is a method for assessing, in specifically estimated dollar amounts, the possible economic impacts of a stockpile to discourage or counteract cartels or unilateral political actions affecting price or supply. The derivation of the Economic Welfare Model for SP-1 is logically divided into two steps: (1) creating a decision tree to identify the spectrum of events which can possibly occur, and (2) developing the cost and benefit functions related to the policy objectives in order to estimate the probable economic net benefits.

The decision tree for SP–1 is shown in figure V–1, As in game theory, the tree identifies the possible damages, costs, and damages averted (consequences) as a result of cartel events occurring when a stockpile does not exist, or when a stockpile does exist, The probability associated with each event is noted on the branches of the tree.

The cost function used to estimate the possible costs of implementing SP–1 is explained in chapter IV; the benefit function used to estimate the possible benefits of SP–1 is explained immediately below. In evaluating the benefit function, one should note the difference between the possibility (certainty) and the probability of an event's occurring, The Economic Welfare Model, used to estimate when and how much of a material should be included in a particular stockpile, is based on the probability that some event affecting the normal flow or price of a material will occur. For example, approximately **28** percent of the zinc presently used in the United States is imported from Canada (55 percent of the total U.S. zinc imports), thus there is the possibility that 28 percent of the zinc requirement could be disrupted by an event which cuts off this supply. However, the probability of such an event happening is very small. Therefore, to stockpile a quantity of zinc metal equal to 28 percent of the U.S. requirement assumes that the event would happen with a probability of 1. That is unrealistic and would lead to a stockpile far in excess of real requirements.

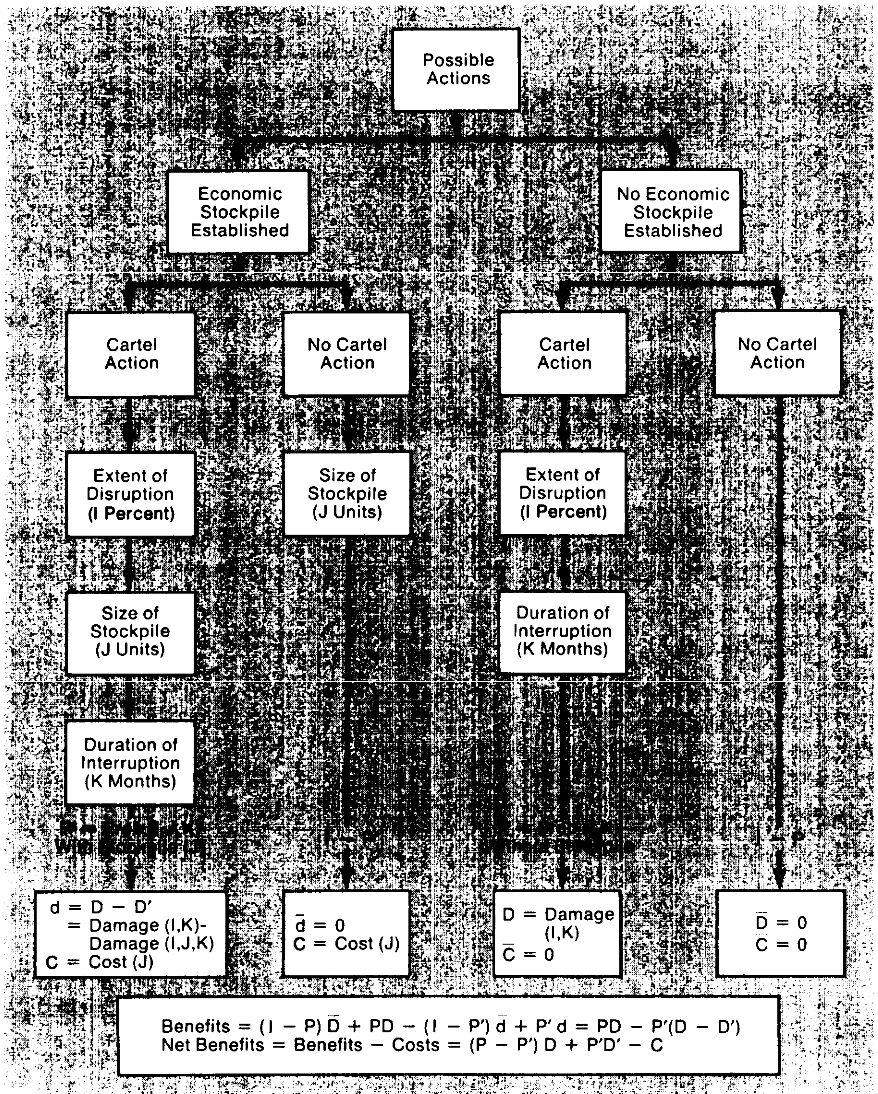
1. Derivation of Benefit Function for SP–1

The decision tree for SP–1 indicates that a stockpile for SP–1 will have two inherent benefits:

- Those derived from the aversion of a cartel or unilateral political action, and
- Those derived from the counteraction of such action after it has occurred.

The benefits derived over the coming time period depend on whether a cartel or unilateral action artificially restricts supply or raises prices, If either event occurs, the benefits are equal to the potential damage to

Figure V-1.
Decision Tree for SP-1



the United States which the stockpile prevents. If neither action occurs because the existence of the stockpile discouraged them, the benefits are equal to the damage averted. Since it is impossible beforehand to know whether such an action will or will not occur, the optimal level of stocks should be determined on the basis of the expected benefits. For a stockpile of a given size, these benefits are equal to: (1) the damage which the stockpile could counteract, multiplied by the probability that a cartel or unilateral action will occur even though the stockpile is in existence; plus (2) the damage which the stockpile averts through discouragement of a cartel or unilateral action, multiplied by the probability that the action would occur without a stockpile.

The damage and probability products are multiplied by 1 plus a risk aversion factor (l+r) which reflects society's reluctance to be exposed to damaging events. The risk aversion factor is analogous to an insurance policy covering a highly damaging (costly) event which has a very low likelihood of occurring. The risk aversion factor is relevant principally when the economic net benefits are negative or the damage not averted by the stockpile is large (presumably due to low probabilities)—enabling the stockpile managers to consider whether a value for r exceeding zero would be appropriate for the specific policy and material being considered. That is, if the event could be sufficiently disastrous (regardless of the probability of its occurrence) that expenditures above those economically justified would be reasonably committed, some positive value assigned to r would increase the expected benefits to the point that economic benefits become positive. That is,

(9a)

where

- B = benefits
- r = risk aversion factor
- D = damage of the action without stockpiling
- D' = damage counteracted with the stockpile
- P = probability of the action without stockpiling
- P' = probability of the action when a stockpile exists

Equation (9a) implicitly assumes that only one type of action by a cartel or unilateral action can occur. Of course, this is rarely, if ever, the case. Conceivably, such actions can embargo anywhere from zero to 100 percent of imports. They can raise prices so high that all imports cease or so little that the domestic demand for imports is negligibly affected. They can last a few weeks or several years. In order to consider the range of possibilities as depicted in the decision tree, equation (9a) can be modified as shown in equation (9b).

$$B=(1+r)\sum_{i}\sum\left[D_{ik}(P_{ik}-P'_{ik})+D'_{ik}P'_{ik}\right] \quad (9b)$$

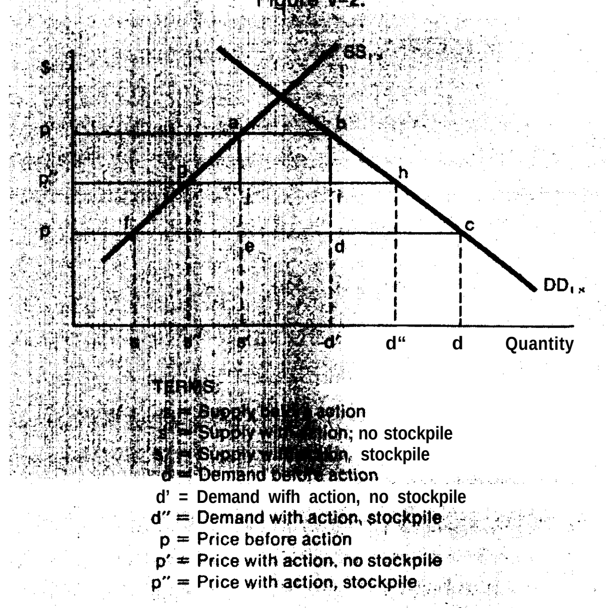
where

- i = the categories representing extent of import disruption
- k = the categories representing duration of the disruption in months

The expected benefits of a stockpile are equal to the probability that imports will be restricted in the time period considered (due either to an embargo or the imposition of higher prices) multiplied by the damage this would cause, both with and without the stockpile. The import disruptions considered must encompass the entire spectrum of possible import disruption with regards to both percent and duration of interruption. The probability that any cartel or unilateral action will occur must be less than or equal to one. Therefore, the probabilities of possible interruptions can be developed to encompass the entire spectrum of events.

The damage incurred by the United States in the event of a cartel or unilateral action which restricts imports by 50 to 75 percent, for example, depends in part on the net loss of consumer surplus caused by the rise in price. Figure V–Z (below) illustrates this loss by the trapezoid abcf on the assumption that the cartel or unilateral action in the absence of a stockpile would raise the price to domestic consumers from p to p'. Again, it is important

Figure V–2.



to point out that the actual loss to domestic consumers is p'bcp, an amount which could appreciably exceed abcf. The difference, however, goes to domestic producers as a transfer payment and does not represent a loss of real resources to the country.

If the stockpile is large enough to discourage a cartel or unilateral action, then the damage averted (D) includes all of trapezoid abcf, If a cartel or unilateral action occurs even though a stockpile exists, then the damage which can be counteracted depends upon the size of the stockpile. If the stockpile were large enough to keep the price of the material in question from rising above p, the damage counteracted would include all of the trapezoid abcf. If this were not the case and the stockpile could only keep the price from rising from p', the savings in consumer surplus would be indicated by the trapezoid abhg.

Since damages expressed in the benefit function are expected damages (i.e., dependent on the specified probability of an import interruption), the optimal stockpile size is unlikely to avert all damages. In figure V–2 above, the stockpile is sufficient only to reduce the price to p". Hence, the damage which the stockpile is not able to avert is the trapezoid ghcf. Consequently, estimation of damage not averted is important if policy makers are to intelligently address the tradeoff between higher stockpile costs and the damage not averted.

The probability (P_{ijk}) that an action will Occur with a stockpile in existence is dependent upon the size of the stockpile. Likewise, the damage (D_{ijk}) counteracted is also dependent upon stockpile size as reflected in the price reduction (p") achieved by release of stocks, The benefits (B) of a stockpile of size (Q_i) are given by the following equation:

$$B_i = (1+r)\sum\sum_k [D_{ik}(P_{ik}-P'_{ijk}) + D'_{ijk}\ P_{ijk}] \quad (9c)$$

where j = identifier of a stockpile of size Q_j

As pointed out in chapter IV in the discussion of the cost function, a price rise may impose, in addition to the net loss in domestic consumer surplus, external costs on society which are not borne by the consumers of the material. For as the latter cut back their production, their suppliers may be hurt and their employees laid off. There may be external costs of a different nature as well. For example, cartel and unilateral actions of the type considered here tend to aggravate international relations between the United States and other countries. The benefits which a stockpile produces by avoiding or reducing these external costs should be counted in the benefit function.

The damage (D_{ik}) a stockpile discourages for a cartel or unilateral action of i percent, k month is estimated from the following equation, so that:

$$D_{ik} = CS_{ik} - PL_{ik} + ED_{ik} \quad (10)$$

where

D_{ik} = damage without stockpile
CS = consumer surplus without stockpile
PL = producer loss without stockpile
ED = external damage without stockpile

From figure V–2:

$$CS = d'(p'-p) + 1/2(d-d')(p'-p) \quad (11a)$$
$$PL = s'(p'-p) - 1/2(s'-s)(p'-p) \quad (11b)$$

which gives the damage function of:

$$D_{ik} = 1/2(s_{ik}-s)(p_{ik}-p) + 1/2(d-d_{ik})(p_{ik}-p) + (d_{ik}-s_{ik})(p_{ik}-p) + ED_{ik}) \quad (11c)$$

where

s = supply without an action
P = price without an action
d = demand without an action

The total damage to the United States is equivalent to the counteracted damage (Dijk) of a stockpile of sufficient size (Q_j) which completely offsets the cartel or unilateral action—i.e., a quantity large enough to lower the price (p") so that it equals the price (p) prior to the cartel or unilateral action.

Once all of the components of equations (10) and (11) are estimated, the damage averted can be calculated. The expected economic benefit of a stockpile of size (Q_j) can be calculated from equation (llc), given society's aversion to risk (r) and the probabilities (P_{ik} and P_{ijk}) associated with cartel or unilateral actions. It should be noted that the probabilities of a cartel or unilateral action effecting a given reduction in imports are likely to decrease as the size of the stockpile increases, since the larger the quantity the smaller and more distant are the benefits of such an action to exporting countries. To trace out the entire benefit function, the calculations described above should be repeated for stockpiles of various sizes,

The foregoing discussion implies that the damage(D'_{ijk}) a stockpile could counteract, should a cartel or unilateral action cut imports by i percent fork months, can be estimated by:

$$D'_{ijk} = CS'_{ijk} - PL'_{ijk} + ED'_{ijk} + CG_{ijk} \qquad (12)$$

where D', CS', PL', and ED' are defined in equation (10) and CG_{ijk} capital gains (losses) accrued by disposal of the stockpile.

From Figure V–2:

$$CS' = d'(p'-p'') + 1/2(d''-d')(p'-p'') \qquad (13a)$$
$$PL' = s'(P'-p'') - 1/2(s'-s'')(p'-p'') \qquad (rib)$$

which give the damage function of:

$$D'_{ijk} = 1/2(s_{ik}-s_{ijk})(p_{ik}-p_{ijk}) + 1/2(d_{ijk}-d_{ik})(p_{ik}-p_{ijk}) + (d_{ik}-s_{ik})(p_{ik}-p_{ijk}) + ED'_{ijk} + CG_{ijk} \qquad (13c)$$

where

S_{ik} = supply when the action occurs without stockpiling

s_{ijk} = producer supply with disposal of the stockpile j

p_{ik} = price when the action occurs without stockpiling

p_{ijk} = price with disposal of the stockpile j

d_{ik} = demand when the action occurs without stockpiling

d_{ijk} = demand with disposal of the stockpile j

The first term on the right-hand side of equation (13c) estimates the savings in consumer surplus which arise because domestic producers incur a smaller increase in real incremental costs due to the fact that their output increases only to s" rather than s'. As figure V–2 illustrates, this savings (which is reflected by the triangle ajg) is equal to one-half the increase in domestic supply, which did not occur due to stockpile releases, multiplied by the increase in price, assuming the domestic supply curve is approximately linear in the price range p" to p'.

The second term in equation (13c) estimates the savings in consumer surplus which occurs because fewer consumers of the material are driven out of the market. This savings is reflected in figure V–2 by the triangle bhi. Equation (13c) assumes that the demand curve over the relevant price range is linear so that this component of consumer surplus can be estimated by one-half of the product of the prevented increase in domestic price and decrease in domestic demand.

The third term of equation (13c) represents the savings in consumer surplus which arise because the price paid to foreign producers is kept at p", rather than being permitted to rise to p', This savings is reflected in figure V-2 by the rectangle abij. It can be estimated by the product of the prevented price increase and the level of imports which would occur at the price p',

The fourth term (ED') reflects the savings produced by the stockpile in the external damages which are not borne by the users of the material. The first three terms can be approximated on the basis of estimates of the prevented price increase (p'–p") and the elasticities of domestic supply and demand which apply for the time period and price range being considered. It is far more difficult to estimate ED'.

The fifth term, capital gains or losses (CG), related to disposal of a portion or all of the stockpile are determined from the difference between the acquisition and disposal prices. These gains (or losses) are added to the damages averted for counteraction of a specific interruption as given in equation (12). Capital gains (losses) were explicitly computed for stockpiling policies 3, 4, and 5 in order to illustrate its application and test the sensitivity of this variable. Capital gains ('losses) were set at zero for policies 1 and 2.

2. Types of Economic Impacts Associated With SP-1

Four types of economic impacts resulting from stockpiling under SP–1 can be estimated using the Economic Welfare Model:

- Direct benefits and costs to materials producers,
- Direct benefits and costs to materials consumers,
- Benefits and costs borne by the stockpile investor, and
- External benefits and costs resulting from stockpile operation.

These benefits and costs occur in each of the three phases of the operation of an economic stockpile, Estimates of each of the four types of economic impacts have been made and are presented following this discussion.

a. Materials Producers Incur Direct Gains or Losses in Domestic Producers Surplus.—Materials producers are impacted during all three phases of the operation of an economic stockpile under SP–1. During acquisition, the materials producers derive a gain from the increased demand for a commodity and the resulting higher prices. The holding phase of stockpile operation does not generate actual losses for materials producers; however, during this phase the existence of the stockpile will prevent producers from reaping gains as a result of a cartel or unilateral action. That is, the producers will not be able to sell the commodity at increased prices and obtain excess profits.

The direct benefits and costs to materials producers can be estimated by the gain or loss in domestic producer surplus. During stockpile acquisition, the direct producer gain (PG) is dependent upon the rate of commodity accumulation and the resultant price impact of the accumulation. The direct producer loss (PL) during the disposal stage can be determined from the damage function and the probabilities that an event will occur.

b. Materials Consumers Incur Direct Gains or Losses in Domestic Consumer Surplus.—Materials consumers are impacted concurrently with materials producers under SP–1. When the materials producers incur a direct gain, the materials consumers incur a direct loss, and vice versa. The difference between the direct consumer loss and the direct producer gain is the net loss (savings) in domestic consumer surplus, During the acquisition phase of an economic stockpile under SP–1, the materials consumers suffer a direct loss due to the increased price of the stockpiled commodity. The materials consumers realize a direct savings or gain in the holding and disposal stages as a result of discouraging or counteracting cartel or unilateral actions,

The direct benefits and costs to materials consumers can be estimated by the savings or loss of domestic consumer surplus. As with direct benefits and costs to the materials producer, the direct impact on materials consumers is the expected loss or savings.

c. Direct Benefits and Costs Are Borne by the Government In Operating the Economic Stockpile.—These costs are the initialization costs during the acquisition phase, the holding costs, and the disposal costs, The direct benefits of the stockpile operation are the capital gains (or losses which give negative benefits) realized upon disposal of the material in the stockpile. Under SP–1, capital gains or losses can only be realized if the stockpile is used to counteract a cartel or unilateral action when it occurs. Therefore, the benefit is the expected capital gain or loss, which is the possible capital gain or loss multiplied by the probability that a cartel or unilateral action will occur,

d. External Benefits and Costs are the Indirect Economic Costs and Benefits of the Stockpile.—These externalities are included in the cost and benefit functions of the

Economic Welfare Model. The external costs of acquisition and the external costs averted through holding materials to discourage cartel or unilateral actions and of disposing materials to counteract such actions are a major portion of the economic net benefits of an economic stockpile,

These externalities, which are caused by stockpile operation and cartel or unilateral actions, arise from the indirect effects of price changes or supply interruptions, These indirect costs are not easily attributable to either materials producers or consumers, but apply generally to the producers, the consumers (both immediate, intermediate, and final), as well as to other parties,

3. Estimation of Economic Net Benefits for SP-1

Calculations are presented for a key material in order to demonstrate the use of the Economic Welfare Model as a means of estimating, on a macroeconomic scale, the economic net benefits to the United States of economic stockpiling. For the input variables specified, the calculated values were produced by computer program.

Petroleum has been selected as the example material to demonstrate how the Economic Welfare Model can be used to determine when and how much petroleum should be stockpiled to achieve the two objectives of SP–1. The calculations related to this example demonstrate that the quantity of a material to be stockpiled should properly be based upon the probability of a supply interruption, rather than on the possibility of such interruption.

a. Background Information.—The values and assumptions for the key parameters used in the estimations are summarized below.

- Postembargo U.S. demand for petroleum remains constant at 6,010 million barrels per year, of which 2,000 million is met by imports,
- U.S. domestic supply remains constant at 4,010 million barrels,
- There is a price response to changes in the supply which varies with the intensity and duration of import interruption,
- All petroleum consumed in the United States is valued at a post-1973 embargo price of $10 per barrel.
- External costs are estimated indirectly by establishing a relationship between changes in GNP and the U.S. demand for energy. For the period 1950–72, petroleum accounts for about 46 percent of the gross energy used. This relationship then permits, based on the best estimate of experts, an approximate determination of the loss in GNP resulting from an interruption of imports of petroleum.
- The probabilities of varying levels and durations of import interruption have been specified for situations with and without a stockpile. These probabilities are shown in table V–1.

The estimation of probabilities consists of two steps: first, to define the range of possible import interruptions; and second, to estimate the probability of an event occurring in each interval of the range of interruptions. It is important to note that the selected intervals of interruption span both the percentage and duration of the spectrum of possible interruptions. The discrete interruptions used in the following calculations are the median points of the intervals and represent the interval in which they occur,

For SP–1 the probability estimates considered the following factors with respect to the material under review: the existence or nonexistence of a carte]; the likelihood. of an effective cartel 1ike OPEC; and the likelihood of unilateral political actions,

That other cartels could be formed is influenced by such actions as are oc-

Table V–l.—Probability of cartel action without a stockpile*

‘/0 Import Interruption			Months of Duration					
			o	0-2	2-4	4-8	8	Total
No Interruption								0.0
	i	k		1	2	3	4	
0-1o	1			0.0	0.0	0.0	0.0	0.00
10-40	2			0.0	0.36	0.27	0.0	0.63
40-60	3			0.0	0.27	0.1	0.0	0.37
60-100	4			0.0	0.0	0,0	0.0	0.0
Total				0.0	0.63	0.37	0.0	1.00

● Precision on the probability values is due to the averaging of values specified by three or more material specialists.

Probability of cartel action with stockpile Q_1*

‘/0 Import Interruption			Months of Duration					
			o	o-2	2-4	4-8	8	Total
No Interruption			0,70					0.70
	i	k		1	2	3	4	
0-1o	1			0.0	0.0	0.0	0.0	0.0
10-40	2			0.0	0.05	0.10	0.0	0.15
40-60	3			0.0	0.10	0.05	0.0	0.15
60-100	4			0.0	0.0	0.0	0.0	0.0
Total			0.70	0.0	0.15	0.15	0.0	1.00

● (Q_1=250 Mil bbl)

Probability of cartel action with stockpile Q_2*

% Import Interruption			Months of Duration					
			o	0-2	2-4	4-8	8	Total
No Interruption			0.91					0.91
	i	k		1	2	3	4	
0-1o	1			0.0	0.0	0.0	0.0	0.0
10-40	2			0.0	0.0	0.02	0.0	0.02
40-60	3			0,0	0.02	0.05	0.0	0.07
60-100	4			0.0	0.0	0.0	0.0	0.0
Total			0.91	0.0	0.02	0.07	0.0	1.00

● (Q2=500 Mil bbl)

Probability of cartel action with stockpile Q_3*

‘/0 Import Interruption	Months of Duration	Total
No Interruption		1.0
Total		1.0

*(Q_3=1 Bil bbl

curring now with respect to chromite. Shipments of chromite from Rhodesia to the United States have been hindered more and more by slowdown tactics in neighboring Mozambique. Rhodesia is landlocked and forced to ship by rail to ocean ports in Mozambique. Ships have been known to depart half loaded with chromite after 70 days of loading. This has become more forceful, and sanctions are being invoked by the United Nations.

b. Input Values.—The values for the input variables to the computer program for SP–1 are listed in table V–2. This table lists the mathematical symbol, the name or description of the variable, the units of measure, and the numerical value of the input variable for each. The calculations for SP-1 were performed by computer program for the input variables listed in table V–2.

c. Calculated (Output) Values.—The values for the output variables calculated by computer program for SP–1 are listed in table V–3. This table lists the mathematical symbol, the description of the variable, and the numeral value of the output variable for each stockpile j.

d. Graphic Representation of the Calculation.—Figure V–3 is a graphic representation of the calculated costs, benefits, and net benefits for the SP–1. The values were com-

Table V–2.—Input Variables SP–1

Math Symbol	Program Symbol	Description	Units	Either not dependent on J, or J=1	J=2	J=3
Q_j	Q	Stockpile size	Million Barrels	250.	500.	1000,
c .	Cu	Unit Cost	$ per Barrel	10.00	10.30	11.
c_f	CF	Fixed initialization cost	Million $	0.5		
c“	CV	Variable initialization cost	$ per Barrel	5.		
	XI	Interest rate	Percent per year	0.08		
d	SLR	Spoilage loss rate	Percent per year	0.0		
s	SC	Storage cost	$ per Barrel per year	1.0		
c_d	CD	Unit disposal cost	$ per Barrel per year	0.0		
P	P	Price	$ per Barrel	10.00		
P':	PP	Increased price	$ per Barrel	10.0	10.3	11.0
1	D	U.S. demand at price p	Million Barrels	6010.		
d’j	DP	U.S. demand at price p’	Million Barrels	6010.	5969.	5872.
s	S	U.S. supply at price p	Million Barrels	4010.		
s’j	SP	U.S. supply at price p’	Million Barrels	4010.	4010.	4010,
EC_j	EC	External cost	Million $	0.0	873.270	2923.5
R	R	Risk aversion factor	Coefficient	0.0		
$c\ g_j$	CG	Capital gains	Million $	0.0	0.0	0.0
Q_{dj}	QD	Stockpile disposal	Million Barrels	0.000	.000	.000

Math Symbol	Program Symbol	Description	Units	J=I	K=1	K=2	K=3	K – 4
ED_{ik}	ED	External damage - no stockpile	Million $	1=1	.000	.000	.000	.000
				1=2	.000	11863.00	23458.00	.000
				1=3	.000	23458.00	47458.00	.000
				1=4	.000	.000	.000	.000
P'_{ik}	PWOS	Price without stockpiling	$ per Barrel	J = I				
				1=1	10.0	10.0	10.0	10.0
				1=2	10.0	12.0	14.0	10.0
				1=3	10.0	11.75	13.3	10.0
				1=4	10.0	10.0	10.0	10.0
S'_{ik}	SWOS	Supply without stockpiling	Million Barrels	J = I				
				1=1	4010.	4010.	4010.	4010.
				1=2	4010.	4010.	4010.	4010.
				1=3	4010.	4010.	4010.	4010.
				1=4	4010.	4010.	4010.	4010.
d'_{ik}	DWOS	Demand without stockpile	Million Barrels	J = I				
				1=1	0.0	0.0	0.0	0.0
				1=2	0.0	5885.0	5760.0	0.0
				1=3	0.0	5760.0	5510.0	0.0
				1=4	0.0	0.0	0.0	0.0

Table V–2.—Input Variables SP-1—continued

				J=l	K=l	K=2	K=3	K – 4
P'_{ik}	PROB	Probability of cartel action without stockpile	Percent per year	J=1				
				1=1	0.0	0.000	0.000	0.00
				1=2	0,0	0.364	0.273	0.00
				1=3	0.0	0.273	0.090	0.00
				1=4	0.0	0.000	0.000	0.00
ED_{ijk}	EDP	External damage - with stockpile	Million $	J=1				
				1=1	0.000	0.000	0.000	0.000
				1=2	0.000	0.000	0.000	0.000
				1=3	0.000	0.000	47458.000	0.000
				1=4	0.000	0.000	0.000	0.000
				J=2				
				1=1	0.000	0.000	0.000	0.000
				1=2	0.000	0.000	23458.000	0.000
				1=3	0.000	23458,000	0.000	0.000
				1=4	0.000	0.000	0.000	0.000
				J=3				
				1=1	0.000	0.000	0.000	0.000
				1=2	0.000	11863.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0.000	0.000	0.000	0.000
P'_{ijk}	PWD	Price with disposal of stockpile j	$ per Barrel	=1,2.3				
				1=1	10.0	10.0	10.0	10.0
				1=2	10.0	10.0	10.0	10.0
				1=3	10.0	10.0	11.65	10.0
				1=4	10.0	10.0	10.0	10.0
S''_{ijk}	SWD	Producer supply with disposal of stockpile j	Million Barrels	=1,2,3				
				1=1	4010.	4010.	4010.	4010.
				1=2	4010.	4010.	4010.	4010.
				1=3	4010.	4010.	4010.	4010.
				1=4	4010.	4010.	4010.	4010.
d''_{ijk}	DWD	Demand with disposal of stockpile	Million Barrels	=1,2,3				
				1=1	6010.	6010.	6010,	6010.
				1=2	6010.	6010.	6010.	6010.
				1=3	6010.	6010.	5980.	6010.
				1=4	6010.	6010.	6010.	6010.
P'_{ijk}	PRCBP	Probability of cartel action with stockpile Q_j	Percent per year	J=1				
				1=1	0.000	0,000	0.000	0.000
				1=2	0.000	0.050	0.100	0.000
				1=3	0.000	0.100	0.050	0.000
				1=4	0.000	0.000	0.000	0.000
				J=2				
				1=1	0.000	0.000	0.000	0.000
				1=2	0.000	0.000	0.020	0.000
				1=3	0.000	0.020	0.050	0.000
				1=4	0.000	0.000	0.000	0.000
				J=3				
				1=1	0.000	0.000	0.000	0.000
				1=2	0.000	0.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0.000	0.000	0.000	0.000

Table V-3.—Calculated results for SP–1

Symbol	Description	Economic impacts of stockpiling petroleum (Billions of dollars)* J=1	J=2 (Millions of barrels)	J=3
		250,000	500,000	1,000,000
NB_j	Net benefits	19.1	19,0	14.5
B:	Benefits function	20.8	23.9	26.3
C:	Cost function	1.7	4.9	11.7
E(DN)	Expected damage not averted	5.4	2.4	.000
	Benefit variables:			
	With stockpiling:			
$E(PL'_j)$	Expected producer loss	3.1	1.1	0.000
$E(CS'_j)$	Expected consumer savings	4.44	1.6	.000
$E(ED'_j)$	Expected external damage	2.4	.9	.000
	Without stockpiling:			
$E(PL_j)$	Expected producer loss	7.1	9.3	10.4
$E(CS_j)$	Expected consumer savings	10.3	13.7	15.3
$E(ED_j)$	Expected external damage	13.7	18.1	21.4
	Cost variables:			
HC_j	Holding costs	.5	.9	1.9
	Initialization costs	1.3	2.5	5.0
LEWj	Loss in economic welfare	.000	.6	1.9
CL_j	Consumer loss	.000	1.8	5.8
PG_j	Producer gain	.000	1.2	4.0
DC_j	Disposal cost	.000	.000	.000
OC_j	Operating costs	4.2	8.6	17.9
AC_j	Acquisition costs	2.5	5.2	11.0
**	Economic impact of no stockpile	20.8	23.9	26.3

* All calculations have been rounded for simplicity

**The economic impact of no stockpile is equivalent to the benefits (expected damages averted) attributed to the stockpile which are foregone in the absence of the stockpile,

puted for only three stockpile sizes and zero stockpile.

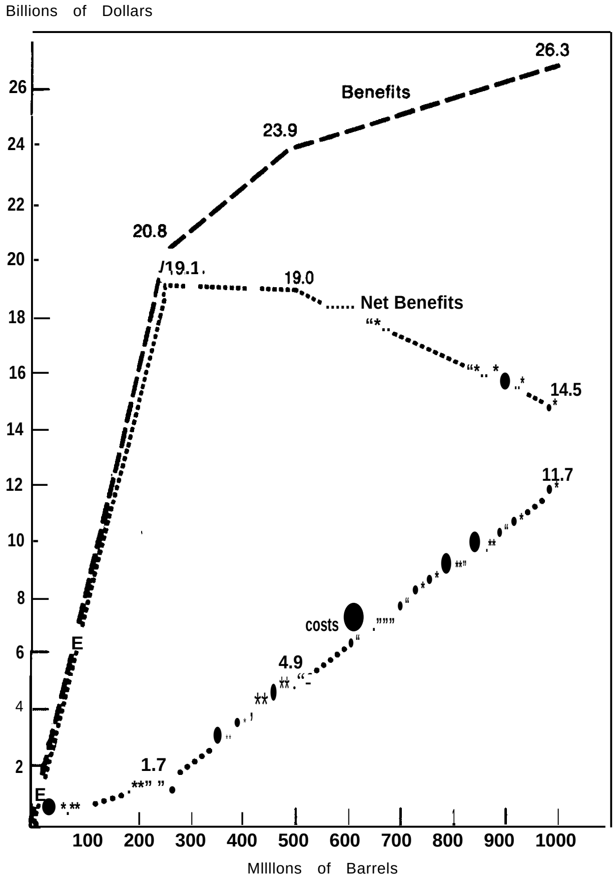
e. Optimal Stockpile Size.—The net benefit curve in figure V-3 can be used to indicate the probable optimal stockpile size, where the curve appears to be at a maximum positive value (or minimum negative value). Although this can only be taken as an indication of the area of an optimal quantity, it illustrates the desired value of the stockpile size for the values of the input variables chosen.

The calculations resulted in an optimal stockpile size of 250-500 million barrels accumulated over a l-year period. The economic net benefits expected for this stockpile will be approximately $19 billion. It should be emphasized that the estimates apply only to the specific materials examined and within the scenario assumptions described, and should therefore not be taken to indicate that precise quantities of specific materials should or should not be stockpiled. Nevertheless, the nature and magnitude of the estimates are sufficient to indicate that an economic stockpile should be given detailed consideration as one component of a more comprehensive national materials policy and that measuring the benefits or costs of a supply disruption in terms of the probability, rather than the certainty, of a disruption will significantly reduce the quantity of material to be stockpiled,

As a measure of scale for the results of these calculations, two current stockpiling proposals can be examined. The first proposal, Title II of

Figure V-3.

Economic Net Benefits of SP-1



the Administration's Energy Independence Act (IEP)—the National Strategic Petroleum Reserve (Civilian) Act of 1975—proposes the establishment of a strategic petroleum reserve of 1 billion barrels' reserve for the military. The second proposal is part of the requirements for allocation rights under the International Energy Agency which stipulates that each participating country maintain emergency oil reserves sufficient to sustain consumption for 60 days with no net imports. For the United States, which presently is importing 5,5 million barrels per day, satisfaction of this obligation would require a stockpile of 330 million barrels. The IEP also calls for demand curtailment measures which would reduce consumption by 7 percent in the event of an embargo--or 67 1/2 million barrels over a 60-day period.

In this example, the optimal stockpile size of 250–500 million barrels was based on the probability of four distinct cartel/unilateral actions and the damages which would result from each action (i.e., a 6-month, 50-percent import interruption; and a 3-month, 25-percent import interruption; a 3-month, 50-percent interruption; and a 3-month, 25-percent import interruption). At the lower end of the scale this stockpile size falls short of the IEP requirement by a minimum of 10 percent and is approximately 25 percent the size of the NSPR act's proposed stockpile. It is interesting to note that both the IEP requirement and that calculated with the Decision Criteria for SP-1 are approximately one-third of the possible total petroleum import interruption of 1 billion barrels for a 6-month period,

In summary, the example calculations for SP–1 indicate that the stockpile size should be based upon the expected economic net benefits of the stockpile. The example calculations also show that a stockpile based upon the probability of an interruption is significantly smaller than one based on the certainty of total interruption.

These calculations also illustrate the role of the risk aversion factor. It should be noted, for example, that the difference in economic net benefits for stockpile sizes of 250 and 500 million barrels is relatively small ($140 million). Yet the protection provided by the larger stockpile in the event of a cartel action is substantially greater, The risk aversion factor has been treated as an unknown, and the value of r which equates the economic net benefits for the two stockpile sizes has been solved. The resulting small value of 1.007 suggests that implementation of the larger stockpile should be given serious consideration. If the value for r were equal to say, 3,5, such a high-risk aversion would most likely be questioned.

f. Sensitivity Analysis for SP–1.—This section is a discussion of the particular sensitivity analysis of SP–1. An examination of table V-4 indicates the economic net benefits to be fairly insensitive to any input variable per-

Table V-—4.-Percent change based on 10 percent perturbation of variables for SP–1

Perturbed* variable	Benefits			cost			Net benefits		
	Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3
CF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cv	.00	.00	.00	7,35	5.12	4.26	–.65	–1.31	–3.44
Cu	.00	.00	.00	1.18	.84	.75	–.10	–.22	–.61
Sc	.00	.00	.00	1.47	1.02	.85	–.13	–.26	–.69
EC	.00	.00	.00	.00	1.79	2.49	.00	–.46	–2.01
ED	6.60	7.57	8.14	.00	.00	.00	7.18	9.51	14.72
PROB	12.61	10.99	10.00	.00	.00	.00	13.73	13.81	18.07
PROBP	–2.61	– .99	.00	.00	.00	.00	–2,84	–1.25	.00
PP	.00	.00	.00	117.61	41.78	18.10	–10.45	–10.72	–14.61
D	2.53	2.91	2.97	.00	1.85	2.56	2.76	3.18	3.30
s	–1 .69	–1.94	–1 .98	.00	–1.23	–1.71	–1,84	–2.12	–2.20
SWD	–.73	– .23	.00	.00	.00	.00	–.79	–.30	.00
DWD	1.09	.35	,00	.00	.00	.00	1.18	.44	.00
EDP	1.14	.39	.00	.00	.00	.00	1.24	.49	.00

● See table V–2 for definition of variables

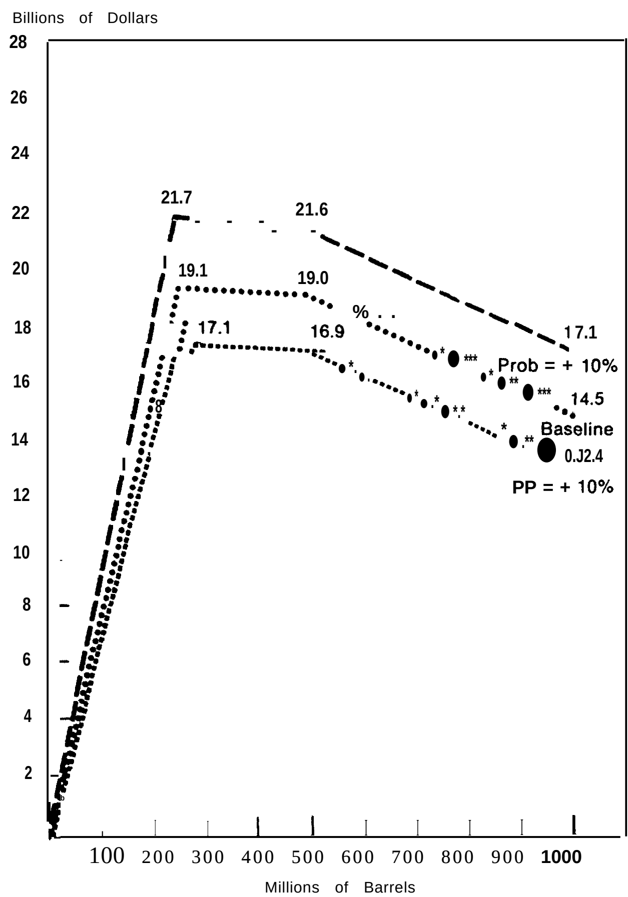
turbation (a + 10-percent change in probability, external damage, or increased price result in changes of only –7 to +18 percent in the economic net benefits). Using this table as a guide, the actual computed economic net benefits for the baseline, probability, and increased price perturbation runs were plotted as shown in figure V-4, Examination of this figure shows that the range of stockpile sizes for achieving maximum benefits still lies in the 250- to 50()-million-barrel range. The figure also indicates two further conclusions:

- Given an increased probability of a cartel action without a stockpile, the optimal stockpile size increases to 600 or 700 million barrels.
- Given an increased price of petroleum, the optimal stockpile size does not significantly change.

4. Discussion of Partial Economic Benefits and Costs for Each Phase of Stockpile Operation for SP-1

So far, the Economic Welfare Model has been employed to estimate the aggregate

Figure V-4.
Perturbations for SP-1



77-119 0 -76-8

economic benefits and costs to the U.S. economy (society) as a result of stockpiling petroleum. However, the model can also be extended to estimate the economic benefits and costs for each phase of stockpile operation-acquisition, holding and disposals well as the distribution of economic benefits and costs between consumers and producers. As the examples in this assessment demonstrate, the distributive effects of economic stockpiling can be significant, and given the policy concerns within the United States for the distribution effects of programs and policies, it is appropriate for the Economic Welfare Model to address them explicitly.

In this assessment, four categories of distributive effects are identified: consumers, producers, the stockpile operator (presumably the Federal Government), and external costs. In the application of the Economic Welfare Model, further disaggregation (such as by discrete income classes, employment groups or regions) may be desirable.

The direct benefits and costs of stockpiling petroleum associated with each of the categories are presented in four individual tables immediately below. It is important to note that insofar as transfer payments between consumers and producers are incorporated, these benefits and costs differ from those estimated earlier. As will be seen, these transfer payments can be substantial,

a. Direct Benefits and Costs to Materials Producers. —Direct benefits and costs to materials producers as a result of a petroleum stockpile under SP-1 are summarized below:

Benefits and costs to producers		Stockpile size (Millions of bbl)		
Operational action	Type of benefit or cost	[illegible]	500,000	1,000,000
		(Billions of dollars)		
Acquisition	Producer gain (PG)	0.00	1.2	4.0
Holding	Producer loss E (PL)*	7.0	9.3	10.4
Disposal	Producer loss E (PL')*	3.0	1.1	0.00

● These terms are expressed as expected values, i.e., they have been weighted by probabilities,

b. **Direct** Benefits and Costs to Materials Consumers. —Direct benefits and costs to materials consumers as a result of a petroleum stockpile under SP-1 are summarized below:

Benefits and costs to consumers		Stockpile size (Millions of bbl)		
Operational action	Type of benefit or cost	250,000	500,000	1,000,000
		(Billions of dollars)		
Acquisition	Consumer loss (CL)	0.00	1.8	5.9.
Holding	Consumer savings E (CS)*	10,3	1.4	15.3
Disposal	Consumer savings E (CS')*	4.4	1.6	.000

● These terms are expressed as expected values, i.e., they have been weighted by probabilities.

c. **Costs** and Benefits to the Stockpile Investor.—The costs and benefits to the stockpile investor for an economic stockpile of petroleum under SP–1 are summarized below:

Revenues and costs to stockpile operators		Stockpile size (Millions of bbl)		
Operational action	Type of benefit or cost	250,000	500,000	1,000,000
		(Billions of dollars)		
acquisition	Initialization cost (IC)	1.3	2.5	5.0
Holding	Holding cost (HC)	.5	.9	1.9
Disposal	Disposal cost (DC)	.000	.000	.000
	Capital gains (CG)	.000	.000	.000

d. **Estimation** of External Costs and Damages.—The estimation of external costs and damages can be done in a generalized first-order approximation, or it can be rigorously determined. The illustrative calculations for a petroleum stockpile under SP-1 utilize the first approach, a general approximation. The resulting external benefits and costs as given in the petroleum example are summarized below:

External costs and damages		Stockpile size (Millions of bbl)		
Operational action	Type of benefit or cost	250,000	500,000	1,000,000
		(Billions of dollars)		
Acquisition	External cost (EC)	0.000	.9	2.9
Holding	External damage E (ED)*	13.7	18.1	21.4
Disposal	External damage E (ED')*	2.4	.9	.000

"These terms are expressed as expected values, i.e., they have been weigbted by probabilities.

The external damage is the expected external damage, Therefore:

$$(ED_j) = \sum_i \sum_k (P_{ijk} - P'_{ijk}) ED_{ijk} \quad (14a)$$

and

$$(ED'_j) = \sum_i \sum_k P'_{ijk} ED'_{ijk} \quad (14b)$$

Estimation techniques for external costs and damages can be based on proxies or indicators. A general approximation of external costs based upon proxy variables or other indicators provides quantifiable values which can be applied using the Economic Welfare Model. For an economic stockpile of petroleum under SP–1, the proxy variable used in the illustrative calculations was gross national product (GNP). The relationship determined from historical data was that a percentage change in the gross energy product (GEP) of the United States reflected an equivalent *percentage* change in the GNP. The base period data for 1973 indicated that 46 percent of the GEP was attributable to petroleum and the GNP was $1.3 trillion, while the consumption of petroleum was 6.3 billion barrels, Thus, a 10-percent drop in the annual petroleum consumption (630 million barrels) would cause a 4.6-percent decrease in the GNP, or $59.8 billion.

5. Summary of Economic Net Benefits and Partial Benefits for SP–1

The operation of an economic stockpile consists of three types of action—acquisition, holding, and disposal—as discussed in the section on the conceptual logic of stockpiling in chapter 111. Each of these actions generates economic benefits and costs to the U.S. economy which must be identified and analyzed. Table V–5 is a tableau which relates the types of economic benefits and costs with the individual actions in the operation of an economic stockpile. The tableau may be explained as follows: first, the economic net benefits to the United States of a particular stockpiling policy may be defined as the net algebraic addition of all the terms in the tableau related to that policy; second, the separate terms under each operational phase indicate the partial economic benefits and costs for the four categories of economic impacts. The economic benefits and costs to the materials producers and consumers do not include those portions of the economic benefits and costs to the stockpile operator and the external costs which are ultimately borne by these two interest groups.

The results of the calculations for SP-1 are summarized in table V-6. These results are for the initial year of operation and include heavy operating costs for acquisition and substantial impacts on producers and consumers associated with acquisition and holding,

Table V–5.—Economic benefits and costs of economic stockpiling arrayed by operational action

Types of economic benefits and costs	SP	Operational actions					
		Acquisition		Holding		Disposal	
		Terms	Eq.	Terms	Eq.	Terms	Eq.
Direct benefits and costs to materials producers	1	PG	3	PL	14	PL’	12
	2	PG	3	PL		PL	13a
	3	APs	28	PL		APS	28
	4	PC	19a	PL		PL	19e
	5	APS	26	PL		APS	26
Direct benefits and costs to materials consumers	1	CL	3	CS	14	CS’	12
	2	CL	3	CS		CS’	13b
	3	CL	29	CS		CS’	29
	4	CL	19b	CS		CS	19d
	5	CL	24	CS		CS’	24
Indirect benefits and costs borne by stockpile operator*	1	IC	2	HC	5	DC	6
	2	IC	2	HC	5	DC	6
	3	IC	2	HC	5	DC+CG	25
	4	IC	2	HC	5	DC+CG	20
	5	Ic	2	HC	5	DC+CG	25
External benefits and costs	1	EC	7	ED	13	ED’	11
	2	EC	7	ED		ED’	17
	3	ED’	28	ED		ED’	28
	4	EC	7	ED		ED	20
	5	ED’	23	ED		ED’	23

Table V–6.—Partial benefits and costs of SP–1 for first year of operation
[In Billions of dollars]

Type of benefit or cost	Size of stockpile [Millions of bbl]	Operational action		
		Acquisition	Holding	Disposal
		PG_j	$E(PL_j)$	$E(PL'_j)$
Producers. ., ...	250	$0.0	-$7.0	-$3.0
	500	1.2	-9.3	– 1.1
	1000	4.0	-10.4	-0.0
		CL_j	$E(CS_j)$	$E(CS'_j)$
Consumers.	250	0.0	10.3	4.4
	500	-1.8	13,7	1.6
	1000	-5.9	15.3	
		I C	HC_j	$(DC_j\text{-}CG_j)$
Stockpile operator	250	–1.3	- 0.4	0.0
	500	–2.5	– 0.9	0.0
	1000	–5.0	- 1.9	0.0
		EC_j	E (ED j	$E(ED'_j)$
External costs (benefits),	250	0.0	13.7	2.4
	500	-0.9	18.1	0.9
	1000	-2.9	21.4	0.0

Net benefits are 19. I millions, 19.0 millions, and 14.5 millions for 250-, 500-, and 10() -mbbl stockpile, respectively.

In this particular case, the result of stockpiling yields significant gains to consumers and losses to producers, which can be interpreted as a transfer of resources from producers to consumers. The magnitude of transfers from producers to consumers declines as the size of the petroleum stockpile increases, explained in this example principally by changes in the probabilities of cartel action associated with each stockpile size. For comparison, table V-7 illustrates the terms in the benefit and cost functions for the second year under the assumption that the prices, elasticities, and cartel probabilities are the same. It should be noted that economic net benefits are expressed in their present value. Since these net benefits are realized in a future time period, it is appropriate that they be discounted to present value. A discount rate of 8 percent has been used. The values for all other terms in table V–7 have not been discounted. In practice, the stockpile operator would periodically reassess probabilities (and other data) for cartel operation and recalculate estimated economic net benefits. The results might cause the operator to increase or decrease the stockpile size with attendant economic impacts.

The data in tables V-6 and V–7 provide the basis for assessing the effects of a petroleum stockpile as follows, The cost to the Government of establishing a 250-million-barrel stockpile is estimated to be about $4.20 billion in the first year, with the major components being $2.5 billion for purchase of oil plus $1.25 billion for purchase of storage and other facilities, In each succeeding year the cost of operation would be about $450 million if the stockpile size remained unchanged. In return for this expenditure, the estimated economic net benefits to the United States would be approximately $19.1 billion in the first year. In the second year, economic net benefits change as initialization costs are deducted and the new net benefits are discounted to their present value at a discount rate of 8 percent.

Table V–7.—Partial benefits and costs of SP–1 for second year of operation

In millions of dollars

Type of benefit or cost	Size of stockpile [Millions of bbl]	Operational action: Holding	Operational action: Disposal
		$E(PL_j)$	$E(PL'_j)$
Producers	250	-$7.0	-$3.0
	500	-9.3	- 1.1
	1000	-10.4	0.0
		$E(CS_j)$	$E(CS'_j)$
Consumers	250	$10.3	$4.4
	500	13.7	1.6
	1000	15.3	
			$(DC_j-CG_j$
Operators	250	-$.04	$0.0
	500	-0.9	0.0
	1000	-1.9	0.0
		$E(ED_j)$	$E(ED'_j)$
External	250	$13.7	$2.4
	500	18.1	0.9
	1000	21.4	0.0

The present value of net benefits are 18.9 millions, 21.3 millions, and 22.6 millions for 250-, 500-, and 1000-mbbl stockpile, respectively.

C. ECONOMIC IMPACTS OF STOCKPILING TO CUSHION THE IMPACTS OF NONPOLITICAL IMPORT DISRUPTIONS (SP–2)

The procedure for calculating the benefits of SP-2 is identical to that developed for the second benefit component of SP-1, i.e., the benefits derived from the counteraction of a supply interruption after it has occurred. The cost function for SP-2 has been described in the section in chapter IV on the Economic Welfare Model, equation (7). The benefit function for SP-2 is developed immediately following subsequent paragraphs, and calculations of the net benefits are presented thereafter.

1. Derivation of Benefit Function for SP-2

Like SP-1, the benefits derived from SP-2 over the coming time period depend upon the specific import disruptions which will restrict supplies of a material. The benefits for SP–2 should be determined on the basis of expected benefits obtained from a stockpile of a given size. These benefits are equal to the damage that the stockpile could offset multiplied by the probability that the disruption will occur. These benefits must be determined for each possible import interruption. The benefit function for SP-2 is given as:

$$B_j = (1+r)\,[D'_{ijk}P_{ik}] \qquad (15)$$

where

B_j = benefits derived from stockpile j

risk aversion factor

D'_{ijk} damage offset by stockpile j

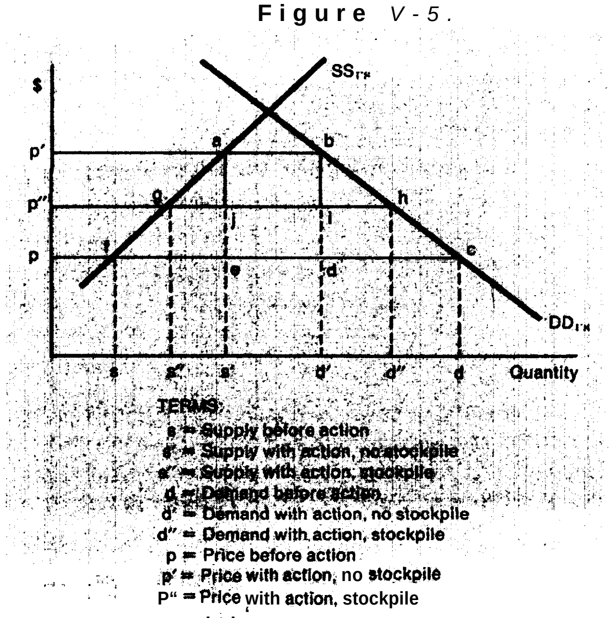
P_{jk} = probability of the interruption occurring
i = the percent import disruption
k = the duration of the disruption in months

The 'benefits for each stockpile examined (i.e., stockpiles of size Q_j) can be determined from equation (15), given the risk aversion factor (1+r) which reflects society's reluctance to be exposed to the import disruption, the probability (P_{ik}) that a specified interruption will occur, and the damages (D'_{ijk}) which can be offset by the stockpile when the interruption occurs.

The damage which can be offset by a stockpile depends upon the size of the interruption and the size of the stockpile. Figure V-5 illustrates the effect of a decrease in imports upon the domestic market. The damage incurred by the country is twofold: a loss of consumer surplus and the external costs imposed upon society.

Figure V-5 shows the price rise associated with an import disruption (i. e., the price rises from p to p'). The effect of releasing stocks is to lower the price to p". If the stockpile is of sufficient size, the disposal of stocks can completely offset the import disruption (i.e., p"=p) The loss of consumer surplus which is offset by disposal of the stockpile is shown in figure V-5 as the trapezoid abhg. As pointed out in the general discussion of the cost function, the actual loss to domestic consumers which is offset is p'bhp, an amount which could appreciably exceed abcf. The difference, however, goes to domestic producers as a transfer payment and does not represent a loss of real resources to the country.

Figure V-5.



As pointed out in the discussion of the cost function in chapter IV, a price rise may impose in addition to the loss in net consumer supplies, external costs on society which are not borne by the consumers of the material, For as the latter cut back their production, their suppliers may be hurt and their employees laid off. The benefits which a stockpile produces by avoiding or reducing these external costs should be counted in the benefit function. Capital gains (or losses) resulting from the disposal of stocks are added to (subtracted from) the damages in the benefit fulnction.

The damage offset through disposal of a stockpile of size Q o is calculated from equation (15) which is similar in form to equation (13c) of SP–1:

$$D'_{ijk} = 1/2(s'_{ik} - s''_{ijk})(p'_{ik} - p''_{ijk}) + 1/2(d''_{ijk} - d'_{ik})(p'_{ik} - p''_{ijk}) + (d'_{ik} - s'_{ik})(p'_{ik} - p''_{ijk}) + ED_{ijk} \quad (16)$$

where

D'_{ijk} = damage offset by the stockpile
s'_{ik} = supply when the interruption occurs without stockpiling
s''_{ijk} = producer supply with disposal of the stockpile j
p'_{ik} = price when the interruption occurs without stockpiling
p''_{ijk} = price with disposal of the stockpile j
d'_{ik} = demand when the interruption occurs without stockpiling
d'_{ijk} = demand with disposal of the stockpile j
ED_{ijk}=eXternal damage, the external costs saved by the disposal of the stockpile j

The first term on the right-hand side of this equation estimates the saving in consumer surplus which arises because domestic producers incur a smaller increase in real incremental costs due to the fact that their output increases only to s" rather than s'. As figure V-5 illustrates, this savings, which is reflected by the triangle ajg, is equal to one-half the increase in domestic supply which did not take place due to stockpile releases multiplied by the increase in domestic price which was prevented. The product of the prevented increase in domestic supply and price is multiplied by one-half, on the assumption that the domestic supply curve is approximately linear in the price range p" to p'.

The third term of equation (15) represents the saving in consumer surplus which arises because the price paid to foreign producers is kept at p" rather than being permitted to rise to p'. This saving is reflected in figure V-5 by the rectangle abij, It can be estimated by the product of the prevented price increase and the level of imports which would occur at the price p',

The fourth term, ED, reflects the saving produced by the stockpile in the external costs which are not borne by the users of the material. The first three terms can be approximated on the basis of estimates of the prevented price increase (p' – p") and the elasticities of domestic supply and demand which apply for the time period and price range being considered. Estimates for ED must be based on other relationships.[12]

The sum of the probabilities that import interruptions will occur cannot exceed 1 and must encompass the entire spectrum of possible import interruptions. The expected benefit of a stockpile of a size Q_j can then be calculated from equation (15), once the damage offset by disposal of the stockpile during a possible interruption has been estimated, and society's risk aversion factor has been specified. The calculations described above should be repeated for stockpiles of various sizes in order to trace out the entire benefit function,

2. Estimation of Economic Net Benefits for SP-2

The following discussion is a presentation of the estimated economic net benefits of stockpiling zinc for SP–2. Although the reserves of zinc are distributed worldwide, the supply to the United States is concentrated in a few countries, Canada and Mexico being dominant, with these imports constituting roughly one-half of the total U.S. consumption. A nonpolitical action, such as a strike in the highly unionized zinc mining industry in Canada, could temporarily interrupt imports to the United States which would not be offset through increased imports from other sources.

a. Background Information.—Several of the important values and assumptions used in the estimation of net benefits of stockpiling for SP–2 are outlined below:

- Based on supply-demand relationships during the period of 1969–71—when U.S. production remained relatively constant, prices rose, and imports and total demand fell—an implicit price elasticity of demand for zinc falls in the range of -0.5 and -0.7, This range of price responses was retained in the computation with some reduction for short-term interruptions (o–3 months).
- U.S. demand of 1,500,000 tons, U.S. supply of 750,000 tons, U.S. imports of 750,000 tons and a unit price of $720 were retained as the baseline values for the computations,
- It is assumed that acquisition of zinc for the stockpile will come solely from additional imports, which in turn implies no external cost during the acquisition phase,

[12] The external costs (and external damages) are frequently a significant portion of the costs and expected benefits derived from stockpiling. These external costs are also the most difficult to determine, Simplified, first-order approximations of the external costs can be made as shown in this section

- Probabilities of a temporary interruption of zinc imports were specified for two durations and four levels, as shown in the following table.

Probabilities					
Duration in months	Percent interruption				
	0	0-10	10-25	25-50	50-100
0	0.58				
o–3		0.25	0.10	0.05	0
3–12		0.02	0	0.05	0
Total	0.58	0.27	0.1	0.1	0

For SP–2 the probability estimates considered the following factors with respect to the material under review: (1) as it pertains to strikes, the nature and history of labor union organization in producing countries and in transportation lines—railroad and ocean shipping; as it pertains to natural disasters, the concentration of supply in various geographical areas particularly subject to such events; and (2) as it pertains to nonnatural (manmade) disasters, the concentration of supply in industrial organizations.

Two illustrations will clarify the history of materials problems which might be alleviated with SP–2, A fire at the U.S. 'S largest silver mine, the Sunshine Mine at Kellogg, Idaho, in May 1972 killed 91 men. The mine was closed for 7 months and this resulted in a drop of 10 percent of the U.S. mine output that year. A strike lasting almost 6 months at the largest nickel mine in the world at Sudbury, Canada, in 1969 resulted in loss of production of about one-third Canadian output for the year. This was somewhere between 7–10 percent of the world's supply.

b. Input Values.—The-values for the input variables to the computer program for SP–2 are listed in table V–8. This table lists the mathematical symbol, the name or description, of the variable, the units of measure, and the value of the input variable for each I, J, and K. The calculations for SP–2 were performed by the computer program using the input variables listed in table V–8.

c. Calculated (Output) Values.—The values for the output variables calculation by the computer program for SP–2 are listed in table V-9. This table lists the mathematical sym-

Table V–8.—Input variables SP–2

Math symbol	Program symbol	Description	Unit	Either not dependent on J, or J=l	J=2	J=3
Q_j	Q	Stockpile size	Million tons	0.05	0.10	0.15
CU_j	CU	Unit cost	$ per ton	720.	720.	792,
C_f	CF	Fixed initialization cost	Million $	0.5		
c“	CV	Variable initialization cost	$ per ton	0.0		
	XI	Interest rate	Percent per year	0.00		
d	SLR	Spoilage loss rate	Percent per year	0.0		
s	SC	Storage cost	$ per ton per year	0.1		
C_d	CD	Unit disposal cost	$ per ton per year	0.0		
p	P	Price	$ per ton	720.		
P!	PP	Increased price	$ per ton	720.	720.	792.
d^1	D	U.S. demand at price p	Million tons	1.5		
d!	DP	U.S. demand at price p'	Million tons	1.5	1.5	1.0815
s^1	s	U.S. supply at price p	Million tons	0.75		
s_j	SP	U.S. supply at price p'	Million tons	0.75	0.75	0.75
EC	EC	External cost	Million $	0.0		
R	R	Risk aversion factor	Coefficient	0.0		
CG_j	CG	Capital gains	Millions $	0.0		
Q_{dj}	QD	Stockpile disposal	Million tons	0.0		

Table V–8.—Input variables SP–2— continued

Math symbol	Program symbol	Description	Unit	[illegible]	[illegible]	[illegible]	K=3	K=4
ED_{ik}	ED	External damage-no stockpile	Million $	1=1	0.000	0.000	0.000	0.000
				1=2	0.000	0.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0.000	0.000	0.000	0.000
				J=1				
P_{ik}	PWOS	Price without stockpiling	$ per ton	1=1	756,000	864.000	1008.000	720.000
				1=2	792.000	720.000	720.000	720.000
				1=3	720.000	720.000	720.000	720.000
				1=4	720.000	720.000	720.000	720.000
				J=1				
S'_{ik}	SWOS	Supply without stockpiling	Million tons	1=1	0.750	0.750	0.750	0.750
				1=2	0.750	0.750	0.750	0.750
				1=3	0.750	0.750	0.750	0.750
				1=4	0.750	0.750	0.750	0.750
				J=1				
d'_{ik}	DWOS	Demand without stockpile	Million tons	1=1	1.481	1.454	1.407	0.000
				1=2	1.425	0.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0.000	0.000	0.000	0.000
				J=1,2,3				
P_{ik}	PROB	Probability of interruption without stockpile	Percent per year	1=1	0.250	0,100	0.050	0.000
				1=2	0.020	0.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0.000	0,000	0.000	0.000
				J=1				
ED'_{qk}	EDP	External damage-with stockpile	Million $	1=1	7,484	21.646	45.338	0.000
				1=2	39.854	0.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0.000	0.000	0.000	0.000
				J=2				
				I=1	7,484	21.645	83,878	0.000
				I=2	58.934	0.000	0.000	0.000
				I=3	0.000	0.000	0.000	0.000
				I=4	0.000	O.000	O.000	0.000
				J=3				
				1=1	7.484	21.646	83.876	0.000
				1=2	58.984	0.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0.000	0.000	0.000	0.000
				J=1				
P'_{ijk}	PWD	Price with disposal of stock-pile j	$ per ton	1=1	720.000	720.000	852.340	720,000
				1=2	743.360	720.000	720.000	720.000
				1=3	720.000	720.000	720.000	720.000
				1=4	720.000	720.000	720,000	720.000
				J=2,3				
				1=1	720.000	720.000	720.000	720.000
				1=2	720.000	720.000	720.000	720.000
				1=3	720.000	720.000	720.000	720.000
				1=4	720.000	720.000	720,000	720.000

Table V-8.—Input variables SP-2 —continued

Math symbol	Program symbol	Description	Unit	J=1	K=l	K=2	K=3	K–4
				J=1,2,3				
s'_{ijk}	SWD	Producer supply with disposal of stockpile j	Million tons	1=1	0.750	0,750	U.750	0.750
				1=2	0.750	0.750	0.750	0.750
				1=3	0.750	0.750	0.750	0.750
				1=4	0.750	0.750	0.750	0.750
				J=l				
d'_{ijk}	DWD	Demand with disposal of stockpile	Million tons	1=1	1,500	1.500	1.458	0.000
				1=2	1.476	0.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0,000	0.000	0.000	0.000
				J=2				
				1=1	1.500	1.500	1.500	0.000
				1=2	1.500	0.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0.000	0.000	0.000	0.000
				J=3				
				1=1	1.500	1.500	1.500	0.000
				1=2	1.500	0.000	0.000	0.000
				1=3	0.000	0.000	0.000	0.000
				1=4	0.000	0.000	0.000	0.000

Table V–9.—Calculated results for SP-2

Economic impacts of stockpiling zinc
[Millions of dollars]

‘Symbol .	Description	J=1	J = 2	J=3
		[Millions of tons]		
		0.050	0.100	0.160
NB_j	Net benefits	$26.2	30.3	–12.4
B	Benefits function	29.6	36.6	36.7
c	Cost function	3.4	6.3	48.9
E(DN)	Damage not averted	5.5	0.000	0.0
	Benefit variables:			
$E(CS'_j)$	Expected consumer savings	78.8	95.8	95.8
$E(PL'_j)$	Expected producer loss	56.3	68.7	68.7
$E(Ed_j)$	External damage	7.1	9.4	9.4
	Cost variables:			
HC_j	Holding costs	2,9	5.8	9.519
	Initialization costs...	0.5	0.5	0.5
LEW_j	Loss uneconomic welfare	0.0	0.0	38.9
CS.	Consumer loss	0.0	0.0	92.9
PG	Producer gain.	0.0	0.0	54.0
DC_j	Disposal cost...	0.0	0.0	0.0
OCj	Operating costs	39.4	78.3	128.8
AC_j	Acquisition costs	36.0	72.0	118.0
•*	Economic impact of no stockpile	29.6	36.7	36.6

“All calculations have been rounded for simplicity

**The economic impact of no stockpile is equivalent to the benefits (expected damages averted) attributed to the stockpile which are foregone in the absence of the stockpile.

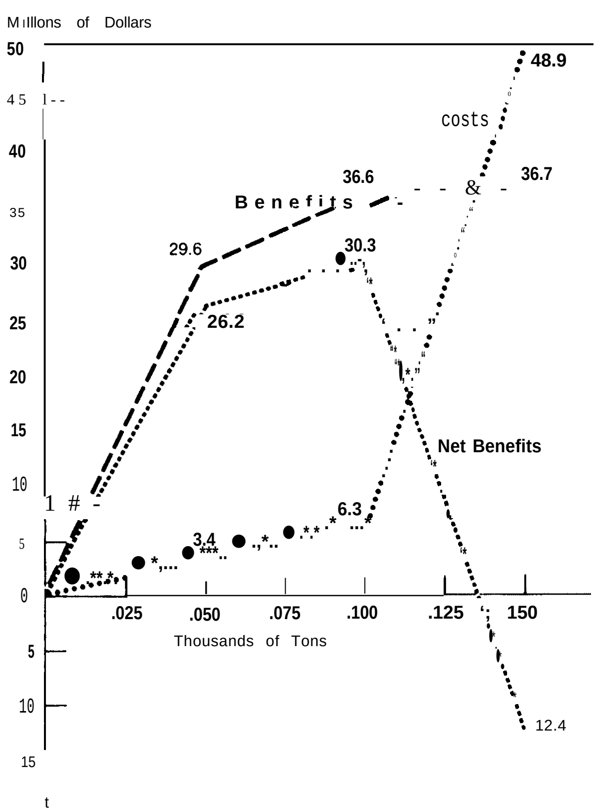
bol, the description of the variable, and the numerical value of the output variable for each stockpile, j.

d. Graphic Representation of the Calculations.—Figure V-6 is a graphic representation of the calculated costs, benefits, and net benefits (benefits minus costs) for SP–2, Values were computed for only three stockpile sizes and zero stockpile,

e. Optimal Stockpile Size.—The net benefit curve in figure V–6 can be used to indicate the probable optimal stockpile size, where the curve appears to be at a maximum positive value (or minimum negative value). This can only be taken as an indication of the area where the optimal size stockpile occurs; however, it will serve to illustrate the desired value of the stockpile size for the values of the input variables chosen.

Figure V 6.

Economic Net Benefits of SP-2



The calculations resulted in an optimal stockpile size in the area of 100,000 tons accumulated over a l-year period. The expected economic net benefits for this stockpile are estimated at $30 million. It should be emphasized that the estimates apply only to the specific materials examined and within the scenario assumptions described, and should therefore not be taken to indicate that precise quantities of specific materials should or should not be stockpiled. Nevertheless, the nature and magnitude of the estimates are sufficient to indicate that an economic stockpile should be given detailed consideration as one component of a more comprehensive national materials policy and that measuring the benefits or costs of a supply disruption in terms of the probability, rather than the certainty, of a disruption will significantly reduce the quantity of material to be stockpiled.

The U.S. stockpile of zinc in late 1974 was 373,000 short tons, while the stockpile objective is 203,000 short tons, The optimal stockpile range was based on the probability of our distinct possible interruptions and the damages that they would cause. The optimal stockpile is a minimum of 11 percent of the total annual imports of zinc.

The methodology illustrated by the example calculations for a zinc stockpile show that the stockpile size should be based upon the expected net benefits of the stockpile, The example calculations also show that a stockpile based upon the probability of an interruption is smaller than that required to offset every possible interruption in its entirety,

f. Sensitivity Analysis,—The computer program performs the "baseline" calculations and then automatically perturbs an input variable by +10 percent and reruns the calculations, The new costs, benefits, and net benefits are compared to the base calculations and the percentage change is computed. This process is repeated for each input variable.

The resulting percent changes in net benefits from a +10 percent change in each input variable for SP–2 are listed in table V–10,

Table V–10.—Percent change on 10 percent perturbation of variables SP–2

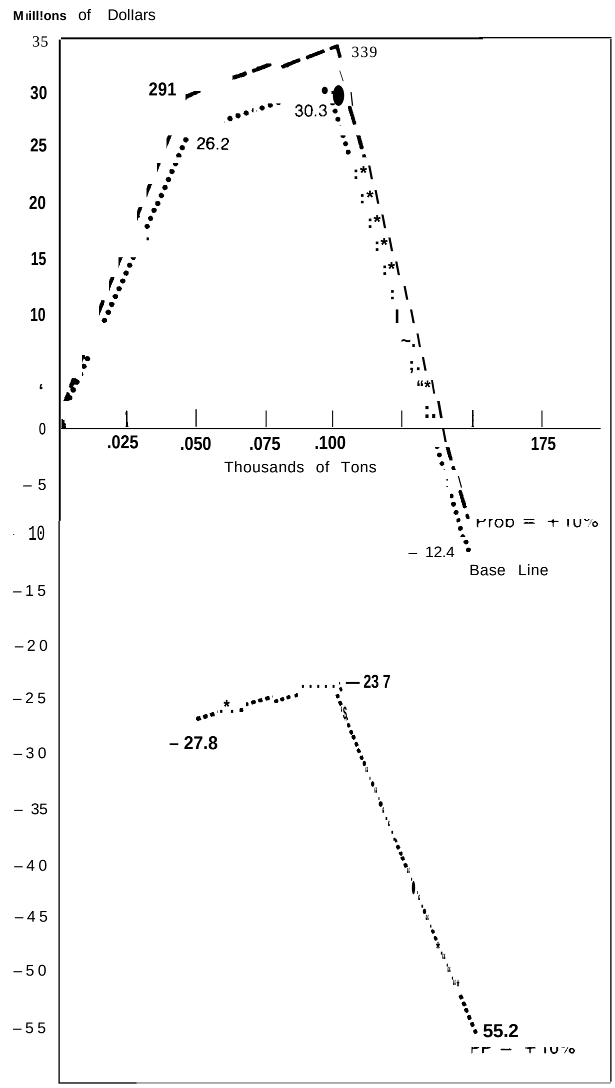
Perturbed variable	Benefits			cost			Net benefits		
	Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3
CE	0.00	0.00	0.00	1.48	0.80	0.10	–0.19	–0.17	0.40
Cu	0.00	0.00	0.00	8.51	9.19	1.94	–1.10	–1.90	7.67
SV	0.00	0.00	0.00	.01	0.2	.00	.00	.00	.01
PROB	10.00	10.00	10.00	0.00	0.00	0.00	11.29	12.07	–29.52
PP	0.00	0.00	0.00	1595.27	861.24	87.49	–206.06	–178.23	345.79
D	0.00	0.00	0.00	0.00	0.00	11.03	0.00	0.00	43.60
s	0.00	0.00	0.00	0.00	0.00	–5.52	0.00	0.00	–21.80
DWD	.11	.09	.09	0.00	0.00	0.00	.12	.10	– .25
SWD	–.05	–.04	–.04	0.00	0.00	0.00	–.06	–0,5	.13
EDP	2.40	2.57	2.57	0.00	0.00	0.00	2.71	3.11	–7.60

An examination of table V–10 shows the net benefits to be fairly insensitive to any input variable perturbation except for PP, increased price, While the net benefits for the baseline case show a peak in the range of 80,000 to 100,000 tons, this analysis shows that a IO-percent increase in price will result in a negative net benefit for this economic stockpile. This result is dramatically illustrated in Figure V–7.

3. Discussion of Partial Benefits and Costs for Each Phase of Stockpile Operation for SP–2

The above presentation of economic net benefits is supplemented by a discussion of the four categories of impacts. The economic impacts of a stockpile for SP–2 can be determined with the Economic Welfare Model for four types of impacts: direct benefits and costs to materials producers, direct benefits and costs to materials consumers, benefits and costs borne by the stockpile operator, and external benefits and costs. Calculations have been made to estimate each of these four types of economic impacts.

Figure V-7.
Perturbations of SP-2



a. Direct Benefits and Costs to Materials Producers.—The direct benefits and costs to materials producers of a zinc stockpile under SP–2 are summarized below:

Benefits and costs to producers		Stockpile size (Millions of tons)		
Operational action	Type of benefit or cost	0.1	0.1	0.2
Acquisition	Producer gain (PG_j)	0.0	0.0	54.0
Holding	Producer savings/loss	0.0	0.0	0.0
Disposal	Producer loss E (pL'_{ijk})*	56.3	68.7	68.7

● This term is expressed as an expected value (E).

b. Direct Benefits and Costs to Materials Consumers.—Direct benefits and costs to materials consumers of zinc as a result of a zinc stockpile under SP–2 are summarized below:

Benefits and costs to consumers		Stockpile size (Millions of tons)		
Operational action	Type of benefit or cost	0.1	0.1	0.2
Acquisition	Loss in consumer surplus (CLj)	0.0	0.0	92.9
Holding	Consumer savings/loss	0.0	0.0	0.0
Disposal	Consumer savings E (Cs'_{ijk})"	78.8	95.8	95.8

● This term is expressed as an expected value (E).

c. **Costs** and Benefits to the Stockpile Operator. -Costs and benefits to the stockpile operator for zinc stockpile under SP–2 are summarized below:

Revenues and costs to stockpile operators		Stockpile size (Millions of tons)		
Operatoinal action	Type of benefit or cost	0.1	0.1	0.2
Acquisition	Initialization cost (IC)	0.5	0.5	0.5
Holding	Holding cost (HC)	2.9	5.8	9.5
Disposal	Disposal cost (DC)	0.0	0.0	0.0
	Capital gains (CG)	0.0	0.0	0.0

d. **Estimation** of External Costs and Damages.—Estimation of external costs and damages can be done in a generalized first-order approximation, or it can be rigorously determined. The illustrative calculations. for a zinc stockpile under SP–2 utilize the first approach, a general approximation. The resulting external benefits and costs as given in the petroleum example are summarized below:

External costs and damages ,		Stockpile size (Millions of tons)		
Operational action	Type of benefit or cost	0.1	0.1	0.2
Acquisition	External cost (EC)	0.0	0.0	0.0
Holding	External damage (ED)	0.0	0.0	0.0
Disposal	External damage (ED')*	7.1	9.4	9.4

● The External Damage is the expected external damage (E).

Therefore:

$$ED'_j = \sum_i \sum_k P'_{ijk} ED'_{ijk} \qquad (18)$$

4. Summary of Economic Net Benefits and Partial Benefits for SP–2

The results of the calculations for SP–2 are summarized in table V-11, These results are for the initial year of operation and include heavy operating costs for acquisition and substantial impacts on producer and consumers associated with acquisition. During disposal, large savings accrue to consumers, while producers incur substantial losses. For comparison, table V–12 shows the terms in the net benefit function for the second year under the assumption that the prices, elasticities, and probabilities are the same. The costs to the stockpile operator fall significantly. The gains and losses to producers and consumers during acquisition and disposal are the same as in year 1. Expected net benefits are lower since they are expressed in present value terms, using a discount rate of 8 percent. For the second year, the optimal stockpile size remains in the area of 100,000 tons. In practice, the stockpile operation would periodically reassess probabilities and other data and recalculate net benefits. The results might indicate that the stockpile size should be increased or decreased with attendant economic impacts,

The cost to the Government of establishing a 100,000-ton stockpile is estimated to be about $78 million in the first year, with the major components being $72 million for purchase of zinc plus $0.5 million for purchase of storage and other facilities. In each succeeding year the cost of operation would be about $5.7 million if the stockpile size remained unchanged.

Table V-11.—Partial economic benefits and costs of SP–2 for first year of operation
(In Millions of dollars)

Type of benefit or cost	Size of stockpile millions of tons	Operational action*		
		Acquisition	Holding**	Disposal**
		PG_j	$E(PL_j)$	E(PL'j)
Producers.	0.050	0.0	-0.0	–56.3
	0.100	0.0	-0.0	-68.7
	0.150	54.0	-0.0	-68.7
		CL_j	$E(CS_j)$	E(CS' j)
Consumers.	0.050	-0.0	0.0	78.8
	0.100	-0.0	0.0	95.8
	0.150	-92.9	0.0	95.8
		IC_j	HC_j	(DC+CG)
Stockpile operators	0.050	-0.5	-2.9	-0.0
	0.100	-0.5	–5.8	-0.0
	0.150	-0.5	-9.5	-0.0
		EC	$E(ED_j)$	$E(ED'_j)$
External costs.	0.050	-0.0	0.0	7.1
	0.100	-0.0	0.0	9.4
	0.150	-0.0	0.0	9.4

Economic net benefits are 26.8 millions, 31.4 millions, and –11.2 millions for 0.050, 0.100, and 0.150 million tons of stockpile, respectively.

"Signs Indicate the sign which each term should have when summing to indicaty net benefits
● "Values in these columns are expected values ie they have been weighted by probabilities

Estimated economic net benefits and operating costs for three sizes of zinc stockpile for SP–2 under assumed conditions described in the text. Results are for the second year (or later years) and are illustrative only.

Table V–12.—Partial benefits and costs of SP–2 for second year of operation
(In Millions of dollars)

Type of benefit or cost	Size of stockpile millions of tons	Operational action*	
		Holding**	Disposal**
		$E(PL_j)$	$E(PL'_j)$
Producers	**0.050**	-0.0	–56.3
	0.100	-0.0	48.7
	0.150	4.0	-68.7
		$E(CS_j)$	$E(CS'_j)$
Consumers	**0.050**	0.0	78.8
	0.100	0.0	95.8
	0.150	0.0	95.8
		HC_j	$(DC_j\text{-}CG_j)$
Operators	**0.050**	–2.4	-0.0
	0.100	–5.8	-0.0
	0.150	4.5	4.0
		$E(ED_j)$	$E(ED'_j)$
External , ..., , ...	**0.050**	0.0	7.1
	0.150	0.0	9.4
	0.150	0.0	9.4

The present value of economic net benefits are 23.0 millions, and –9.6 millions for 0.050, 0.100, **and 0.150** million tons of stockpile, respectively

*Signs indicate the sign which each term should have when summing to indicate net benefits
"*Values in these columns are expected values. ie . they halve been weighted by probability

D. ECONOMIC IMPACTS OF STOCKPILING TO ASSIST IN INTERNATIONAL MATERIALS MARKET STABILIZATION (SP-3)

The procedure for calculating the benefits of SP–3 is discussed immediately below, and the calculations of the net benefits are presented thereafter. The cost function for SP–3 has been described in the section in chapter IV on the Economic Welfare Model, equation **(7),**

1. Derivation of Benefit Function for SP-3

The benefits derived from SP–3 over the coming time period depend upon the degree of stabilization obtained in the international market and the effect upon the U.S. domestic market that such stabilization will produce. Four types of benefits result from the impact of this stockpile upon the domestic economy: an increase in domestic consumer-producer surplus, a decrease in production costs, a reduction in the external costs associated with instability, and the realization of capital gains. A fifth type of benefit is gained as a result of international market stabilization: political benefits that result from the United States entering commodity agreements with other countries.

The benefits from a stockpile of a given size over the entire surplus-shortage cycle should be estimated to calculate the benefit function of this type of stockpile over the coming time period. Since these benefits are derived over the entire surplus-shortage cycle, only a portion of these benefits should be credited to the coming time period, This portion (t) is defined as the ratio of the length of the coming period to the expected length of the surplus-shortage cycle. Thus, the benefits associated with a stockpile of size Q_j can be calculated by:

$$B_j = t(CS_j + PS_j + ED_j + CG_j + PBj) \qquad (17)$$

where

B_j = Benefits expected for stockpile Q_j

t = Portion of surplus-shortage cycle occurring in the coming time period

CS_j = Increase in consumer-producer surplus

PS_j = Decrease in average production costs

ED_j = External damage, external costs saved

CG_j = Capital gains

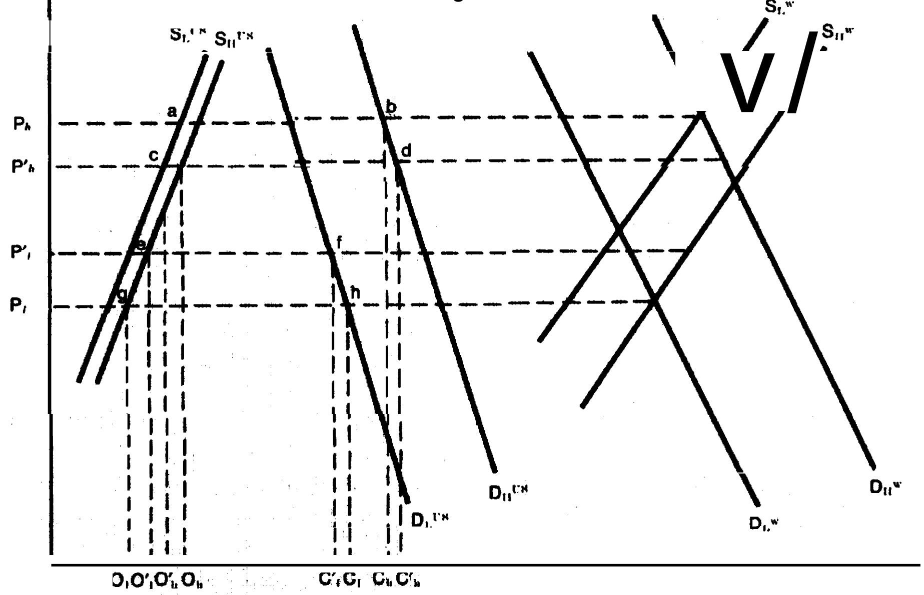
PB_j = Political benefits

It is important to note, however, that the benefits to be measured for this policy are only those captured by the U.S. economy, with these benefits most likely being a small share of the aggregate benefits enjoyed by all participating countries.

The domestic increase in consumer-producer surplus over the surplus-shortage cycle can be estimated using the following procedure. Let ph be the highest price and pi the lowest price over the surplus-shortage cycle in the absence of stockpiling, as illustrated in figure V-8. Then p'_h and p'_i are the high and low prices at which all the material is sold when stockpiling takes place. If over the cycle all of the material were sold at p'_h and in the absence of stockpiling all material would have been sold at p_h, the increase in consumer surplus for the United States would be equal in figure V-8 to the trapezoid phcdp'h. and the loss in producer surplus (assuming there are U.S. producers) would be equal to the trapezoid phabph. Of course, in practice the price would vary over the range pi to ph in the absence of a stockpile and over the range pi to ph with a stockpile, so the increase in consumer surplus and the decrease in producer surplus would be only some fraction of the above amounts. Specifically, these amounts should be multiplied by the coefficient h, which reflects the proportion of total output over the cycle whose price would be higher than p'_h without a stockpile, and the coefficient g, which reduces the estimates of consumer gain and producer loss to account for the fact that

77-119 O -76-9

Figure V-8.



TERMS:

S_L^W = low world supply
S_H^W = high world supply
D_L^W = low world demand
D_H^W = high world demand
P_h = high price without stockpiling
P'_h = high price with stockpiling
P_l = low price without stockpiling
P'_l = low price with stockpiling
S_L^{US} = low U.S. supply
S_H^{US} = high U.S. supply
D_L^{US} = low U.S. demand
D_H^{US} = high U.S. demand
O_l = U.S. output at P_l
O'_l = U.S. output at P'_l
O_h = U.S. output at P_h
O'_h = U.S. output at P'_h
C_l = U.S. consumption at P_l
C'_l = U.S. consumption at P'_l
C_h = U.S. consumption at P_h
C'_h = U.S. consumption at P'_h

in the absence of a stockpile the price which would prevail above p'h would vary over the range p'h to p_h and would not be continually maintained at p_h.

Similarly, during the accumulation phase of a stockpile program, the decrease in consumer surplus and increase in producer surplus can be estimated by multiplying the trapezoids p'hghpl and p'iefpi times the coefficient g and the coefficient m, where the latter is the proportion of total output over the cycle whose price would be lower than P'_i without a stockpile.

Thus, the net gain in consumer-producer surplus over the cycle can be estimated by the following equation on the assumption that the U.S. supply and demand curves are approximately linear over the price ranges $p_h - p_h$ and $p'_l - p_l$:

$$CS_j = hg(P_h - P'_h)\ [C_h + 1/2(C'_h - C_h) - O'_h - 1/2(O_h - O'_h)] + mg(P'_e - P_e)\ [O_l + 1/2(O'_l - O_l) - C'_l - 1/2(C_l - C'_l)] \quad (18)$$

The external damage can be estimated as the reduction in external cost attributable to stockpiling. The estimates of these benefits may be made through judgmental estimates of the stabilizing impact of the stockpile to the total domestic economy. Capital gains (losses) must be added to the benefit function. They are defined in equation (19) as:

(19)

where

P_l = Price at which Q_j is acquired
p_h = Price at which Q_j is Sold
Q^*_j = quantity of stocks accumulated and disposed of over the cycle

Significant capital gains may be realized from this stockpiling policy. While making a financial profit is not the objective of SP–5, the accrual of capital gains will be an additional benefit.

The reduction in production costs that greater cyclical stability produces can be estimated by those familiar with the production technology and past production behavior of materials. The total reduction will depend on the quantity produced as well as the reduction in the average cost of production, as shown in equation (20):

$$PS_i = cp_i s_a \qquad (20)$$

where

PS_j = decrease in production costs resulting from stockpile j
cp_j = unit cost of production saved by stabilization due to stockpiling
s_a = domestic production of material over the entire cycle

The cost function for SP–5 varies slightly from the general cost function (equation 7 in chapter IV) in that it does not incorporate values for loss in domestic consumer surplus (LCS_j) or external cost (EC_j) when the acquisition of the stockpile occurs during the surplus portion of the surplus-shortage cycle. These factors are included in the benefit function as negative benefits during the surplus portion of the cycle as it normally occurs. However, if the initiation of stockpile acquisition does not occur at the beginning of the surplus cycle, the quantity required by the stockpile to alleviate the shortage portion of the cycle would have to be accumulated over a shorter time period than planned, An accelerated acquisition of the stockpile increases both the loss of consumer surplus and external costs,

The political benefits (PB) derived by the United States from participating in an international stockpiling program must be estimated in order to determine the total benefits. The value of political benefits is normative and will be dependent upon such factors as the importance of the material internationally, the countries affected by the stabilization of fluctuations (both producers and consumers), and the prestige attributed to the United States by its leadership in promoting the commodity agreement. These political benefits are expressed as PB_j in equation (17).

Even though the political benefits variable is a normative value, its reasonableness can still be determined. For example, the economic net benefits can be estimated for an international stockpile by setting the political benefits equal to zero. If, in considering a fixed U.S. share of the stockpiling costs, the net benefits for the stockpile are negative, the political benefit variable can be increased to the point where net benefits are positive. This new value can then be examined for its reasonableness in light of the international environment.

The cost function for SP–5 will not have values for loss in domestic consumer surplus LCS_j or external costs (EC_j) when the acquisition of the stockpile occurs during the entire surplus portion of the surplus-shortage cycle. These factors are included in the benefit function as negative benefits during the surplus portion of the cycle as it normally occurs. However, if the initiation of stockpile acquisition does not occur at the beginning of the surplus cycle, the quantity required by the stockpile to alleviate the shortage portion of the cycle would have to be accumulated over a shorter time period than planned, resulting in a greater loss of consumer surplus and increased external costs.

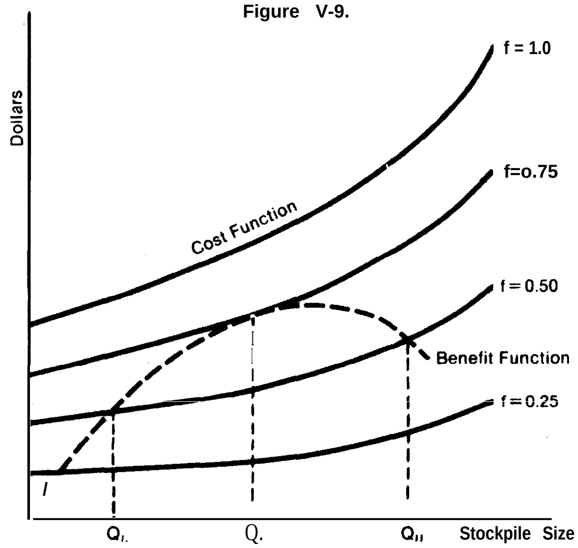
As equation (7) indicates, the remaining terms in the cost equation, aside from the fixed initialization cost (C F), are functions of stockpile size. The cost of the international stockpile is based upon the total stockpile size, only part of which need be borne by the United States. International commodity agreements such as the International" Energy Program (IEP) will establish procedures for sharing the burdens of materials shortages and surpluses. Therefore, only a portion of the total cost of stockpiling will be an obligation of the United States, as given by equation (21):

(21)

where
- C_j = cost of stockpile j
- f = fraction of stockpile costs for which United States is obligated
- C'_j = cost of stockpile j for which United States is obligated

The net benefits for SP–3 are calculated for each stockpile size, Q", from the benefits determined in equation (17) and the costs from equation (21). The calculations described above should be repeated for stockpiles of various sizes to trace out the entire benefit function, The cost function can be calculated for various size stockpiles and for varying values of f as shown in figure V– 9.

Figure V-9.



TERMS:
- f = fraction—U.S. share of stockpile costs
- Q, = low stockpile size where net benefits are positive for f =0.50
- Q_H = high stockpile size where net benefits are positive for f =0.50
- Q. = optimal stockpile size for f = 0.50

The family of cost curves shown in figure V–9 can be used to determine the "critical" value of f (i. e., the maximum fraction of cost incurred by the United States which will insure that net benefits to the United States are positive). The "critical" f occurs for that curve in the family of cost curves tangent to the U.S. benefit function curve. If one wished to determine the optimal stockpile size for a given f, then the slope of that cost function would be equal to the slope of the benefit function.

2. Estimation of Economic Net Benefits for SP–3

Tin has been selected as the material for the application of the Economic Welfare Model to SP–3, World resources of tin are located primarily in Southeast Asia, Bolivia, Brazil, Nigeria, China, U. S. S.R., and Zaire, U.S. imports of tin are mainly from Malaysia (62 percent) and Thailand (25 percent). Between 1966 and 1972, the price of tin on the London Metal Exchange fluctuated between $1,296 and $1,506 per ton. This fluctuation is expected to continue.

a. Background Information.—The important values and assumptions employed in this calculation are summarized here:

- Future prices are assumed to be equal to the prices occurring during the last 6-year cycle. Under this assumption the high, low, and average prices in dollars per ton are respectively $8,250, $7,227, and $7,739.
- The reduction in average production cost due to reduced price fluctuation is set at zero, since U.S. production of tin is negligible.
- Increases and decreases in producer surplus are assumed to be zero since U.S. tin production is negligible.
- External damage averted is again measured in terms of the value of unemployment benefits saved, Savings are estimated below:

	Stockpile size (in tons)		
	J=l	J=2	J=3
	5,000	10,OOO	20,000
Unemployment benefits saved ($ millions)	0.062	0.124	0.124

- The political benefit variable is set at zero. Later, in the "political tradeoff analysis, " the value of this variable required to make the net benefits for the United States just equal to zero is calculated.

The coefficient f (fraction of costs incurred by the United States) is initiallv set at 1 and then adjusted under alternative assumptions.'

b. Input Values.—The values for the input variables to the computer program for SP–3 are listed in table V–13, This table lists the mathematical symbol, the name or description of the variable, the units of measure, and the numerical value of the input variable for each I, J, and K. The calculations for the SP–3 were

Table V-13.—Input variables SP–3

Math symbol	Program symbol	Description	Units	Dependent Either/ on J, or J=l	J=2	J=3
Q_j		Stockpile size	Million ton	0.005	0.01	0.02
Q_j	QS	Stockpile accumulations and disposals	Million ton	0.005	0.006	0.006
Cu	Cu	Unit cost	$ per ton	7588.0	7700.0	7700.0
C_f	CF	Fixed initialization cost	Million $	0.5		
c "	CV	Variable initialization cost	$ per ton	0.0		
i	XI	Interest rate	Percent per year	0.08		
d	SLR	Spoilage loss rate	Percent per year	0.0		
s	SC	Storage cost	$ per ton per year	0.29		
t	T	Portion of surplus-shortage cycle occurring in the coming time period	Million tons	0.166866		
c_{p_i}	CP	Unit cost of domestic production saved by stabilizing due to stockpiling	$ per ton per year	0.0	0.0	0.0
'a	SA	Domestic production of material over the entire cycle	Million tons	0.0		
g	G	Fraction reflecting distribution of prices	Coefficient	0.5		
p_h	PH	High price without stockpiling	$ per ton	8250.0		
p'_h	PHP	High price with disposal of stockpile j	$ per ton	7838.0	7778.0	7778.0
p_l	PM	Low price without stockpile	$ per ton	7227.0		
p'_l	PMP	Low price with acquisition of stockpile j	$ per ton	7588.0	7700.0	7700,0
C_h	CH	High U.S. consumption without stockpile over cycle	Million tons	0.336378	0.342151	0.342151
c'_h	CHP	High U.S. consumption with stockpile over cycle	Million tons	0.341418	0.342151	0.342151
c_l	CL	Low U.S. consumption without stockpile over cycle	Million tons	0.328740		
c'_l	CLP	Low U.S. consumption with stockpile over cycle	Million tons	0.323814	0.322285	0.322285
PB	PB	Political benefits of stockpiling	Million $	0.0		
f	F	Fraction of stockpile costs obligated to by U.S.	Coefficient	1.0		
ED_{ik}	ED	External damage-no stockpile	Million $	0.062	0.124	0.124
m	M	Fraction of total output over the cycle whose price would be lower than p'_l without a stockpile	Coefficient	.38	.5	.5
h	H	Fraction of total output over the cycle whose price would be higher than p'_h without a stockpile	Coefficient	.38	.5	.5

performed by computer program for the input variables listed in table V-13.

c. Calculated (Output) Values.—The values for the output variables calculated by the computer program for SP–5 are listed in table V–14. This table lists the mathematical symbol, the description of the variable, the units of measure, and the numerical value of the output variable for each stockpile j

d. Graphic Representation of the Calculations.—Figure V-10 is a graphic representation of the calculated costs, benefits, and net benefits (benefits minus costs) for SP–3. Values are computed for only the known three chosen stockpile sizes and zero stockpile.

e. Optimal Stockpile Size.—The net benefit curve in figure V-10 can be used to indicate the probable optimal stockpile size, where the curve appears to be at a maximum positive value (or minimum negative value). This can only be taken as an indication of the

Figure V 10.
Economic Net Benefits of SP-3

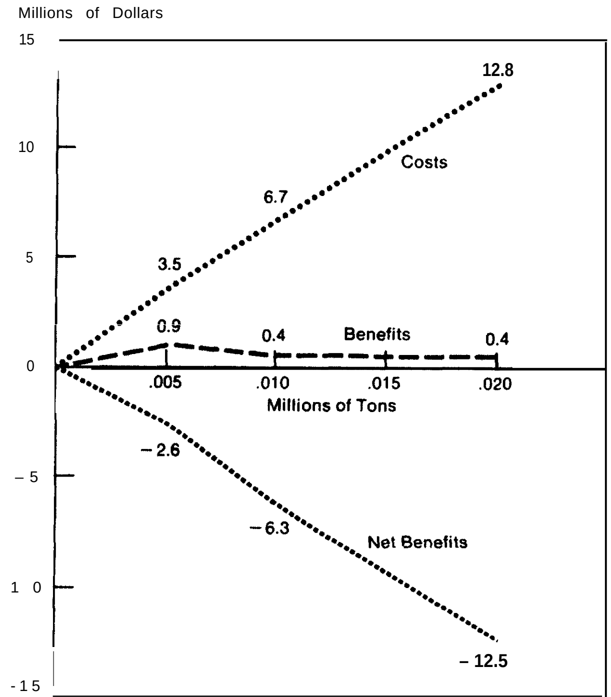


Table V–l4.—Calculated results for SP-3

Economic impacts of stockpiling tin [Millions of dollars]				
symbol	Description	J=1 (Millions of tons) .005	J=2 0.10	J=3 0.20
NB_j	Net benefits	–2.6	–6.3	–12.5
B	Benefits function	0.9	0.4	0.4
C_j	Cost function	3.5	6.7	12.8
DN*	Damage not averted			
	Benefit variables:			
CS_j	Increase in consumer surplus	4.2	1.5	1.5
PROD ST_j	Production costs saved	0.0	0.0	0.0
CG_j	Capital gains	1.3	0.5	0.5
ED_j	External damage	0.1	0.1	0.1
	Cost variables:			
CjF	Cost obligated to United States	3.5	6.7	12.8
HC_j	Holding costs	3.0	6.2	12.3
IC	Initialization costs	0.5	0.5	0.5
DC_j	Disposal costs	0.0	0.0	0.0
OC_j	Operating costs	40.2	83.2	166.4
AC_j	Acquisition costs	37.9	77.0	154.0
	Economic impact of no stockpile	0.9	0.4	0.4

● Damage not averted for SP–3 has not been calculated for reasons described on page
Note: All calculations have been rounded off for simplicity

area where the optimal size occurs; however, it will serve to illustrate the desired value of the stockpile size for the values of the input variables chosen, It should be noted that the benefits (increase in consumer surplus and external damage averted) for stockpile size Q_2 and Q_3 are the same. The reason for this is that full price stabilization-defined as 1 percent fluctuation— is accomplished with a stockpile size equal to about 6,000.

It should be emphasized that the estimates apply only to the specific materials examined *and with in the scenario assumptions* described, and should therefore not be taken to indicate that precise quantities of specific materials should *or* should not *be* stockpiled. Nevertheless, the nature and magnitude of the estimates are sufficient to indicate that an economic stockpile should be given detailed consideration as one component of a more comprehensive national materials policy and that measuring the benefits or costs of a supply disruption in terms of the probability, rather than the certainty, of a disruption will significantly reduce the quantity of material to be stockpiled,

Net benefits are negative for all three stockpile sizes. There are, however, several important factors which have not yet been discussed and which could change the net benefit estimates. First, net benefits could be positive for a stockpile size which is less than 5,000 tons; costs and benefits for smaller stockpile sizes have not been computed in this illustration. Second, it will be recalled that the coefficient f was set at 1.0 which assumes that the United States bears the full cost of the international tin stockpile. Under a more realistic value for f of 0.25, net benefits to the United States increase substantially, resulting in positive net benefits of $0,026 million for J_1. Finally, the base case illustration assumed the political benefits variable (PB) to be zero. For J]—retaining f at I, O-the PB variable would have to be **$2.63** million before net benefits became positive.

As a measure of scale for the results of these calculations, the proposed actions of the 1nternational Tin Council can be considered. Presently, the ITC maintains a stockpile of approximately 20,000 tons. The ITC is contemplating an increase of this buffer stock to 40,000 tons. The U.S. stockpile (as of Nov. 30, 1974) had 207,478 tons of pig tin, while the objective for the stockpile is 40,500 tons of pig tin.

Assuming that the ITC proposes an incremental stockpile of 20,000 tons and that the benefits to the United States and the total stockpile costs are as shown in table V–14, it would be useful to determine the critical values of f and PB under which U.S. participation would be justified. Maintaining PB equal to zero, the fraction of U.S. participation would be only 2,8 percent, or 560 tons. Alternatively, if the U.S. share were set at a more realistic level, say, 10 percent or 2,000 tons, the political benefits (PB) would have to equal or exceed $0.927 million for the net benefits of participation to be positive for the United States. These example calculations demonstrate the utility of the Economic Welfare Model—and particularly the political benefits variable and the U.S. cost fraction—in assessing U.S. participation in an international stockpile.

f. Sensitivity analysis for SP–5. -The computer program performs the "baseline" calculations and then automatically perturbs an input variable by +10 percent and reruns the calculations, The new costs, benefits, and net benefits are compared to the baseline calculations and the percentage change is computed. This process is repeated for each input variable.

The resulting percent changes in net benefits from a +10-percent change in each input variable for SP-3 are listed in table V–15.

An examination of table V–15 shows that the net benefits for SP–5 are fairly sensitive to changes in most of the input variables with the maximum changes occurring with a perturbation of (a) high price without stockpiling (PH) and *(b)* low price with disposal of stockpile (PMP).

Table V–15.—Percent change on 10 percent perturbation of variables of SP–3

Perturbed variables	Benefits			cost			Net Benefits		
	Q1	Q2	Q3	QI	Q2	Q3	Q1	Q2	Q3
CF	0.00	0.00	0.00	1.41	0.75	0.39	1.90	0.79	0.40
Cu	0.00	0.00	0.00	8.58	9.25	9.61	11.56	9.77	9.86
SC	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.00	0.00
ED	0.11	0.56	0.58	0.00	0.00	0.00	–0.04	–0.03	–0.02
T	10.00	10.00	10.00	0.00	0.00	0.00	–3.47	–0.56	–0.29
G	7.60	7.23	7.23	0.00	0.00	0.00	–2.63	–0.41	–0.21
PH	972.65	3279.97	3279.97	0.00	0.00	0.00	–337.11	–184.90	–93.52
PHP	–852.32	–2873.56	–2873.56	0.00	0.00	0.00	295.40	161.99	81.93
PM	820.31	2756.79	2756.79	0.00	0.00	0.00	–264.31	–155.41	-76.60
PMP	–930.76	–3153.78	–3153.78	0.00	0.00	0.00	322.59	177.79	89.92
CH	24.11	93.03	93.03	0.00	0.00	0.00	–8.35	–5.24	–2.65
CHP	24.47	94.63	94.63	0.00	0.00	0.00	–8.48	–5.33	–2.70
CL	–20.64	–91.11	–91.11	0.00	0.00	0.00	7.15	5.14	2.60
CLP	–20.33	–69.32	–89.32	0.00	0.00	0.00	7.05	5.04	2.55
QS	2.28	2.19	2.19	0.00	0.00	0.00	–0.79	–0.12	–0.06
XI	0.00	0.00	0.00	8.58	9.25	9.61	11.56	9.77	9.88
M	–40.96	–160.43	–180.43	0.00	0.00	0.00	14.20	10.17	5.14
H	48.57	187.65	187.65	0.00	0.00	0.00	–16.83	–10.58	–5.35

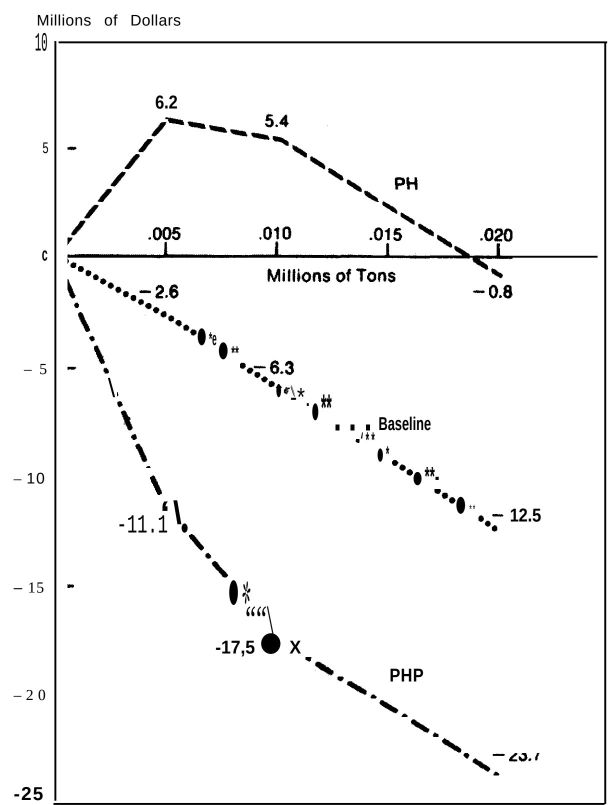
The net benefit functions for the baseline and the extreme perturbation cases are plotted in figure V-11. The conclusions will change to an optimum stockpile size of about 5.000 tons if PH increases by +10 percent.

3. Discussion of Partial Benefits and Costs for Each Phase of Stockpile Operation for SP-3

The above presentation of net benefits can be supplemented by a discussion of how the total is made up of the categories of impacts. The economic impacts of a tin stockpile for SP–3 can be determined with the Economic Welfare Model for three types of impacts: direct benefits and costs to materials consumers, benefits and costs borne by the stockpile investor, and external benefits and costs. Calculations have been made to estimate each of these three types of economic impacts. The costs and benefits shown below by phase of stockpile operation are those expected for the coming time period (i.e., a year) rather than over the full 6-year cycle.

Figure V-1 1.

Perturbations for SP-3



a. The Direct Benefits and Costs to Materials Consumers.—The direct benefits and costs to materials consumers of tin as a result of a tin economic stockpile under SP–3 are summarized below:

Benefits and costs to consumers		Stockpile size (Millions of tons)		
		(Millions of dollars)		
Operational action	**Type of benefit or cost**	**0.005**	**0.010**	0.020
Acquisition	Consumer loss (CL)	–3.7	–6.4	–6.4
Holding	Consumer loss (CL')	.000	.000	.000
Disposal	Consumer Savings (CS)	4.4	6.7	6.7

b. The Costs and Benefits to the Stockpile Investor.—The costs and benefits to the stockpile investor for an economic stockpile of tin under SP–3 are summarized below:

Revenues ● nd costs to stockpile operators		Stockpile size (Millions of tons)		
		(Millions of dollars)		
Operational ● ction	**Type of benefit or cost**	0.005	0.010	0.020
Acquisition	Initialization cost (IC)	0.5	0.5	0.5
Holding	Holding cost (HC)	3.0	6.2	12.3
Disposal	Disposal cost (DC)	0.0	0.0	0.0
	Capital gains (CG)	0.2	0.1	0.1

c. The Estimation of External Costs and Damages.—The estimation of external costs and damages can be done in a generalized, first-order approximation, or it can be rigorously determined. No external costs and benefits were estimated for SP–3. The illustrative calculations for a tin stockpile under SP–3 utilize the first approach, a general approximation. The resulting external benefits and costs as given in the tin example are summarized below:

External costs and damages		Stockpile size (Millions of tons)		
		(Millions of dollars)		
Operational action	**Type of benefit or cost**	**0.005**	**0.010**	0.020
Acquisition	External cost (EC)	0.0	0.0	0.0
Holding	External damage E(ED)*	0.0	0.0	0.0
Disposal	External damage E(ED')*	0.0	0.0	0.0

*Benefits are allocated evenly to the acquisition and disposal stages

4. Summary of Economic Net Benefits and Partial Benefits for SP-3

The results of the calculations for SP-3 are summarized for years one and two in tables V–16 and V–17, respectively. It is assumed that the expected benefits and costs of stockpiling are the same for each year, though the present value of these benefits and costs will differ. As discussed previously, the net benefits of an international tin stockpile are negative for all three specified stockpile sizes when the value of f is set equal to 1 and the value of PB to zero. Changes in the values of f and PB, however, may yield positive net benefits.

For a complete discussion of the Operating Cost Model and estimates of the costs of implementing and running an economic stockpile, refer to the section in chapter VI on Budget Cost Implications. The operating costs are indicated here for conceptual understanding, The cost to the Government of establishing a 5,000-ton" tin stockpile is estimated to be about $40 million in the first year, with the major components being $37.9 million for purchase of tin plus $0.500 million for purchase of storage and other facilities and $3.0 million for holding costs. Offsetting these costs are capital gains of $1.3 million. In each succeeding year the cost of operation would only be the holding costs minus the capital gains if the stockpile size remains unchanged.

The distribution effects of this particular stockpiling policy are not fully illustrated with the example material. For example, potential producer gains in the form of production cost savings have not been estimated. Materials consumers are modest gainers. The stockpile operator captures a capital gain, but it does not completely offset the economic costs of stockpiling. Costs not covered by capital gains are borne solely by the operator (taxpayer), which means that the distributive effects of the cost function cannot readily be estimated.

Table V–16.—Partial economic benefits and costs of SP–3 for first year of operation in **millions of dollars**

Type of benefit or cost	Size of stockpile millions of tons	Operational action*		
		Acquisition	Holding	Disposal
Producers. ... , , ...	0.005	0.0	0.0	0.0
	0.010	0.0	0.0	0.0
	0,020	0.0	0.0	0.0
Consumers.	0.005	–3.7	0.0	4.4
	0.010	6.4	0.0	6.7
	0.020	6.4	0.0	6.7
Operators. ., ...	0.005	–0,6	–3.0	0.2
	0.010	–0.5	–6.2	0.1
	0,020	–0.5	–12.3	0.1
External.	0.005	0.0	0.0	0.0
	0.010	0.0	0.0	0.0
	0.020	0.0	0.0	0.0

Net benefits are $–2.6 millions, $-6.3 millions, and $–12.5 millions for 0.005, 0.010, and 0,020 million tons of stockpile, respectively.

"Signs indicate the sign which each term should have when summing to indicate net benefits

Table V–17.—Partial economic benefits and costs of SP-5 for second year of operation
(In Millions of dollars)

Type of benefit or cost	Size of stockpile Millions of tons]	Operational action*		
		Acqiisition	Holding	Disposal
Producers, , ...	0.005	0.0	0.0	0.0
	0.010	0.0	0.0	0.0
	0,020	0.0	0.0	0.0
Consumers.	0.005	–3.7	0.0	4.4
	0.010	–6.4	0.0	6.7
	0.020	–6.4	0.0	6.7
Operators. ... , ...	0.005	–0.5	–3.0	0.2
	0.010	–0.5	–6.2	0.1
	0.020	–0.5	–12.8	0.1
External. ., ...	0.005	0.0	0.0	0.0
	0.010	0.0	0.0	0.0
	0.020	0,0	0.0	0.0

The present vaIue of net benefits is –$2.4 millions, –$5.8 millions, and –$11.5 millions for 0.005, 0.010, and 0.020 million tons of stockpile, respectively, assuming a time discount rate of 8 percent.

*Signs indicate the sign which each term should have when summing to indicate net benefits.

E. ECONOMIC IMPACTS OF STOCKPILING TO CONSERVE SCARCE DOMESTIC MATERIALS (SP-4)

The benefits derived from SP-4 are a result of the modification of the production and consumption of a material over time from what normally would occur without a stockpile. The cost function has been described in the section in chapter IV on the Economic Welfare Model, equation (7). The only modification required for SP-4 is that holding costs are incurred over the full-time horizon, and thus must be discounted to present value and summed. The benefit function for SP-4 is developed in the subsequent paragraphs. Calculations of the net benefits are presented immediately thereafter.

1. Derivation of the Benefit Function for SP-4

The benefits derived from SP-4 address a stockpile designed to assure that the total available stock of scarce domestic materials is produced and consumed at a rate which differs from that achieved in a market without intervention. This type of stockpile would accumulate stocks now and dispose of them during a later time period. The acquisition of stocks increases prices in the current period, thus reducing consumption and stimulating production.

The reasons private stockpiling might fail to accumulate the optimal level of stocks to achieve the objectives of this stockpiling policy include: (1) the time horizon of firms in the private sector differs from the time horizon of society; (2) the social and private time rates of discount differ; (3) expectations held by the Government and the private sector regarding future scarcity and prices differ; (4) the social benefits associated with this type of stockpile cannot be entirely appropriated by private stockpilers because of price controls, taxes on capital gains, and other factors.

Accumulation of stocks in the coming time period t. will shift the domestic demand curve to the right as shown in figure V-l2a, The price rises from p_0 to p'_0 if stocks equal to q'_o minus q_0 are accumulated, This results in a loss of consumer surplus equal to the trapezoid p'_0dcp_0 and a gain in producer surplus equal to the trapezoid p'_0acp_0 for a net welfare gain equal to triangle dac. This net welfare gain can be derived from the following equations:

$$PG = (p'_0-p_0)q'_0 - 1/2(p'_0-p_0)(g'_0-q_0)0.5 \quad (22a)$$

where PG = Producer gain

$$CL = (p'_0-p_0)q'_0 - 1/2(p'_0-p_0)(q'_0-q_0)0.5 \quad (22b)$$

where CL= Consumer Loss

Net producer surplus (PG – CL) can be derived from the above equations as:

$$1/2(p'_0-p_0)q'_{0i} \quad (22C)$$

where q'_{oj} is the size of the stockpile accumulated in the current period.

Disposal of stocks in a future time period t_f will shift the supply curve to the right, causing a drop in the equilibrium price from p_t to p'_t as illustrated in figure V-12b. This produces an increase in consumer surplus equal to trapezoid $p_tefp'_t$ and a decrease in producer surplus of $p_tegp'_t$ for a net gain of efg. This net gain is derived from equations 22d, 22e, and 22f below,

$$CS = (p_t-p'_t)q'_t - 1/2(p_t-p'_t)(q'_t-q)0.5 \quad (22d)$$

$$PL = (p_t-p'_t)q'_t - 1/2(p_t-p'_t)(q'_t-q)0.5 \quad (22e)$$

Where net consumer surplus (CS – PL) is reduced to the equation:

$$1/2(p_t-p'_t)q'_{ti} \quad (22f)$$

Where q'_{tj} is the size of the stockpile disposed in the future time period.

Figure V-12a.

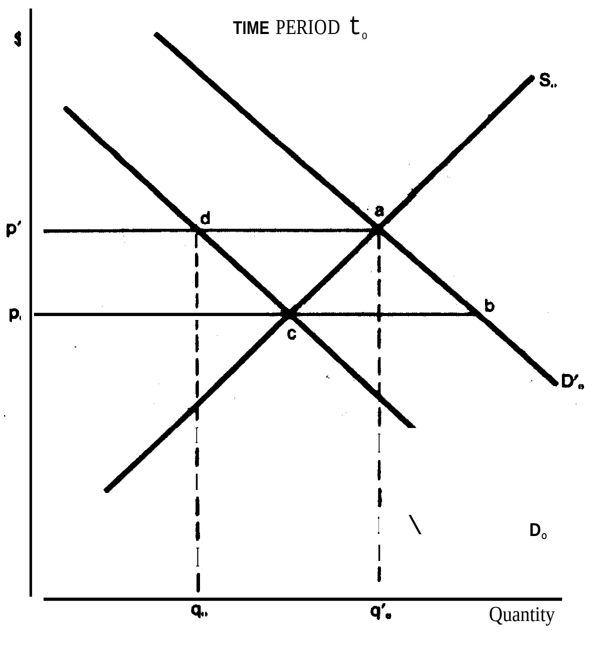
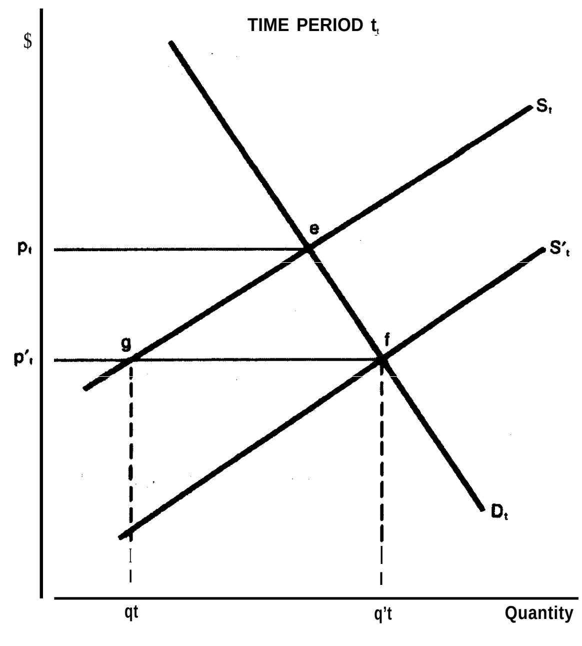


Figure V-12b.



TERMS:
p = price D = demand curve
q = quantities S = supply curve

External damage saved in the future time period t_f due to the disposal of the stockpile must be included in the benefit function, These damages averted will arise from the availability of the material and the increased output this availability will maintain, These external damages must be discounted to their present value as was the future net consumer surplus.

Before the total net benefit to society of saving material in a stockpile for some future time period can be determined, the capital gains (or losses) realized on the purchase and sale of the commodity must be added (subtracted) to the benefits, Since interest costs are included in the calculation of the total costs of stockpiling, the capital gain should not be discounted for time. This implies, however, that society's time rate of discount is the appropriate interest rate to use in the cost function so that the capital gains apply only to the quantity of material available for sale in the future time period (i.e., $q'_t - q_t$).

The benefits associated with stockpiling for SP–4 can be measured by the following equation:

$$
\begin{aligned}
B_j = [\, & 1/2(p'_{0j}-p_0)(Q_{0j}) \\
& +1/2(p_t-p'_{tj})(Q_{tj})\,] \quad (1+i)-tf \\
& +(p'_{tj}-p'_{0j})(Q_{tj}) \; +ED_{tj}(1+i)-tf \qquad (23)
\end{aligned}
$$

where

Bj = Benefits from stockpile j
PO = price in current time period without stockpile acquisition
P_t = price in future time period without stockpile disposal
i = discount rate
tf = time horizon; years between current time and future time
Q_{0j} = size of stockpile j accumulated in current time period
Q_{tj} = size of stockpile j disposed in future time period
P'_{0j} = price in current time period with acquisition
P'_{tj} = price in future time period with disposal
ED_{tj} = External damages saved in future time period with disposal of stockpile j

The first term or equation (23) is the net increase in producer surplus in the current time period, The second term in equation (23) is the net increase in consumer surplus in the future time period discounted to its present value. The third term is the capital gains (or losses) accrued in acquisition and disposal of the stockpile. The fourth term in equation (23) gives the external damages saved in the future time period discounted to its present value.

Under certain conditions, equation (23) could be modified to reflect more complex relationships of the current and future market. One condition would be if the present value of the price in the future time period is below the present value of the expected price in any other time period, t_{ftr}. In such situations, the benefits can be increased by releasing some of the stocks in the period t_{ftr} as well as in period t_f. The price reached by release of stocks in time period t_{ftr} should be reduced to the point that the price discounted with time equals the reduce price in time period t_f [i. e., $p'_t = p'_{t+r}$ (1+i) 4-r]. Equation (23) can be expanded with this method in order to allocate stockpile disposals over several future time periods.

The calculation of benefits and costs must be made for various stockpile sizes to trace out the entire benefit function and cost function for SP-4. The expected net benefits can then be determined for each stockpile size.

2. Estimation of Net Benefits for SP-4

Tungsten was selected as the material for application of the Economic Welfare Model to SP–4. While tungsten satisfies the materials selection criteria for SP-4, it would have been more consistent with the intent of this policy to use a material where domestic production accounts for the bulk of total supply. As it is, imports constitute a major portion of total tungsten supply. Nonetheless, this illustration is based upon that portion of total demand satisfied by domestic production. This assumes that the acquisition of tungsten in a stockpile for a future period will be used solely to stimulate domestic production, while its disposal will be used solely to reduce domestic supply shortages in the future.

a. Background In formation.—Other values and assumptions used in the analysis include the following:

- The time period under consideration is 1974 (the current period) to 1980 (the future period). The year 1980 is taken for ease of calculation. Normally, the time horizon of society under this policy would be on the order of 30, 40, or more years.
- Domestic supply and demand values and prices for 1974 and 1980 are presented in the table below. Growth rates of 7 percent and 2percent are postulated for demand and supply respectively.

	1 9 4	1980
Price ($/tons]	8,500	12,500
Demand (tons)	3,875	5,820
Supply (tons)	3,875	4,364

- The price elasticity of supply is estimated to fall in the range of 0.35 to 0.5 in the current period but to decline by 50 percent in the future period.
- The price elasticity of demand for tungsten is estimated to be in the area of -0.9 for both current and future periods.
- A discount rate of 8 percent has been used for computing future costs and benefits of stockpiling tungsten to their present value.
- External costs and damages averted for tungsten are estimated by using from SP–2 the ratio of GNP lost to the value of zinc imports interrupted (1.008), which in turn is applied to the value of tungsten acquired or forgone to derive losses of GNP. Implicit in this approach is that interindustry relationships of the two materials are the same. Admittedly, this approach to estimating external costs and damages averted can provide only an approximation to the actual values.

b. Input Values.—The values for the input variables to the computer program for SP-4 are listed in table V-18. This table lists the mathematical symbol, the name, or description, of the variable, the units of measure, and the numerical value of the input variable for each stockpile size. The calculations for the SP-4 were performed by computer program for the input variables listed in table V–18.

c. Calculated (Output) Values.—The values for the output variables calculated by the computer program for SP-4 are listed in table V–19. This table lists the mathematical symbol, the description of the variable, the units of measure, and the numerical value of the output variable for each stockpile j.

d. Graphic Representation of the Calculations.—Figure V-13 is a graphic representation of the calculated costs, benefits, and net benefits (benefits minus costs) for SP-4. Values are computed only for three stockpile sizes and zero stockpile,

e. Optimal Stockpile Size.—The net benefit curve in figure V-13 can be used to indicate the probable optimal stockpile size, where the curve appears to be at a maximum positive value (or minimum negative value). This can only be taken as an indication of the area where the optimal occurs; however, it will serve to illustrate the desired value of the stockpile size for the values of the input variables chosen. It should be emphasized that the estimates apply only to the specific materials examined and within the scenario assump-

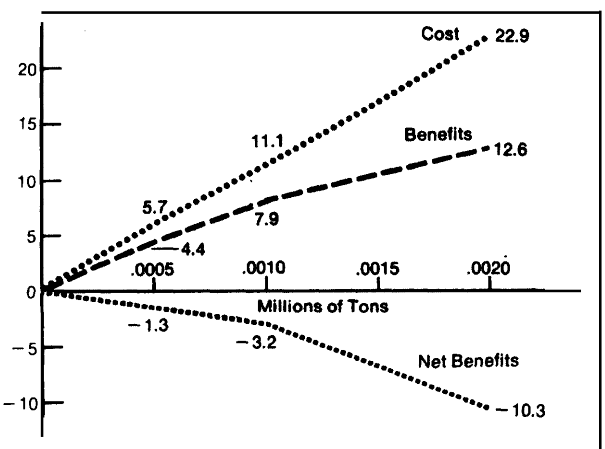
Table V-18.—Input variables SP-4

Math symbol	Program symbol	Description	Units	on J, or J=1	J=2	J=3
Q_j	Q	Stockpile size	Millions tons	0.0005	0.001	0.002
C	Cu	Unit cost	$ per ton	8755.5	9011.0	9522.0
C_f	CF	Fixed initialization cost	Million $	0.5		
C“	CV	Variable initialization cost	$ per ton	0.0		
	XI	Interest rate	Percent per year	0.08		
d	SLR	Spoilage loss rate	Percent per year	0.0		
S	SC	Storage cost	$ per ton per year	2.5		
EC_j	EC	External cost	Million $	3.529	7.284	15.352
Po	PO	Price in current time period without stockpile acquisition	$per ton ,	8500.0		
P_{0j}'	POP	Price with acquisition of stockpile j	$ per ton	9500.0	10900.0	13300.0
P,	PT	Price in future without stockpile disposal	$ per ton	12500.0		
P'_{tj}	PTP	Price in future with disposal of stockpile j	$ per ton	10900.0	9300.0	6200.0
i	DR	Discount rate	Percent per year	0.08		
tf		Time horizon	Years	6.0		
Q_{0j}	E	Size of stockpile j accumulated in current time period	Millions tons	.0005	.001	.002
Q_{tj}	QT	Size of stockpile j disposed in future time period	Million tons	.0005	.001	,002
ED_{tj}	EDT	External damages saved in future time period w/disposal of stockpile j	Million $	5.484	10.676	20.338
d_t	DT	Demand in period t without a stockpile	Million tons	.004384		
C_d	CD	Unit disposal cost	$ per ton	.0		
Q_{dj}	QD	Stockpile disposal cost	$ per ton	.0		

Figure V-13.

Economic Net Benefits of SP-4

Millions of Dollars



tions described, and should therefore not be taken to indicate that precise quantities of specific materials should or should not be stockpiled. Nevertheless, the nature and magnitude of the estimates are sufficient to indicate that an economic stockpile should be given detailed consideration as one component of a more comprehensive national materials policy and that measuring the benefits or costs of a supply disruption in terms of the probability, rather than the certainty, of a disruption will significantly reduce the quantity of material to be stockpiled.

In this illustration, net benefits are negative for all three stockpile sizes, which suggests that tungsten should not be stockpiled for

Table V–lg.—Calculated results for SP-4

Economic impacts of stockpiling tungsten (Millions of dollars)				
Symbol	**Description**	J=1	**J=2** (Millions of tons)	**J=3**
		0.0005	0.001	0.002
NB_j	Net benefits	–1.3	–3.2	–10.3
‘j	Benefits function	4.4	7.9	12.6
c_j	Cost function	5.7	11.1	22.9
DN	Damage not averted	5.2	4.5	1.5
	Benefit variables:			
	Consumer savings	6.2	13.2	29.1
	Producer loss	5.0	12.2	25.1
CS_j	Net consumer savings:	0.2	1.0	4.0
	Producer gain	4.2	11.0	25.8
	Consumer loss	4.0	9.9	21.0
PG_j	Net producer gain	0.3	1.2	4.8
CF_j	Capital gains	0.4	–1.0	–8.9
ED_j	External damage	3.4	6.7	12.8
	Cost variables:			
HC_j	Holding costs (discounted)	1.6	3.3	7.1
	Initialization costs	0.5	0.5	0.5
DC_j	Disposal costs	0.0	0.0	0.0
OC_j	Operating costs	4.8	11.2	30.0
AC_j	Acquisition costs	4.4	9.0	19.0
*	Economic impact of no stockpile	4.4	7.9	12.6

All calculations have been rounded off for simplicity

*The economic impact of no stockpile is equivalent to the benefits (expected damages averted) attributed to the stockpile which are foregone in the absence of the stockpile

SP-4. However, a stockpile size less than 500 tons might yield positive net benefits. A longer time horizon for holding the stockpile could yield considerably higher prices of tungsten in period t though the present value of benefits (and cost) become increasingly smaller as the time horizon is extended.

f. Sensitivity Analysis for SP–4.—The computer program performs the “baseline” calculations and then automatically perturbs an input variable by +10 percent and reruns the calculations. The new costs, benefits, and net benefits are compared to the baseline calculations and the percentage change is computed. This process is repeated for each input variable.

The resulting percent changes in net benefits from a +10-percent change in each input variable for SP–4 are listed in table V–20, An examination of table V-20shows the net benefits to be fairly sensitive to most of the input variables, but not exceeding about plus or minus 90 percent. The maximum changes occur for variations in (a) external damages saved in future time period with disposal of stockpile, and (b) external cost.

The net benefit functions for the baseline case and for perturbations of +10 percent in EDT and EC are plotted in figure V-14. In both cases the net benefits are negative for stockpiles of 0.0005 and 0.001 million tons,

3. Discussion of Partial Benefits and Costs for Each Phase of Stockpile Operation for SP-4

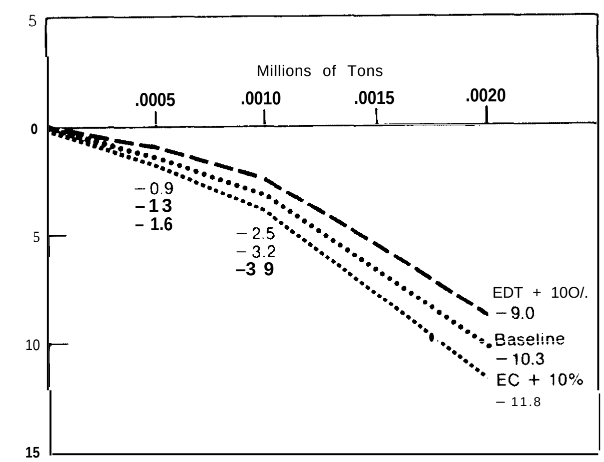
The above presentation of net benefits can be supplemented by a discussion of how the

Table V–20.-Percent change based on 10 percent perturbation of variables for SP-4

Perturbed variable	Benefits Q1	Benefits Q2	Benefits Q3	cost Q1	cost Q2	cost Q3	Net benefits Q1	Net benefits Q2	Net benefits Q3
CF	0.00	0.00	0.00	0.88	0.45	0.22	3.95	1.57	0.40
Cu	0.00	0.00	0.00	2.86	3.00	3.07	12.77	10.48	6.85
Sc	0.00	0.00	0.00	.01	.01	.01	.05	.04	.02
EC	0.00	0.00	0.00	6.24	6.54	6.70	27.84	22.84	14.93
Po	–4.84	–5.36	–6.73	0.00	0.00	0.00	16.77	13.36	8.27
POP	–1.41	–1.79	–2.74	0.00	0.00	0.00	4.88	4.46	3.37
PT	4.49	4.97	6.23	0.00	0.00	0.00	–15.54	–12.38	–7,66
PTP	3.91	3.70	3.09	0.00	0.00	0.00	–13.55	–9.21	–3.80
TF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
QO	.57	1.51	3.80	0.00	0.00	0.00	–1.97	–3.77	–4.67
EDT	7.85	8.49	10.14	0.00	0.00	0.00	–27.17	–21.15	–12.47
DT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TF_1	0.00	0.00	0.00	2.87	3.01	3.08	12.82	10.51	6.87
TFX	9.43	8.49	6.20	0.00	0.00	0,00	–32.64	–21.15	–7.62

Figure V 14.

Perturbations for SP-4



total is made up of four categories of impacts. The economic impacts of a stockpile for SP-4 can be determined with the Economic Welfare Model for four types of impacts: direct benefits and costs to materials producers, direct benefits and costs to materials consumers, benefits and costs borne by the stockpile investor, and external benefits and costs. Calculations have been made to estimate each of these four types of economic impacts. A tableau arraying the conclusions is presented below for each phase in the operation of a stockpile, followed by the supporting derivations,

a. **Direct Benefit and Costs to Materials Producers.—**Direct benefits and costs to materials producers of a tungsten stockpile under SP-4 are summarized below:

Benefits and costs to producers		Stockpile size (Millions of tons) (Millions of dollars]		
Operational action	Type of benefit or cost	0.0005	0.001	0.002
Acquisition	Producer gain (PG)	4.245	11.088	25.776
Holding	Producer loss (PL)	0.000	0.000	0.000
Disposal	Producer loss (PL')*	5.993	12.237	25.084

"This term ıs expressed as a present value

b. Direct Benefits and Costs to Materials Consumers.—Direct benefits and costs to materials consumers of a tungsten stockpile under SP-4 are summarized below:

Benefits and costs to consumers		Stockpile size (Millions of tons)		
		(Millions of dollars)		
Operational action	Type of benefit or cost	0.0005	0.001	0.002
Acquisition	Consumer loss (CL)	3.995	9.888	20.976
Holding	Consumer savings (CS)	0.000	0.000	0.000
Disposal	Consumer savings (CS')*	6.245	13.245	29.053

"This term is expressed as a present value.

c. Costs and Benefits to the Stockpile Investor.—The cost and benefits to the stockpile investor for a tungsten stockpile under SP-4 are summarized below:

Revenues and costs to stockpile operators		Stockpile size (Millions of tons)		
		(Millions of dollars)		
Operational action	Type of benefit or cost	0.0005	0.001	0.002
Acquisition	Initialization cost (IC)	0.500	0.500	0.500
Holding	Holding cost (HC)*	1.625	3.344	7.066
Disposal	Disposal cost (DC)	0.000	0.000	0.000
	Capital gains (CG)	0.441	–1.008	–8.948

"This term is expressed as a present value

d. Estimation of External Costs and Damages.—The estimation of external costs and damages can be done in a generalized, first-order approximation, or it can be rigorously determined. The illustrative calculations for a tungsten stockpile under SP-4 utilize the first approach, a general approximation. The resulting external benefits and costs as given in the tungsten example are summarized below:

External costs and damages		stockpile size (Millions of tons)		
		(Millions of dollars)		
Operational action	Type of benefit or cost	0.0005	0.001	0.002
Acquisition	External cost (EC)	3.529	7.264	15.352
Holding	External damage (ED)	0.000	0.000	0.000
Disposal	External damage (ED')*	3.443	6.728	12.813

"This term is expressed as a present value.

4. Summary of Economic Net Benefits and Partial Benefits for SP-4

The results of the calculations for SP–4 are summarized in table V–21. These results are for the entire time horizon of the operation of the stockpile, with acquisition being in year 1, the holding phase over years 1-6 and disposal in year 7, In the initial year of operation, large external consumer costs are incurred. During disposal, external damages are avoided and gains in consumer surplus are captured.

For a complete discussion of the Operating Cost Model and estimates of the costs of implementing and running an economic stockpile, refer to the section in chapter VI on Budget Cost Implications. The operating costs are indicated here for conceptual understanding, The cost to the Government of establishing a 500-ton” tungsten stockpile is estimated to be about $4.8 million in the first year, with the major components being $4.4 million for purchase of tungsten plus **$0.5** million for purchase of storage and other facilities and $1.6 million for holding costs. Offsetting these costs are capital gains of $0.4 million. In each succeeding year the cost of operation would only be the holding costs minus the capital gains if the stockpile size remains unchanged,

On balance, materials consumers realize a small net gain, with materials producers being approximately even over the full cycle. Consequently, only nominal transfer payments occur in this illustration. Nonetheless, the distributive effects can be significant. External costs and damages are large, but their distributive effects are unknown. Moreover, because this policy is concerned with the use of resources over time, the discount rate used determines distribution in another sense, namely, between present and future generations. The lower the discount rate the greater is the preference given to future users.

Table V–21.—partial economic benefits and costs of SP–4 for the fuIl cycle of operations

(In millions of dollars)

Type of benefit or cost	Size of stockpile [Millions of tons]	Operational actfon*		
		Acquisition	Holding	Disposal
		PG_j	PL_j	PL'_j
Producers. ., ...	0.005	4.2	0.0	6.0
	0.001	11.1	0.0	12.2
	0.002	25.8	0.0	25.1
		CL_j	CSj	CS'_j
Consumers. . . . . , ...	0.005	4.0	0.0	6.2
	0.001	9.9	0.0	13.2
	0.002	21.0	0.0,	29.1
		IC_j	HC_j	(DC+CG)
Stockpile operators ... , , .	0.0005	0.5	1.6	0.4
	.001	0.5	3.3	–1.0
	.002	0.5	7.0	–8.9
		EC	ED_j	ED'_j
External costs. ... , ...	0.005	3.5	0.0	3.4
	0.001	7.3	0.0	6.7
	,002	15,4	0.0	12.8

Economic net benefits are –1.3 millions, –3.2 millions, and –10.3 millions for 0.0005, 0.001, and 0.002 million tons of stockpile, respectively.

“Signs indicate the sign which each term should have when summing to indicate net benefits

F. ECONOMIC IMPACTS OF STOCKPILING TO PROVIDE A MARKET FOR TEMPORARY SURPLUSES AND EASE TEMPORARY SHORTAGES (SP-5)

The procedure for calculating the benefits of SP–5 is similar to that developed for the benefit function of SP–3. The cost function for SP–5 also takes the same form as for SP–3, as discussed in chapter IV on the Economic Welfare Model, equation (7). The benefit function for SP–5 is developed in the subsequent paragraphs. Calculations of the net benefits are presented immediately thereafter.

1. Derivation of the Benefit Function for SP-5

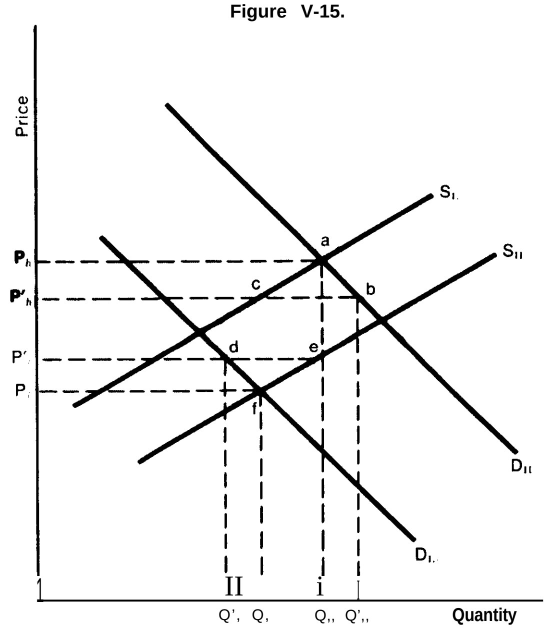
The objective of this stockpiling policy is to stabilize the price of a material around its long-run (market clearing) trend. Attempts to keep the price either above or below the market clearing level in the long run are inconsistent with the stated objective of SP–5, and in fact a stockpile used for this purpose is almost certain to fail. If price is maintained above the long-run level, stockpiles tend to grow increasingly larger over time. If price is maintained below the long-run level, stockpiles are sooner or later depleted.

This stockpiling policy produces four types of benefits: an increase in consumer-producer surplus, a decrease in production costs, a reduction in the external costs associated with price instability, and the realization of capital. The increase in consumer-producer surplus, as shown below in figure V-15, arises because the gain in consumer surplus exceeds the loss in producer surplus caused by stockpile accumulations and the gain in producer surplus exceeds the loss in consumer surplus caused by the disposal of stockpiles.

The decrease in production costs arises because both producers and consumers of the material can, with a stockpile, operate at a more stable production rate. During periods of shortages, producers are not forced to put obsolete and expensive equipment into service, and during periods of surpluses, they do not have to idle production capacity. Therefore, capital and fixed costs are reduced for the producers of the material. The case is similar, though to a lesser extent, for the material consumers,

The reduction in external costs reflects the benefits of greater stability realized by third parties other than producers or (direct) consumers of the material. For example, the suppliers and workers of producing firms during periods of surpluses would now be kept more fully occupied, Similarly, the suppliers and workers of firms indirectly consuming the

Figure V-15.



TERMS:

S, = low supply curve
S = high supply curve
D = low demand curve
D = high demand curve
P = high price without stockpile
P' = high price with stockpile
P, = low price without stockpile
P', = low price with stockpile
Q, = high consumption without stockpile
Q', = high consumption with stockpile
Q, = low consumption without stockpile
Q' = low consumption with stockpile

material would no longer face interruptions in production during periods of shortages. Capital gains are realized on the operation of the stockpile because stocks are accumulated during periods of surpluses when prices are low and disposed of during periods of shortages when prices are high.

The benefits from a stockpile of a given size over the entire surplus-shortage cycle should be estimated to calculate the benefit function for this type of stockpile over the coming time period. Since these benefits are derived over the entire surplus-shortage cycle, only a portion of these benefits should be credited to the coming time period. This portion t is given by the ratio of the length of the coming period to the expected length of the surplus-shortage cycle. Thus, the benefits associated with a stockpile of size Q_j over the coming time period can be calculated by:

$$B_j = t(CS_j + PS_j + ED_j + CG_j) \qquad (24)$$

where

B_j = benefits expected for stockpile of size Q_j

t = portion of surplus-shortage cycle occurring in the coming time period

CS_j = increase in consumer-producer surplus

PS_j = decrease in average production costs

ED_j = external damage, external costs saved

CG_j = capital gains

The increase in consumer-producer surplus over the surplus-shortage cycle can be estimated using the procedure described below, which is based on the following assumptions:

- The price of the material reflects the benefits to marginal consumers (i.e., consumers who do without if asked to pay more for the material), as well as the production costs of the management producer;
- The demand and supply curves are linear within the range of the price fluctuations, and
- No sharp increase or decrease in the long term market clearing price occurs over the surplus-shortage cycle.

Let ph be the highest price and p_l the lowest price at which the material would be sold over the surplus-shortage cycle in the absence of stockpiling. This fluctuation in price could be caused by a shift in the demand curve, a shift in the supply curve, or shifts in both curves. In the latter case, demand could increase when supply was increasing, thereby tending to reduce price fluctuations, or demand could increase when supply was falling (as illustrated in fig, V–15), thereby tending to accentuate price changes. The p'_h and p'_j are the high and low prices, respectively, that occur with a stockpile. If over the cycle half of the material in the absence of stockpile were sold at p_h and half at p_l, the increase in consumer surplus during the accumulation of the stockpile would be given by the trapezoid $p_h a b p_h$ and the loss in producer surplus by the trapezoid $P_h a c P'_h$ so that the net gain in welfare would be represented by the triangle abc. This triangle can be approximated by 1/2 (ph-p'h)Q*j where Q^*_j equals the amount of stocks acquired during the accumulation phase (cb in fig. V-15) and sold during the disposal phase (de in fig. V-15). It is possible for Q^*_j to be smaller than the size of the stockpile (Q_j) if the latter is not entirely exhausted over the cycle.

During the disposal phase, the increase in producer surplus is given by the trapezoid $p_l d f p_l$ for a net gain in welfare equal to the triangle def, which can be approximated by 1/2 (P'l-pl) Q*j. Over the entire cycle then, the gain in consumer-producer welfare would equal 1/2 Q*j(pl –pl +ph–p'h). Of course, it is highly probably that without a stockpile the price would vary over the range *p]* to *ph so* the increase in consumer surplus would be only some fraction (g) of this amount as indicated in the following equation:

$$CS_j = 1/2gQ^*_j(p'_l - p_l + p_h - p'_h) \qquad \textbf{(25)}$$

where

CS_j = increase in consumer-producer surplus

g = fraction reflecting distribution of prices

Q_j quantity of stocks accumulated and ed of over cycle

ph = high price without stockpile

ph = high price with disposal of stockpile j

P_l = low price without stockpile

P'_l = low price with acquisition of stockpile j

The increase in consumer-producer surplus is dependent upon the size of the stockpile. That is, the stockpile size determines the level to which the high and low price fluctuations can be dampened, If the stockpile is of sufficient size, all of the price fluctuations will be dampened and the high and low prices would equal the average price (i.e., p'h = p'l = Pa).

The formulation of consumer-producer surplus assumes that the market clearing price remains constant over the cycle considered. If the long-run (market clearing) price tends to change appreciably over the surplus-shortage cycle, the procedure can be adjusted through the normalization of prices around the long-term price trend. The conceptual basis of benefits PS, ED_j, and CGj is the same for SP–3 as that outlined for SP–5 and hence is not *re*-peated here.

The net benefits for SP–5 are calculated for each stockpile size Qj from the benefits determined in equation (24) and the costs from equation (7). The calculations described above should be repeated for stockpiles of various sizes to trace out the entire benefit function and the entire cost function.

2. Estimation of Net Benefits for SP-5

Copper has been selected as a representative material for the calculation of net benefits arising from a stockpile intended to moderate temporary surpluses and shortages. The domestic price and supply of copper has fluctuated considerably over the last 5 years, with fluctuations occurring within a given year and from year to year. For example, the price of copper increased from 68.6 cents per pound in February 1974 to 86.6 cents in July 1974, and then fell to 64.2 cents by February 1975. Over the last 5 years the average annual price has fluctuated between 51,2 cents and 77.1 cents, following supply changes with a lag. Continued uncertainties in the copper industry regarding land restoration, waste disposal, air quality and water supply, combined with the large U.S. reserves of copper ore, are expected to reinforce this price fluctuation,

a. Background Information.—The values and assumptions used in the calculation of net benefits for stockpiling copper under SP–5 are outlined below:

- Future copper prices are assumed to be equal to the prices during the last 5-year cycle. Under this assumption, the high, low, and average prices per ton of copper are respectively **$1,542**, **$1,024**, and $1,283.
- It is estimated that complete stabilization of the price of copper would reduce the average cost of production by 2 cents per pound, with the actual cost reduction being proportional to the percent reduction in price fluctuation.
- External damage averted through reduction of price fluctuations is estimated as the value of unemployment benefits saved, These values are presented in the following table for each of three stockpile sizes:

	Stockpile size in thousand tons		
	500	2500	5,000
Unemployment benefits saved ($ million).	.6	3.0	13.0

b. Input Variables.—The values for the input variables to the computer program for SP–5 are listed in table V–22. This table lists the mathematical symbol, the name, or description of the variable, the units of measure, and the numerical value of the input variable for each I, J, and K. The calculations

Table V–22.—Input variables SP–5

Math symbol	Program symbol	Description	Units	Either not dependent on j, or J=1	J=2	J=3
Q_j	Q	Stockpile size	Million tons	0.5	2.50	5.00
Q'_j	QS	Stockpile accumulations and disposals	Million tons	0.5	1.94	1.94
C_{uj}	Cu	Unit cost	$ per ton	1089.0	1276.0”	1276.0’
C_f	CF	Fixed initialization cost	Million $	0.5		
C_v	CV	Variable initialization cost	$ per ton	0.0		
i	XI	Interest rate	Percent per year	0.08		
d	SLR	Spoilage loss rate	Percent per year	0.0		
s	SC	Storage cost	$ per ton per year	0.39		
t	T	Portion of surplus-shortage cycle occurring in the coming time period	Coefficient	0.2		
cp_j	CP	Unit cost of production saved by stabilization due to stockpiling	$ per ton	14.40	40.00	40.00
s_a	SA	Output of material over the entire cycle	Million tons	11.46		
g	G	Fraction reflecting distribution of prices	Coefficient	0.5		
p_h	PH	High price without stockpiling	$ per ton	1542.0		
p'_h	PHP	High price with disposal of stockpile j	$ per ton	1448.0	1289.0	1289.0
p_l	PM	Low price without stockpile	$ per ton	1024.0		
p'_l	PMP	Low price with acquisition of stockpile j	$ per ton	1089.0	1276.0	1276.0
Q_h	QH	High consumption without stockpile over cycle	Million tons/ 5 year cycle	11.5		
Q'_h	QHP	High consumption with stockpile over cycle	Million tons/ 5 year cycle	12.0	13.432	13.432
Q_l	QL	Low consumption without stockpile over cycle	Million tons/ 5 year cycle	11.195		
Q'_l	QLP	Low consumption with stockpile over cycle	Million tons/ 5 year cycle	10.695	8.696	8.696
ED	ED	External damage-no stockpile	Million $	.600	3.000	3.000
m	M	Fraction of total output over the cycle whose price would be lower than p'_l without a stockpile	Coefficient	.15	.5	.5
h	H	Fraction of total output over the cycle whose price would exceed p'_h without a stockpile	Coefficient	15	.5	.5

These costs would he higher than indicated if the entire stockpile of 2.5 or 5.0 million tons was acquired during the period under consideration The figures shown assume accumulations of 1.94 millions tons during the period under consideration

for the SP–5 were performed by the computer program for the input variables listed in table V–22.

c. Calculated (Output) Values.—The values for the output variables calculated by the computer program for SP-5 are listed in table V–23. This table lists the mathematical symbol, the description of the variable, the units of measure, and the numerical value of the output variable for each stockpile j.

d. Graphic Representation of the Calculations.—Figure V-16 is a graphic representation of the calculated costs, benefits, and net benefits (benefits minus costs) for the SP-5. Values are computed only for three stockpile sizes and zero stockpile.

e. Optimal Stockpile Size.—The net benefit curve in figure V-16 can be used to indicate the probable optimal stockpile size, where the curve appears to be at a maximum

Table V–23.—Calculated results for SP–5

Economic Impacts of Stockpiling Copper
{Millions of dollars]

symbol	Description	J=1	J=2 (Millions of tons)	J=3
		0.500	2.500	5.000
NB_j	Net benefits	28.7	–110.4	–366.5
Bj	Benefits function.	73.0	146.3	146.3
C	Cost function..	44.3	2.56.7	512.9
DN	Damage not averted	73.3	0.0	0.0
	Benefit variables:			
CSj	Increase in consumer-producer surplus	19.9	244.9	244.9
$PROD\ CST_j$	Production costs saved.	165.0	458.4	458.4
CG_j	Capital gains	179.5	25.2	25.2
ED_j	External damage	0.6	3.0	3.0
	Cost variables:			
HC_j	Holding costs..	43.8	256.2	512.4
IC	Initialization costs.	0.5	0.5	0.5
DC_j	Disposal costs..	0.0	0.0	0.0
OCj	Operating costs	409.3	3421.5	6867.6
AC_j	Acquisition costs.	544.5	3190.0	6380.0
•*	Economic impact with no stockpile	73.0	146.3	146.3

All calculations have been rounded for simplicity
● "The economic impact of no stockpile Is equivalent to the benefits (expected damages averted) attributed to the stockpile which are foregone in the absence of the stockpile

positive value (or minimum negative value). Though this can only be taken as an indication of the area where the optimal occurs, it illustrates the desired value of the stockpile size for the values of the input variables chosen. It should reemphasized that the estimates apply only to the specific materials examined and within the scenario assumptions described, and should therefore not be taken to indicate that precise quantities of specific materials should or should not be stockpiled. Nevertheless, the nature and magnitude of the estimates are sufficient to indicate that an economic stockpile should be given detailed consideration as one component of a more comprehensive national materials policy and that measuring the benefits or cost of a supply disruption in terms of the probability, rather than the certainty, of a disruption will significantly reduce the quantity of material to be stockpiled.

The calculations resulted in an optimal stockpile size of about 500,000 tons accumulated during the surplus portion of the surplus-shortage cycle. The economic net benefits expected for this stockpile are estimated at $28.7 million.

In summary, the example calculations for a copper stockpile show that the required size of a stockpile to stabilize prices and supply can be relatively large. The calculations demonstrate that the optimal stockpile size is not that required to completely stabilize the fluctuations of a materials' supply and price. Stockpile sizes J_2 and J_3 yield the same benefits since both are capable of reducing the price fluctuation close to the average price of $1,283 per ton of copper. * In practice it is recognized that a stockpile—regardless of size—would probably not be able to reduce price fluctuations to the degree assumed in this illustration.

The quantity of copper required to achieve full price stabilization is estimated to be 1.9 million tons, which is less than the sizes

*It is assumed that price fluctuations of 1 percent will continue.

Figure V-16.
Economic Net Benefits of SP-5

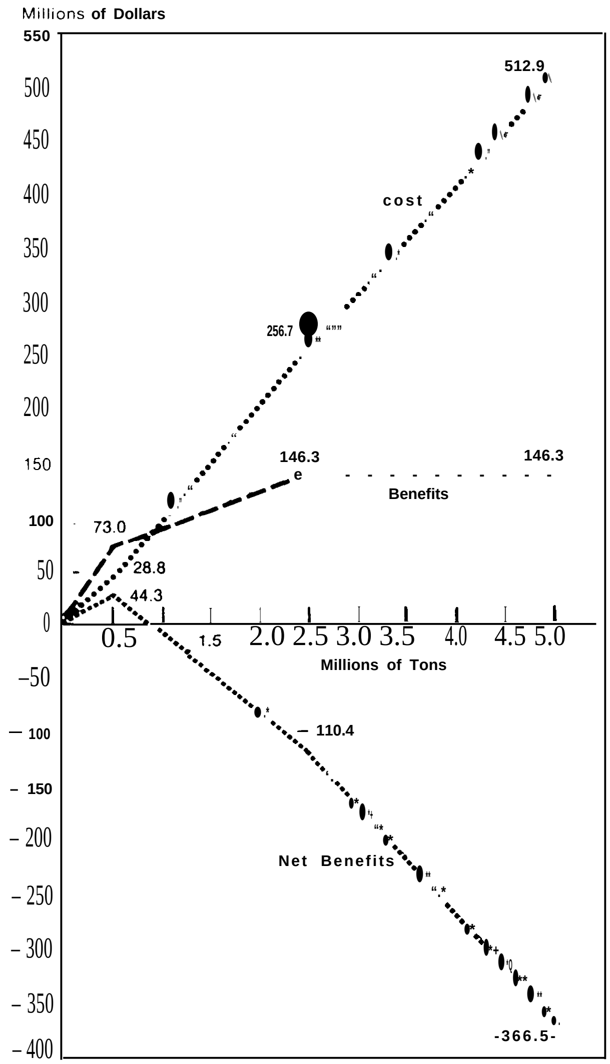
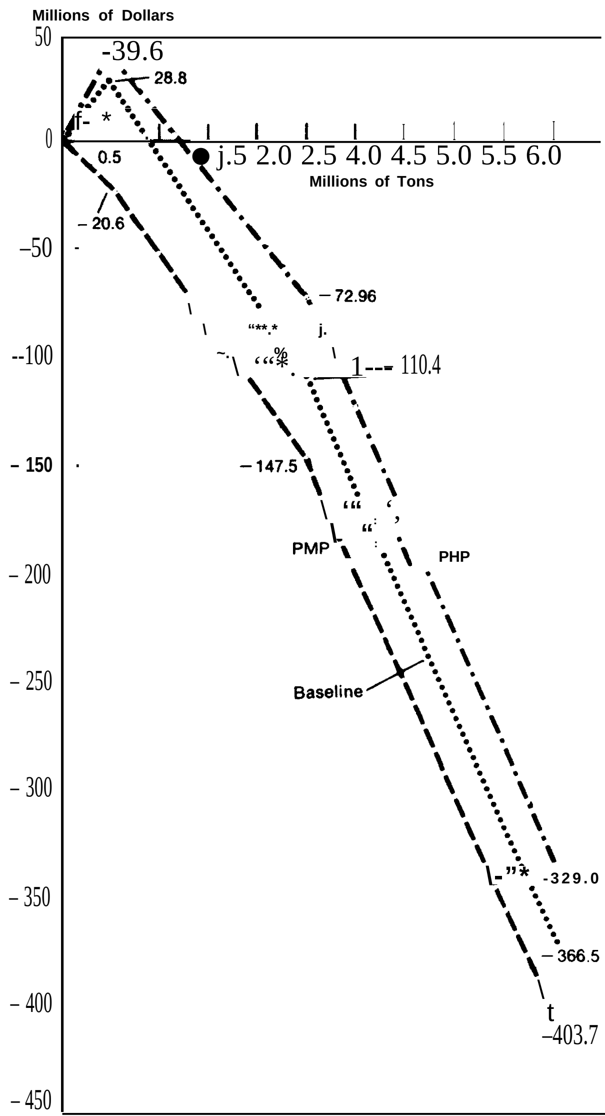


Figure V-17.
Perturbations for SP-5



specified for J_2 and J_3. The cost of this stockpile size is $192.3 million, which yields lower but still negative benefits of $52.9 million. The optimal stockpile size is therefore less than 1.9 million tons.

f. Sensitivity Analysis for **SP–5.—**The computer program performs the "baseline" calculations and then automatically perturbs an input variable by +10 percent and reruns the calculations. The new costs, benefits, and net benefits are compared to the baseline calculations and the percentage change is computed. This process is repeated for each input variable.

The resulting percent changes in net benefits from a +10-percent change in each variable for SP–5 are listed in table V–24.

An examination of table V–24 shows the net benefits are fairly sensitive to changes in many of the input variables. The maximum changes are caused by perturbation of (a) high

Table V–24.—Percent change based on 10 percent perturbation of variables SP–5

Perturbed variable	Benefits			cost			Net benefits		
	Q1	Q2	Q3	QI	Q2	Q3	Q1	Q2	Q3
CF	0.00	0.00	0.00	0.11	0.02	0.01	–0.17	0.05	0.01
Cu	0.00	0.00	0.00	9.84	9.94	0.95	–15.15	23.12	13.92
Sc	0.00	0.00	0.00	0.04	0.04	0.04	–0.07	0.09	0.05
ED	0.02	0.04	0.04	0.00	0.00	0.00	0.04	–0.05	–0.02
T	10.00	10.00	10.00	0.00	0.00	0.00	25.40	–13.26	–3.99
CP	4.52	6.27	6.27	0,00	0.00	0.00	11.48	–8.31	–2.50
SA	4.52	6.27	6.27	0.00	0.00	0.00	11.48	–8.31	–2.50
G	0.54	3.35	3.35	0.00	0.00	0.00	1.38	–4.44	–1.34
PH	5.28	10.22	10.22	0.00	0.00	0.00	13.41	–13.55	–4.08
PHP	14.88	25.64	25.64	0.00	0.00	0,00	37.78	–33.99	–10.23
PM	–3.51	–6.79	–6.79	0.00	0.00	0.00	–8.91	9.00	2.71
PMP	–11.19	–25.38	–25.38	0.00	0.00	0.00	–28.41	33.64	10.13
	0.00	0.00	0.00	9.84	9.94	9.95	–15.15	23.12	13.92
QS	5.46	3.69	3.69	0,00	0.00	0.00	13.87	–4.89	–'1.47

price with stockpiling (PHP) and (b) low price with stockpiling (PMP).

The net benefit functions for the baseline case and for perturbations of +10 percent in PHP and PMP are plotted in figure V-17. In both cases the net benefits remain positive for a stockpile of 0.5 million tons and negative for stockpiles of 2.5 and 5.0 million tons.

3. Discussion of Partial Benefits and Costs for Each Phase of Stockpile Operation for SP-5

The above derivation of net benefits can be supplemented by a presentation of the component parts of the net benefit function: direct benefits and costs to materials producers, direct benefits and costs to materials consumers, benefits and costs borne by the stockpile investor, and external benefits and costs. Calculations have been made to estimate each of these four types of economic impacts. The costs and benefits shown below by phase of stockpile operation are those expected for the coming time period (i.e., a year) and are equal to one-fifth the costs and benefits realized over the full 5-year cycle.

a. Direct Benefits and Costs to Materials Producers.—Direct benefits and costs to materials producers of a copper stockpile under SP–5 are summarized below.

Benefits and costs to consumers		Stockpile size (Millions of tons)		
Operational action	Type of benefit or cost	0.5	2.5	5.0
		(Millions of dollars)		
Acquisition	Producer cost saved	16.5	45.8	45.8
	Change" in producer surplus**	12.3	149.8	149.8
Holding	None***	.0	.0	.0
Disposal	Producer cost saved'	16.5	45.8	45.8
	Change in producer surplus**	'14.2	'133.2	'133.2

● Benefits are alleviated evenly to the acquisition and disposal phases. Also producers are assumed here to appropriate all of the benefits associated with lower production costs. In practice some of these benefits may be passed on to consumer through lower prices. If so, the distribution of these benefits could be changed to reflect this, though some estimate of the portion of benefits passed on to consumers would have to be made.

● *On the basis of figure V-15, gains in producers surplus are estimated by

$$tg\left[m(P'_l - P_l)\,Q'_l + m/2\,(P'_l - P_l)(Q_l - Q'_l) + 1/2\,(P'_l - P_l)Q^*_l\right]$$

and the losses in producer surplus by

$$tg\left[h(P_h - {}_h)Q_h + h/2(P_h - P'_h)\,(Q'_h - Q_h) - 1/2(P_h - P'_h)Q^*_i\right]$$

Since Q'_l and Q_f reflect the consumption that would occur over the 5 year cycle if low demand and high supply conditions prevailed over the entire period, the gain in producer surplus measured by the first equation above (and loss in consumer surplus) during stockpile acquisition will be overestimated unless these variables are multiplied by m, the proportion of total output over the cycle whose price would be lower than Pi' without a stockpile. Similarly, the loss in producer surplus measured by the second equation and gain in consumer surplus during the disposal phase will be overestimated unless the variables Q'h and Qh are multiplied by h, the proportion of total output over the cycle whose price would be higher than p'h without a stockpile.

● **The mere holding of stocks, as opposed to acquiring or disposing of stocks, is not assumed to affect prices or generate benefits. In practice, however, this may not always be the case. In particular, speculative demand may be influenced by the existence of large stocks. This would produce benefits and costs to producers and other groups over the cycle. These benefits and costs could be estimated if the effect of holding stocks on prices were determined.

b. Direct Benefits and Costs to Materials Consumers.—Direct benefits and costs to materials consumers of a copper stockpile under SP–5 are summarized below:

Benefits and costs to consumers		Stockpile size (Millions of tons)		
Operational action	Type of benefit or cost	0.5	2.5	5.0
		(Millions of dollars)		
Acquisition	Change in consumer surplus*	-10.7	'125.3	'125.3
Holding	None	.0	.0	.0
Disposal	Change in consumer surplus*	16.6	157.7	157.7

● Gains in consumer surplus are estimated by

$$tg \quad h(P_h - P'_h)Q_h + h/2(P_h - P'_h)(Q'_h - Q_h)$$

and 1oss by

$$tg \quad m(P'_l - P_l)Q'_l + m/2(P'_l - P_l)(Q_l - Q'_l).$$

c. **Costs** and Benefits to the Stockpile Investor.—The costs and benefits to the stockpile investor of a copper stockpile under SP-5 are summarized below:

Benefits and costs to consumers		Stockpile size (Millions of tons)		
Operational action	Type of benefit or cost	0.5	2.5	5.0
		(Millions of dollars)		
Acquisition	Initialization cost	0,5	0.5	0.5
Holding	Holding cost	43.6	256.2	512.4
Disposal	Disposal cost	0.0	0.0	0.0
	Capital gains	35.9	5.0	5.0

d. Estimation of External Costs and Damages.—The estimation of external costs and damages can be done in a generalized, first-order approximation, or it can be rigorously determined. The illustrative calculations for a copper stockpile under SP–5 utilize the first approach, a general approximation. The resulting external benefits and costs as given in the copper example are summarized below:

Benefits and costs to consumers		Stockpile size (Millions of tons)		
Operational action	Type of benefit or cost	0.5	2.5	5.0
		(Millions of dollars)		
Acquisition	External damage*	0.3	1.5	1.5
Holding	External damage	.0	.0	.0
Disposal	External damage*	0.3	1,5	

● Benefits are allocated evenly to the acquisition and disposal phases,

4. **Summary of Economic Net Benefits and Partial Benefits for SP–5**

The result of the calculations for SP–5 are summarized in table V–25. These results are for the initial year of operation. For comparison, table V-26 shows the terms in the net benefit function for the second year under the assumption that the relevant input variables are the same. It is assumed that the expected benefits and costs are the same for both years.

For a complete discussion of the Operating Cost Model and estimates of the costs of implementing and running an economic stockpile, refer to the section in chapter VI on Budget Cost Implications. The operating costs are indicated here for conceptual understanding. The cost to the Government of establishing a 500,000-ton copper stockpile is estimated to be about $409 million in the first year, with the major components being $544.5 million for purchase of copper plus $0.5 million for purchase of storage and other facilities and $43.8 million for holding costs. Offsetting these costs are capital gains of $35.9 million. In each succeeding year the cost of operation would only be the holding costs minus the capital gains if the stockpile size remains unchanged,

The distribution of costs and benefits among materials consumers, materials producers, and the stockpile operator differ from the distribution under the previous three stockpile policies. Both consumers and producers are net gainers as a result of implementing this policy, with net gains increasing as the stockpile size increases, It is also interesting to note that the economic costs of stockpiling are borne entirely by the operator—which is not the case in the previous three policies—which in turn means the taxpayer, Consequently, the distributive effects of the cost function cannot readily be ascertained.

Table V–25.—Summary of economic benefits and costs of SP–5 for first year of operation
(In Millions of dollars)

Types of benefit or cost	Size of stockpile millions of tons	Operational action*		
		Acquisition	Holding	Disposal
Producers.	0.500	28.8	0.0	2.3
	2.500	195.6	.0	– 87.3
	5.000	195.6	.0	– 87.3
Consumers.	0.500	– 10.7	0.0	16.6
	2.500	–125.3	.0	157.7
	5.000	–125.3	.0	157.7
Operators.	0.500	– 0.5	– 43.8	35.9
	2.500	– 0.5	–256.2	5.0
	5.000	-- 0.5	–512.4	5.0
External. . . . ., .,	0.500	0.1	0.0	– 0.1
	2.500	0.3	.0	0.3
	5.000	0.3	.0	0.3

Net benefits are $287 millions $-1104 millions, and $-3665 millions for 05, 25, and 50 million ton stockpile, respectively

"Signs indicate the sign which each term should have when summing to indicate net benefits

Table V–26.—Summary of economic benefits and costs of SP–5 for second year of operation
(In Millions of dollars)

Types of benefit or cost	**Size of stockpile millions of tons**	**Operational action***		
		Acquisition	Holding	DisposaI
Producers.	0.500	28.8	0.0	2.3
	2.500	195.6	0.0	–87.3
	5.000	195.6	0.0	–87.3
Consumers.	0.500	–10.7	0.0	16,6
	2.500	–125.3	0.0	157.7
	5.000	– 125.3	0.0	157.7
Operators.	0.500	–0.5	–43.8	35.9
	2.500	–0.5	–256.2	5.0
	5.000	–0.5	–512.4	5.0
External	0.500	0.1	0.0	0.1
	2.500	0.3	0.0	0.3
	5.000	0.3	0.0	0.3

Net benefits are $28.7 millions, $–110.4 millions, and $-266.5 millions for 0.5, 2.5, and 5.0 million ton stockpile, respectively.

*Signs indicate the sign which each term should have when summing to indicate net benefits

Chapter VI

MANAGEMENT AND INSTITUTIONAL CONSIDERATIONS FOR IMPLEMENTING AND OPERATING AN ECONOMIC STOCKPILE

CHAPTER VI

MANAGEMENT AND INSTITUTIONAL CONSIDERATIONS FOR IMPLEMENTING AND OPERATING AN ECONOMIC STOCKPILE

The decision regarding whether or not to implement an economic stockpile as a national policy is an exceedingly complex process which includes both domestic and international issues covering the full range of economic, social, legal, and political variables. While the United States does maintain stockpiles for strategic purposes, it is important to recognize that there is no direct experience in the United States with economic stockpiling, particularly as to what impact such governmental intervention may have on the marketplace or various public sectors. For these reasons, consideration has been given in this assessment to the entire decisionmaking process related to developing, implementing, and operating an economic stockpile.

The decisionmaking process developed here (termed "Decision Criteria Model") provides a conceptual model for accomplishing four requirements: (a) how to assess whether or not to stockpile certain materials for economic purposes, (b) how to identify candidate materials and estimate the optimal quantity of those materials to be stocked, as well as the timing of their acquisition and disposal, (c) how to specify the functional nature of the stockpiled materials, and (d) how to estimate the annual and projected budget costs required to operate the stockpile.

This chapter is a discussion of the pertinent considerations related to implementing and operating an economic stockpile, with particular attention to the management and institutional options which should be analyzed in the development of stockpiling policies. The following sections are included:

- Decision criteria—a model for making decisions regarding an economic stockpile;
- Information requirements of an economic stockpile;
- Organizational options of an economic stockpile;
- Interrelationships of an economic stockpile with existing US. and foreign stockpiles and with other U.S. materials policies; and
- Budget implications of an economic stockpile.

A. DECISION CRITERIA MODEL FOR DEVELOPING AND IMPLEMENTING ECONOMIC STOCKPILE POLICY

1. Components of Decision Criteria Model

As discussed in chapter III, the Decision Criteria Model is composed of four components: (a) Materials Selection Criteria, (b) Economic Welfare Model, (c) Specification of Functional Nature of Stockpile, and (d) Operating Cost Model. The nature and purpose of the first two of these components are developed and discussed in chapter IV; therefore, it only remains to explain their value from a management point of view. The last two components, however, are presented in detail in subsequent sections of this chapter.

The Materials Selection Criteria provide the guidelines with which decisions can be made as to which materials ought to be considered for an economic stockpile. These decisions would be made after a particular stockpiling policy has been selected for implementation. In turn, after the specific material or materials have been identified, the Economic Welfare Model provides the method by which the integral parts of a stockpile--optimal quantities and timing of acquisition or disposal--an be estimated by the management agency.

2. Specification of Functional Nature of Stockpile

Having determined the manner in which materials are selected for an economic stockpile and the method by which decisions are made as to the quantity and timing of acquisitions (or disposals) of those materials, there is a need to consider the third component of an economic stockpile—the Specification of Its Functional Nature. A distinction is made here between the management operations and the specification of a particular stockpile. The basic agency organization might not vary from one stockpile to another and could be easily adapted for administering two or more stockpiles simultaneously. In contrast, the functional nature of a stockpile could vary greatly, depending upon the nature of the policy objective and the particular characteristics of the materials involved.

Aside from the economic impacts, there are certain political and social impacts which may help determine the nature of an economic stockpile. These may be either domestic or international, or both. The extent to which the nature of a stockpile may affect such matters as employment, the environment, materials conservation, foreign policy, and foreign trade should be considered, and consultation with industry and with interested Government agencies should be held accordingly.

Four major categories of requirements need to be considered to specify the functional nature of an economic stockpile:

- Acquisition and disposal,
- Time factors,
- Form of material, and
- Location and storage.

Some of these considerations relate to the type of material stockpiled and the rate of acquisition or disposal, but they may be stated in general terms in order to encompass various contingencies. To a considerable extent, the four categories are similar to those which have been analyzed with respect to a defense-oriented stockpile, although the scope and ramifications of an economic stockpile may be broader and more involved. The history and experience of the strategic stockpile can nevertheless provide considerable insight as to the direction of an economic stockpile and are drawn upon in the following discussion.

a. Acquisition and Disposal.—Materials acquisition may be from domestic or foreign sources. For those stockpiles in which support of domestic production or other domestic activity is not a factor, acquisition can be achieved either through purchase or through transfer of materials from the strategic/critical materials stockpile, or by exchange for other materials such as surplus agricultural commodities. For those stockpiles in which domestic support is involved, acquisition would have to be made through domestic purchase. In order to do so, however, information required about the sources would include such items as size, location, accessibility, types of productive facilities, degree of nationalization (of foreign sources), possibilities and probabilities of import disruptions of any kind, and quantities available in excess of normal requirements of the sources. The kinds of transportation facilities normally used, their adequacy, alternative routes, and vulnerability to disruptions by strikes are also factors for consideration. Among domestic sources, there may be questions of equitability among suppliers of various sizes, including small businesses, as well as among suppliers in various geographical locations. Seasonal variations in supply, substitutability of other materials, and technological changes in production and consumption should also be taken into account in specifying acquisitions and disposals.

Some of the factors mentioned above with respect to acquisitions would apply also to disposals, e.g., location of recipients, availability of transportation facilities, and equitability. Those stockpiling policies aimed at solving problems of indefinite duration, such as import/price disruptions or a scarcity of domestic materials, would tend to involve less-frequent disposals than those aimed at such problems of limited or intermittent duration, as nonpolitical import disruptions, temporary surpluses/shortages, or instability in international markets. It is presumed that, if required, stockpiles would be created in anticipation of the problems and therefore far enough in advance of problem events like temporary surpluses/shortages to provide the quantities required in overcoming the difficulties. On that basis acquisitions would tend to follow domestic supply/import patterns and normal transportation routes. Nevertheless, problems could arise. For example, members of a potential cartel (bauxite, perhaps) could conceivably withhold supplies in order to defeat the purposes of an anticartel stockpile. In that case, shifts to other sources, including whatever domestic sources may be available, would probably be difficult if not impossible,

Disposals would involve equitability of allocations to domestic consumers, a potential matter of concern for the agency administering the stockpile. The allocation programs enacted by the Federal Energy Administration demonstrate the public sensitivity to equitable distribution of supplies and the difficulties in obtaining adequate solutions.

Acquisitions and disposals may also be affected by how such time factors as the duration of an emergency situation or the time required to obtain certain materials impact on various stockpiles. This subject is discussed in the following section.

b. Time Factors. Time factors which must be considered prior to materials acquisitions and disposals include: the duration of the materials to be stored, the time to acquire materials, and the time to make materials available to consumers. The duration of the materials problem—i.e., whether it is temporary or of indefinite extent—will influence the need for and the timing of acquisitions, as well as the total life of the stockpile. A short-term supply disruption may, for example, require consideration of seasonal and regional variations. The duration of the materials problem is related to the probability of its occurring within certain time limits. The latter is in turn a factor in the decision criteria governing the quantity and timing of stockpile actions.

The time needed to acquire materials may depend on the availability of unused productive facilities in the United States and in foreign supplying countries. This factor emphasizes the importance of forward planning within the terms of normal production cycles, The time needed to make materials

77-119 0-76-11

available to consumers during stockpile disposals may vary with the type of stockpile specified. Such short-term problems as nonpolitical supply disruptions would involve more rapid movement to the usage site than such long-term problems as cartel actions.

c. Form of Material.—In general, the form of material specified should be at that stage of processing which permits the widest application in end uses and which in effect stockpiles significant inputs of time, labor, transportation, and energy. In the case of metals, the basic refinery shape meets these criteria. The stockpiling of metals in earlier stages, such as ores or concentrates, would require further processing in domestic plants before the material can be used and could result in lost time, especially in the case of short-term supply disruptions. Exceptions to this general standard may occur, as in the case of ferroalloying materials. For these it may be desirable to stockpile not only certain ferroalloys but also ores/concentrates to provide some flexibility in the ferroalloys produced domestically. At the other end of the production line, stockpiling of special alloys or of mill shapes would demand a multitude of forms whose characteristics vary as requirements patterns change. In any event, technological developments in production or consumption could result in changes in the basic forms stockpiled, such as through upgrading or through exchanges.

Whether in metals or nonmetals, the type of stockpile specified may dictate variations from the standards described above. A short-term stockpile may suggest more readily usable forms than a long-term stockpile. In all cases, the availability of U.S. processing facilities—metal processors, petroleum refineries, etc.—to convert materials into the forms needed by consumers must be taken into account in the specification of material forms.

d. Locations and Storage.—Location and storage are also functions of the stockpiling policy objective. For short-term supply disruptions, the location should be closer to normal supply lines and to consumers' plants than that required to meet long-term problems. Since stockpiles for any consumers could involve a large number of relatively small stockpiles and a large number of storage warehouses, tanks, etc., the practical alternatives may be locations close to transportation facilities which would be accessible to several users.

The method of storage specified will depend upon the characteristics of the material involved, particularly its perishability. Protection against climatic elements may be desirable for some materials; protective packaging, for others. The choice of warehouses, tanks, or natural cavities will depend on the type of material and on the availability and relative costs of storage. Maintenance of the quality of those materials with potential deterioration must likewise be considered. This could require periodic review of materials status and possible rotation, i.e., disposal prior to deterioration and acquisition of an equivalent amount of "fresh" materials.

B. INFORMATION REQUIREMENTS FOR AN ECONOMIC STOCKPILE

The Decision Criteria Model sets the realistic and practical boundaries on how much, and what kind of data and information are required for economic stockpiling. Each of the four components of the Decision Criteria Model requires pertinent information which must be refined through a combination of manual and automated mechanisms from the general mass of domestic and foreign data and information. The second and fourth components are economic models which involve simulation of specifically quantifiable conditions. The first and third components are largely judgmental functions involving selective decisionmaking by materials experts; however, they are supported by automatic mechanisms which manipulate huge quantities of data to produce the relevant and highly organized information subsets required by the machine functions.

This section is a discussion of the information required to support the four components of the Decision Criteria Model discussed above; therefore, it contains data elements of three levels: (1) general information to support the methodology of any stockpiling policy, (2) unique or specific data elements applicable to a particular policy, and (3) unique data elements applicable to a particular material under consideration for a given policy.

1. General Information Requirements

Once a policy objective is defined, analysis must be conducted as to what materials to stockpile and the economic benefits of doing so. The Materials Selection Criteria are guidelines which materials experts can use to scrutinize the data and information available to them and identify those materials most directly relevant to the problems which an economic stockpile could alleviate. Calculations are then made to estimate the net economic benefits of stockpiling these Problem-Related Materials.

Two operations are needed to support these materials experts: (1) a technical information center where all hardcopy documentation relevant to stockpiling can be analyzed, classified, and then grouped into materials categories; and (2) a computer-support facility where a large number of automated data bases may be scanned.

a. Materials Selection Criteria.—The materials selection criteria utilized to select a group of materials to satisfy a particular stockpile policy consists of two or more questions applicable to each material, Table VI-1 is a matrix which contains five rows corresponding to the five stockpiling policies. The 12 columns contain the selection criteria which should be asked to determine whether or not a material is related to the problem which the policy is designed to solve. The marked intersections on the matrix indicate the questions which are applied to any material for that stockpiling policy.

Any of the 12 indicated questions as applied to a material and a specific stockpiling policy is highly subjective and requires considerable information to support the decision process. From the point of view of information requirements, the sum total of information available from literature, interviews, relevance trees, and human experience is required to determine whether or not a specific material passes the initial selection test for a particular policy and should therefore be analyzed with the economic welfare model.

For example, in "high degree of import dependence, " how high must the import dependence be for a material to be selected, how is that number quantified, and what information is required to derive the number? Similar questions can be asked of each selection criteria. In each case, if the quantified number is increased (or decreased), additional materials will be rejected (or accepted) from the list for any policy. Of course, some of these materials may be rejected later through application of the cost/benefit functions in the economic welfare model.

It should be possible to establish a quantifiable relationship between data concerning activities related to a selected material and the materials selection criteria related to a particular stockpiling policy. However, care must be taken to assure that the number of subjective assumptions necessary to quantify that relationship does not produce an answer of less validity than a direct subjective estimate made by experts.

b. Economic Welfare Model .—The economic welfare model is based on determining the costs and benefits of stocking specific materials to achieve a policy objective. Since cost and benefit functions can be specified in a quantitative form, it is logical to assume that data items (numbers) can be assigned to each

Table VI-1 —Materials selection criteria applied to selected stockpile policies

Selected Stockpile Policies	Materials selection criteria: Economically and Technologically significant	High degree of import dependence	High potential for political control and price	High degree of concentration of supply	Growing scarcity occasioned by increasingly lower grade resources	Significant volatility of domestic prices	Wide fluctuations in domestic supply/demand	High degree of international trade	Significant volatility of international prices	Wide fluctuations in international supply/demand	Potential for international commodity agreements	Potential for foreign policy benefits
1. Discourage/counteract cartel/unilateral political actions affecting price or supply.	x	x	x									
2. Cushion the impact of nonpolitical import disruptions.	x	x		x								
3. Assist in international materials market stabilization.	x				x							
4. Maintain minimum supply of scarce domestic materials.	x					x	x					
5. Provide a market for temporarv surpluses and ease temporary shortages.	x							x	x	x	x	x

element in the cost/benefit functions. These items may not be easily derived, however, and may require the development of some quantitative data through subjective reasoning.

The cost function has been defined to consist of the external cost (EC), the holding cost (HC), and the loss in domestic consumer surplus (LCS). The significant data items which are required for computation of the cost function (dollars versus quantity) can be listed as follows.

- Storage and administrative cost in $/unit
- Rate of stock loss in units/time
- Interest rate in percent per annum (or other)
- Unit cost of stocks in $
- Fixed costs for initialization of the stockpile in $
- Stockpile size in units
- U.S. supply at price P
- Supply elasticity
- U.S. demand at price P
- Demand elasticity
- Equilibrium price (world) in $
- World price elasticity
- Damage and spoilage storage costs in $/unit or $/time
- Loss in consumer surplus costs in $
- Indirect cost in $

These cost items can be established for each stockpiling policy, and they are different for each material, Time also causes a change in the costs and must be taken into account.

The benefit functions are unique to each stockpiling policy and consist of summations of quantified benefits arrived at through solution of individual benefit equations. These equations, in turn, consist of elements for which quantitative data must be determined,

c. Specification of Functional Nature of Stockpile.—The nature of a stockpile has been discussed as consisting of seven main categories: administration and control, acquisition, disposal, form, location, storage, and rotation.

The administration and control of all stockpiles will be similar and can be considered as general to all policies. The information required for administration and control will include detailed and timely data to allow analysis, policy decision, operations, and monitoring,

Table VI–Z contains the seven categories of information and indicates the required information element for each. These information elements are general and should be determined for each stockpiling policy and specific material.

2. Unique Information Requirements

As discussed in an earlier section, the data requirements for the materials selection criteria, the functional nature, and the cost functions of the decision criteria are fairly general and apply to all stockpiling policies. The information elements for developing the benefit functions are specific to each stockpiling policy and will be discussed here.

Table VI–3 contains a summary matrix of the specific data items which are required (for each material) in order to calculate the benefit functions for each stockpiling policy. This table illustrates the similarity of data items for SP-1, –2, –3, -4, and –5. Further discussion of these data items can be found in chapter V.

3. Requirements for a Materials Information System

The required Materials Information System (MIS) consists of a manual and an automated segment.

The manual segment of the MIS consists of a physical library or "hardcopy" data base and manually applied formulae, procedures, and methodology. The data base is developed through the information gathering and

Table VI–2.—Information elements required for specifications categories

Information elements	Administration and control	Acquisition	Disposal	Form	Location	Storage	Rotation
User location	....	....	....	....	x	....	....
Financing costs	x	....	....	....	....	....	....
Operating costs	x	....	....	....	....	....	....
Materials pricing	x	x	....	....	....	....	....
Distribution costs	x	....	x	....	....	....	....
Storage costs	x	....	....	....	....	x	....
Import/export regulations	x	x	....	....	....	....	....
Storage locations	x	....	....	....	x	....	....
Storage forms	x	x	....	x	....	x	....
Storage quantities	x	x	....	....	....	x	....
Storage life	x	....	....	x	....	x	x
Material sources	x	x	....	....	....	....	....
Material users	x	....	x	....	....	....	....
Supply lines/distribution	x	x	x	....	x	....	....
Local and national laws	x	....	....	....	....	....	....
Other stockpiles (transfers)	x	x	x	....	....	....	....
Quantities available	x	x	x	....	....	....	....
Potential supply disruptions	x	x	x	....	....	....	....
Seasonal supply variations	x	x	x	....	....	....	....
Time to acquire	x	x	....	....	....	....	....
Imported suppliers	x	x	....	....	....	....	....
Domestic suppliers	x	x	....	....	....	....	....
Transportation vulnerability	x	x	x	....	x	....	....
Availability timing	....	....	x	x	....	....	x
User demand fluctuation	....	....	....	....	....	....	x
Stockpile duration	x	....	x	....	....	....	....
User equitability	....	....	x	....	....	....	x

Table VI–3.—Specific data items required for stockpile policies

Stockpile policy					Specific data items
1	2	3	4	5	
x	x	....	....	....	r = Risk aversion factor
x	....	....	....	....	D = Damage of the action without stockpiling
x	....	....	....	....	D’ = Damage counteracted with the stockpile
x	....	....	....	....	P = Probability of the action without stockpiling
x	....	....	....	....	P’ = Probability of the action when a stockpile exists
x	x	x	....	....	i = The % import disruption
x	x	....	....	....	k = The duration of the disruption in months
x	x	....	....	....	S'_{ik} = Supply when the action occurs without stockpiling
x	x	....	....	....	S'_{ijk} = Producer supply with disposal of the stockpile

Table VI–3 Specific data items required for stockpile policies—continued

Stockpile policy 1	2	3	4	5	Specific **data items**
x	x	....	....	....	p'_{ik} ‘price when the action occurs without stockpiling
x	x	....	....	. .	p'_{ijk} ‘price With disposal of the stockpile
x	x	....	....	....	d'_{ik} =Demand when the action occurs without stockpiling
x	x	....	....	....	d'_{ijk} =Demand with disposal of the stockpile
x	x	....	....	....	ED_{ijk} =External costs saved by the disposal of the stockpile
....	x	....	....	....	D'_{ijk} =Damage offset by stockpile j
....	x	....	....	....	P_{ik} =Probability of the interruption occurring
....	....	....	x	....	P_o =Price in current time period without stockpile acquisition
...	....	....	x	....	$P\sim_j$ =Price in current time period with acquisition of stockpile j
....	...	....	x	....	P_t =Price in future time period without stockpile disposal
....	....	....	x	....	P'_{tj} =Price in future time period with disposal of stockpile j
....	....	x	....	x	t =Portion of surplus-shortage cycle occurring in the coming time period
....	....	....	x	....	t_f =Time horizon; years between current time and future time
....	....	....	x	....	Q_{oj} =Size of stockpile j accumulated in current time period
....	....	....	x	....	Q_{tj} =Size of stockpile j disposed in future time period
....	....	....	x	....	ED_{tj} =External damages saved in future time period with disposal of stockpile j
....	....	x	....	x	CS_j =Increase in consumer surplus
....	....	x	....	x	AC_j =Decrease in average production
....	....	x	....	x	ED_j =External damage-external costs saved
....	....	x	....	x	cp_j =Unit cost of production saved by stabilization due to stockpiling
....	....	x	....	x	S_a =Domestic production of material over the entire cycle
....	....	x	....	x	g =Fraction reflecting distribution of prices over fluctuation range
....	....	x	....	x	ph =High price without stockpile
....	....	x	....	x	phj =High price with disposal of stockpile j
....	....	x	....	x	pi =Low price without stockpile
....	....	x	....	x	pl_j =Low price with acquisition of stockpile j
....	....	x	....	x	dh =High demand without stockpile
....	....	x	....	x	$d'h_j$ =High demand with disposal of stockpile j
....	....	x	....	x	d_l =Low demand without stockpile
....	....	x	....	x	$d'l_j$ =Low demand with acquisition of stockpile j
....	....	x	....	...	PBj =Political benefits
....	....	x	....	....	f =Fraction of stockpile costs obligated by the U.S.
....	....	x	....	....	cj =Cost of stockpile j obligated by the U.S.

cataloging of (1) literature, (2) interviews, (3) relevance trees, and (4) bibliography. The automated segment of the MIS consists of an automated data base, storage and retrieval capability, automated analysis, and report generation,

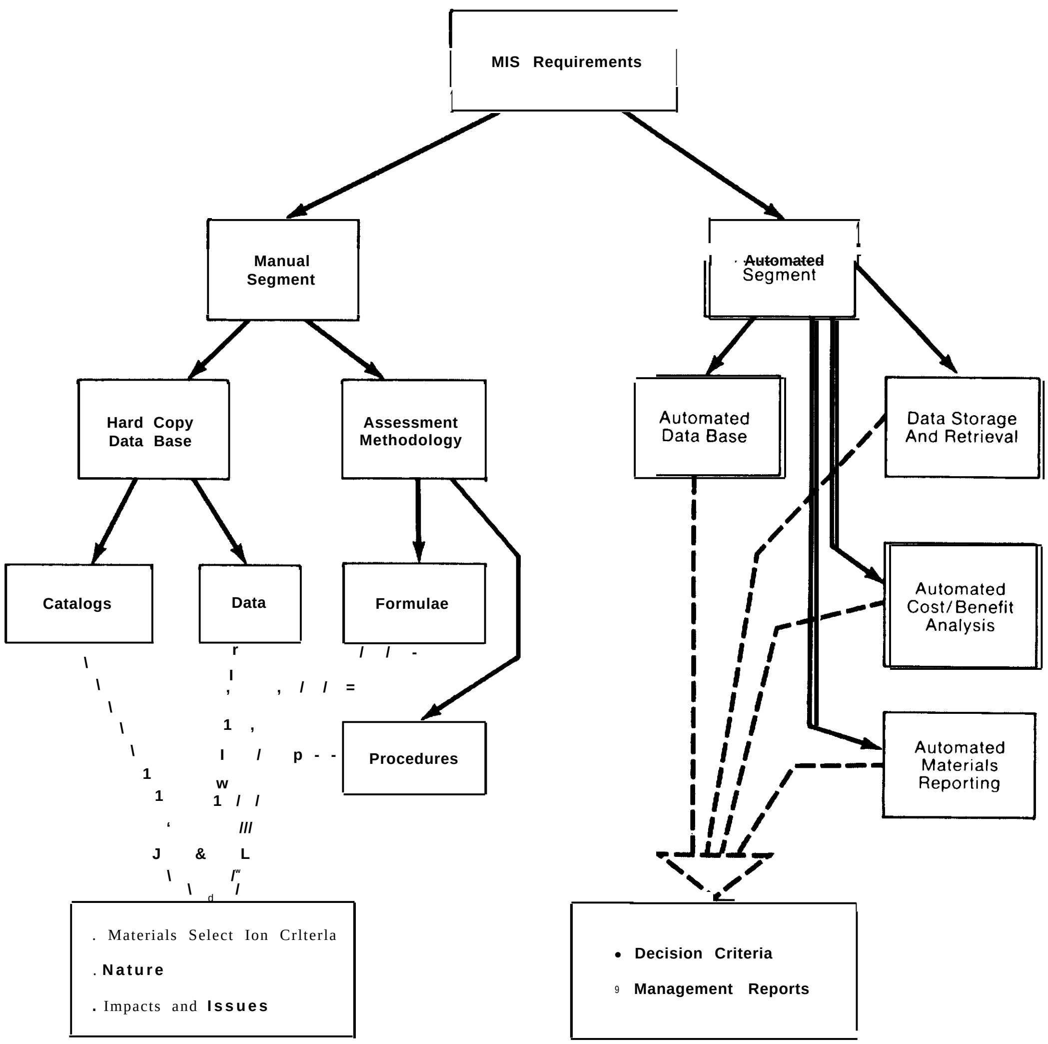
a. Manual Segment.—The "hardcopy" data base can be utilized in conjunction with manual techniques to perform the analysis of stockpiling policies through application of the Materials Selection Criteria, description of the nature of the stockpiles, assessment of the impacts and issues, and development of the final stockpile specification,

b. Automated Segment.—The automated data base, MIS storage and retrieval capability, automated analysis, and report generation capabilities can be used for

- Modeling and futures analysis,
- Automated cost/benefit analysis, and
- Automated materials stockpile management reporting.

Figure VI–1 illustrates the Materials Information System.

Figure VI-I.
Materials Information System



c. MIS Implementation.—The implementation of the automated segment of the Materials Information System is illustrated in figure VI–2,

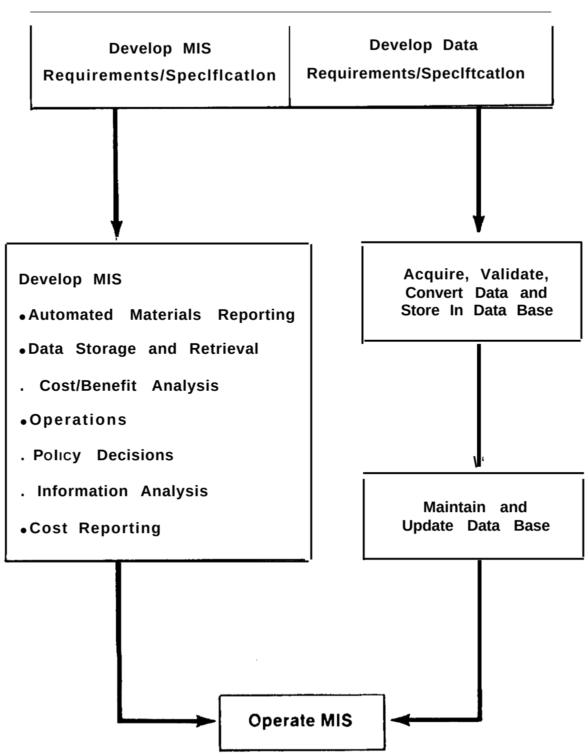
Once the MIS requirements and data requirements have been developed, the next step is to develop the Detailed MIS specification, to include

- Hardware,
- Software, and
- System capabilities.

The detailed data specification must be developed to include

- Specific data items,
- Source, and
- Update frequency.

Figure VI-2.
Automated MIS Implementation



The MIS system must be implemented to include

- Automated materials reporting,
- Data storage and retrieval,
- Cost/benefit analysis,
- Operations status reporting,
- Policy Decision Reporting,
- Information analysis, and
- Cost reporting.

The data base can be implemented by acquisition, validation, conversion, storage of data, and update and maintenance of the data.

4. Conclusions Regarding Information Requirements

In terms of any given material being considered for stockpiling action, specific information is required for each of the special physical, geographic, technological, economic, social, political, historical, and forecasting characteristics of modes of production, processing, transportation, marketing, consumption, conservation, storage, disposal, and cyclic reutilization.

The detailed materials information system should include: (1) a system specification and (2) data specification. An effort should be begun to acquire, validate, and catalog all required data elements to support an economic stockpile if and when it is implemented. In the act establishing the National Commission on Supplies and Shortages, the Congress listed two items which pinpoint explicit inabilities of the United States to coordinate, transfer, and manage data and information. To identify these specific information elements is a task which has not yet been done; however, the Office of Technology Assessment is currently conducting an assessment of Materials Information Systems.

C. ORGANIZATIONAL OPTIONS FOR ESTABLISHING AN ECONOMIC STOCKPILE

The success of an economic stockpiling program could depend in large part on the type of organization established to administer it, especially its ability to operate independently in the national interest, free of influence by special groups, whether inside or outside Government. To a considerable extent, the history of the strategic stockpile has been one of diverse pressures imposed from several directions—the executive branch, legislative branch, producing industries, and consuming industries. Not uncommonly, the interests of the latter two groups were reflected in those of the first two, and there is no reason to expect that an economic stockpile might fare differently, unless there is a concerted effort to avoid such situations.

1. Safeguards Against Stockpile Abuse

A primary concern is the need to establish safeguards which would minimize if not eliminate politically based decisions. A stockpile authority independent of both the executive and legislative branches of the Government may be desirable for this purpose. The stockpile authority should be flexible enough to manage any type of stockpile or combination of stockpiles with a minimum of adjustments. Depending upon its legislative mandate, for example, an economic stockpile could be in any of the several institutional arrangements discussed in chapter VIII.

2. Control of Economic Stockpile

Regardless of how it is organized, the matter of how an economic stockpile will be controlled is a factor which could determine its success or failure as a national policy. Stockpile control is important for several reasons, among which are maintaining an accurate inventory status, preventing theft or other types of stockpile losses, and insuring that the stockpile is specified in the most suitable manner in terms of material acquisition and disposal,

The principal decision regarding stockpile control is whether or not Congress should regularly approve stockpiling actions or leave those day-to-day operations to the stockpile agency (wherever it is located) and exercise control through annual or semiannual oversight, Regardless of whether Congress opts for direct, operational control or general oversight, an economic stockpile will have to be carefully coordinated within the Federal Government so as not to work at cross-purposes with other national or international programs, Moreover, some decision will have to be made regarding whether or not, how, and to what degree stockpiling operations need to be insulated from the political uses of the stockpile to serve special-interest groups, As pointed out in chapter II, the ramifications of a national economic stockpile are so enormous and so attractive that one can expect great pressure to be exerted on the agency responsible for material acquisition and disposal,

Obviously, responsibility for the broad policy direction and oversight is lodged with Congress and, as indicated in chapter VIII, should be incorporated into basic legislation establishing the economic stockpile. It is noteworthy that the Stockpiling Act of 1946 made Congress a key part of the operational procedure with absolute veto power over disposals, On the other hand, the legislation is silent about the policy decisions or judgments which led to the calculation of surpluses which could then be disposed, Such an omission could be fatal to any proposed legislation establishing an economic stockpile. Congressional power over appropriations eliminates any parallel problems with respect to acquisition programs.

Another lesson to be learned from the strategic stockpile experience is the need for more expeditious action by Congress with respect to agency disposal plans. Delays of weeks, even months, in completing hearings and taking action regarding the strategic stockpile were not uncommon, While this may be the normal and expected procedure, it should be realized that an economic stockpile will have to react much faster than the strategic stockpile in meeting supply disruptions and price increases, With prices and market conditions changing at an increasingly rapid pace, an extension in stockpiling action could well obviate the mandated purpose of the stockpile. Economic stockpiling is a temporary solution to certain materials problems, thus the ability to act swiftly in overcoming these problems is a factor which should not be overlooked or minimized.

3. Organizational Capabilities

The structure of an administering agency designed to achieve the goals described above could have three organizational capabilities, These capabilities are as follows:

a. A central agency responsible for overall direction of the program, policy formulation, and congressional relations;

b, An organization possessing computer resources; and

c. An organization responsible for day to day operations such as acquisition, disposal, storage, etc.

In addition, there could be professional and support staff in each of the Government agencies with responsibilities related to or affected by the economic stockpile program.

The experience of the strategic stockpile program in the above activities under the Office of Emergency Preparedness (OEP) is enlightening.[1] The first activity was performed for the strategic stockpile program by OEP itself. Since that agency was responsible for a large number of different programs, a substantial number of staff members devoted time to more than one program. However, that agency did have a stockpile policy division which was almost exclusively concerned with the strategic stockpile, Additionally, considerable attention was paid to stockpile matters by members of the Director's Office, the Assistant Director's Office with his assignment, and the planning staff. Together, it is estimated that perhaps 20 man-years per annum were devoted to the stockpile program in OEP proper.

In addition to regular professional staff, OEP, through the Assistant Director for Resource Analysis, provided direction and control over the Mathematics Computation Laboratory (MCL) of the Corps of Engineers, This group had a staff of about 110 persons, including programmers, systems analysts, economists, etc. The unit possessed a Univac 1108 and a full complement of peripheral equipment. Perhaps 20 to 25 percent of the total effort was expended to support the stockpile program in a continuing effort to update data banks, improve analytic techniques, keep stockpile objectives current, and the like,

Work on the stockpile program was also performed in the Federal agencies with responsibilities affected by the program. OEP transferred almost $2 million a years to other agencies for work on defense planning. Almost one-half was transferred to the Business and Defense Services Administration (now Bureau of Domestic Commerce) of the Department of Commerce, which played a large role in developing material supply estimates and requirements for the civilian (including industrial) economy. With the major contribution coming from Interior and Commerce (State and Defense to a lesser degree), it is estimated that 30 man-years were invested in the stockpile program by Federal agencies other than OEP.

[1] OEP became OP (Office of Preparedness) in 1973. Its functions were transferred to the General Services Administration in 1973; and it is now known as the Federal Preparedness Agency (FPA).

[2] 1965–70 conditions in terms of salaries, etc.

D. INTERRELATIONSHIP OF AN ECONOMIC STOCKPILE WITH OTHER MATERIALS POLICIES

An economic stockpile cannot be operated in a vacuum without reference to the environment in which it exists. That environment includes the following real or potential factors: (I) implementing one or more stockpiling policies simultaneously; (2) existing U.S. national stockpiles, including the strategic stockpile; (3) foreign national stockpiles; (4) international stockpiles; (5) other U.S. materials policies; and the entire fabric of foreign economic policy. In the context of implementing and operating an economic stockpile, the managing agency should consider the complex interrelationships with these various factors and their effects on such things as benefits, costs, materials availability, the American consumer, and foreign relations.

1. Implementing Multiple Stockpiling Policies

The analysis of the five stockpiling policies has been conducted as though each policy were totally independent of the other four; however, as a practical matter this independence probably would not exist. It is quite possible that a stockpile dealing with import disruptions resulting from cartel and cartel-like actions (SP–1) would be implemented simultaneously with a stockpile dealing with temporary, nonpolitical import disruptions (SP-2). Moreover, a stockpile designed to achieve domestic market stability (SP-5) could be implemented along with one designed to achieve international market stability. For that matter, any combination of two or more of the five stockpiles could be simultaneously implemented as appropriate to meet the various policy objectives.

The problems of instituting or operating two or more stockpiles simultaneously would not necessarily be additive in scope or difficulty. Depending upon specific policies involved, there may be a considerable degree of commonality in various aspects of the specified stockpiles, e.g., the form of the materials. Furthermore, the net result of acquisition or disposal decisions and actions could preclude the necessity for several such independent actions for the same material.

Interrelationships in the simultaneous operation of multiple economic stockpiling policies will be briefly discussed in the following categories:

- Administration,
- Materials and Budget Costs,
- Economic Welfare Model,
- Stockpile Nature, and
- Information Requirements.

a. Administration.—The administrative aspects of an economic stockpile probably provide the greatest degree of commonality among a combination of stockpiles. A single agency, with increments of personnel as needed, should be able to manage any number of stockpiles. The creation of a single administrative agency which is established to acquire, hold, and release materials in response to specific stockpiling policies under a strict set of regulations may be required to preclude impacts on the U.S. economy which outweigh the benefits of economic stockpiling.

b. Materials and Budget Costs.—As indicated above, the same materials may be stockpiled for more than one policy objective. For example, out of the total of 33 materials being considered for 1 or more stockpiles, 16 are involved in at least 2 stockpiles (2 in 4 different stockpiles, 4 in 3 stockpiles, and 10 in 2 stockpiles). See chapter III, table 111-4, for a display of these materials.

Acquisition costs and other costs of two or more stockpiles operated simultaneously will vary by material and the quantities needed. Where a certain quantity of a particular material serves more than one stockpiling objective, the acquisition costs and related costs are reduced in proportion. Savings in administrative and management costs will be limited by the degree of overlapping of function.

c. Economic Welfare Model.—Because each Economic Welfare Model applies to a specific stockpiling policy, individual determinations based on these models must be made separately, However, all policy development should consider the most efficient method of arriving at the net effect of several simultaneous, or nearly simultaneous, actions, taking into account the interrelationships of their economic, social, political, and legal impacts.

d. Stockpile Nature.—The form in which a specific material should be stockpiled, the method of acquisition (by purchase, transfer, or exchange), the method of disposal, the timing of acquisitions and disposals, the method of storage, the location, and the degree of rotation may or may not differ among stockpiling policies. A high degree of commonality of these elements would, of course, limit the problems in specifying multiple stockpiling policies.

e. Information Requirements.—Information requirements will tend to be similar for more than one stockpile, In fact, some information needs may be common to all of the five policies.

f. Summary.—The potential is large for achieving the objectives of two or more economic stockpiling policies simultaneously with a minimum of duplicate effort and duplicate burden on the economy. Arriving at the most effective and most efficient stockpile wouId have to be the responsibility of an administrative agency operating within established ground rules, taking into account all relevant factors and the net effects of several simultaneous or nearly simultaneous actions.

2. Existing U.S. National Stockpiles

The United States maintains several stockpiles for strategic purposes, each acquired under a different legislative authority, One is the national stockpile acquired in the open market, under the authority of the Stockpiling Act of 1946. The second is the Defense Production Act inventory which, under the Defense Production Act of 1950, was accumulated through the acquisition of generally premium-priced materials purchased as an incentive to expand production. As permitted by the Defense Production Act, these materials can be released by the Director of OEP at any time without legislative approval, but they cannot be sold at less than market price. The third stockpile is the Supplemental Stockpile, consisting of an inventory of materials acquired as the result of barter of agricultural surpluses for strategic materials, under the authority of the Agricultural Trade Development and Assistance Act of 1954. By statute, the release and disposal of these materials is governed by the provisions of the Stockpiling Act.

Notwithstanding the fact that materials have been acquired under three separate authorities, and placed in three separate inventories, all materials of specification grade are credited to the strategic stockpile objectives. Furthermore, they are all drawn upon as necessary in developing a strategic distribution of the materials in storage areas adjacent to points of consumption but out of target areas. Material reserves in the strategic stockpile are based upon the defined length of a possible war. In 1944, this was defined to be 5 years; in 1958, it was reduced to 3 years; and in 1959 the “Six-Month Rule” was adopted under which the maximum objective was to be not less than 6 months use by U.S. industry during periods of active demand. Until 1962, the inventories and objectives of these stockpiles were classified and were closely guarded secrets. In addition to these, there are special stockpiles such as the Energy Research and Development Administration (ERDA) stockpiles and the Naval Petroleum Reserves.

The analysis in this assessment has shown that whether or not it was intended, the strategic stockpile has created effects beyond its intended purpose and its legislative mandate. Furthermore, in periods of high industrial demand the strategic stockpile has increasingly been subjected to demands from industry for release of materials in short supply. The redefining of the length of the war has continually resulted in materials being declared surplus and available for disposal. For material to be sold from the strategic stockpile, it must be both declared surplus and approved by Congress. The revenue from the materials sales reverts to the Treasury for general use.

The strategic stockpile has been the subject of various governmental studies, including those by the Federal Preparedness Agency and the General Accounting Office. The National Security Council is currently conducting an interagency study on the operation of the strategic and critical materials stockpiles. While the content of this study has not been released, it may result in a directive to revise the guidelines and objectives governing the strategic stockpile program. Possible changes could include a better resolution of the problem of meeting stockpile objectives in a timely fashion without significantly affecting domestic or international markets. Another possible change is an extension of the definition of national emergencies to include periods of severe supply disruptions, whether or not they are related to wartime conditions. The feasibility of combining one or more economic stockpiles with existing stockpiles must be weighed against the advantages and disadvantages of entirely separate systems, taking into account their various goals and ramifications.

3. Foreign National Stockpiles

The same threats of supply disruptions of foreign source materials which could seriously affect the United States can also damage the economies of other nations. Many countries are more foreign source material dependent than the United States and have planned and/or initiated economic stockpiles or variations thereof as a form of self-protection. The U.S. Government must consider the implications of such developments in foreign countries in arriving at an economic stockpiling policy for this country. A detailed analysis of economic stockpiling in selected countries is presented in appendix c.

4. International Stockpiles

International stockpiles may have more significant impacts on U.S. policy than would individual foreign stockpiles. International stockpiles would likely be related to international commodity agreements, and the number of countries and materials would probably be larger than for foreign national stockpiles.

The international tin buffer stocks, as part of the International Tin Agreement (which the United States has recently signed and submitted to the U.S. Senate for advice and consent to ratification), is an existing example of an international stockpile. This agreement is described in detail in chapter VII.

The possibilities of economic cooperation and of market and price stabilization (or manipulation) among producers, consumers, or combinations of both in the application of international stockpiles could be extensive in scope and effect. In this assessment, such a stockpile is considered an alternative arrangement to a national stockpile. U.S. participation in the management of such a stockpile would be but one consideration of the economic, legal, and political aspects of international stockpiles.

5. Other U.S. Materials Policies

National materials policy encompasses the total range of public and private decisions which impinge on the supply and demand of all types of materials. Materials policy has been the subject of many discussions and studies, including that by the National Commission on Materials Policy, whose report was published in June 1973. It has also been a subject of concern by Congress as discussed in chapter I.

One significant aspect of national materials policy was set forth in the Mining and Minerals Policy Act of 1970, The act states that it is the continuing policy of the Federal Government in the national interest to foster and encourage private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metal, and mineral reclamation industries; (z) the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security, and environmental needs; **(3)** mining, mineral, and metallurgical research, including the natural and reclaimable mineral resources; and (4) the study and development of methods for the disposal, control, and reclamation of minerals waste products and mined land, in order to lessen any adverse impact of mineral extraction and processing upon the physical environment which may result from mining or mineral activities,

Economic stockpiling policy development should be considered as part of a national strategy for combating materials supply and price problems, and such development should be coordinated among the responsible governmental, industrial, and public agencies,

E. BUDGET IMPLICATIONS OF AN ECONOMIC STOCKPILE

As one component of the Decision Criteria, the Economic Welfare Model takes into account the overall economic benefits and costs-both gross and net—applicable to a specific economic stockpiling policy. Some of the cost elements in this model are likewise components of the Operating Cost Model. However, the latter is used not to help arrive at a measure of the net economic benefits to society, but rather to estimate the out-of-pocket costs which, as budget outlays, are of concern to the stockpile operator, namely, the Federal Government. One fundamental difference between the Economic Welfare Model and the Operating Cost Model is the inclusion in the latter of the capital required for the acquisition of material for a stockpile. The Economic Welfare Model, on the other hand, neutralizes this cost as offset by the value of the stockpiled material.

Budget costs are incurred during each operational phase of an economic stockpile: the acquisition, holding, and disposal phases. Such costs for a particular stockpile might be as large or even larger than the economic costs of the stockpile. The exact size of such operations will depend on the precise objectives and timing of implementations in relation to the existing U.S. and world situation,

1. Method of Financing an Economic Stockpile

Acquisition and disposal transactions can be dealt with in several ways in the fiscal system, Congress can authorize the outlays for acquisition, either open ended or up to some predetermined limit, permitting it to be financed by borrowings from the Treasury to be repaid from appropriations after the fact. Or an independent corporation might be set up with nominal capitalization and authority to borrow for its current needs. Either of these methods essentially bypasses the budget-appropriations process and may allow the stockpile managers limited or unlimited freedom to roll over the funds in selling and buying, with little or no fiscal control. There are ample precedents for both.

An alternative is to keep the acquisition/disposal financing within the normal budget-appropriation process, appropriating funds each year against budget estimates or prospective acquisitions and disposals. In this way the stockpile operation can be kept within budget limitations and be subject to congressional and executive fiscal control. Admittedly, this alternative presents problems of anticipation and flexibility which the other alternatives avoid by more open-ended arrangements. It requires that stockpile managers, acting pursuant to authorizations under stockpiling legislation for specified purposes (as represented by the several stockpiling policies), present to the Office of Management and Budget (OMB) annual estimates of their prospective budgetary requirements for acquisition and disposal to be included in the budget and subject to appropriations legislation. Thus stockpile managers will be required to account for their activities, past and prospective, in defining their budget requests both to OMB and Congress. The necessary flexibility might be achieved by an appropriation of an uncommitted revolving fund which, in combination with multiyear appropriations, would enable the stockpile managers to respond quickly to contingencies or market situations. The revolving fund could be restored after the fact by regular or, if necessary, supplemental appropriations. On the other hand, proceeds from stockpile disposals, except perhaps those generated by price stabilization actions, would not be available for a revolving fund. These would be treated as offsets in determining amounts to be budgeted and appropriated.

2. **Discussion of Operating Cost Model**

This section describes the Operating Cost Model which can be used to estimate the operating costs for an economic stockpile. Following a discussion of the model, illustrative calculations are made for each of the five stockpiling policies, using the same materials previously used in the impacts analysis to specify the functional nature of the stockpiles for each of the stockpiling policies, For illustrative purposes, it is assumed that each of these stockpiles would be implemented separately.

a. Operating Cost Equation.—The basic operating cost equation consists of adding the initialization cost, the acquisition cost, the holding cost, and the disposal cost, then subtracting from that the capital gains so that

$$OC = IC + AC + HC + DC - CG \quad (26)$$

where

IC (Initialization Cost) = $C_f + C_i Q$ = Fixed cost of initialization + (variable unit cost of initialization x stockpile size)

AC (Acquisition Cost) = $C_u Q$ = Unit cost X size of acquisition

HC (Holding Cost) = $(S + dc_u + ic_u) Q$ = [Storage and administrative cost per unit + (rate of stock loss X unit cost) + (interest rate X unit cost] x stockpile size

DC (Disposal Cost) = $C_d Q d_1$ = Unit cost of disposal X size of disposal

CG (Capital Gain) = $Q d_p] - Qa_p 2$ = (Size of disposal X unit price of disposal) - (size of acquisition X unit price of acquisition)

Each element in equation will vary from policy to policy and from material to material. In addition to the quantities of materials and the timing involved in acquisition and disposal which are determined using the Economic Welfare Model, the operating cost model includes the following considerations:

- Acquisition sources,
- Form of material,
- Location,

. Storage, and

. Rotation,

For a detailed discussion of the above considerations, see section A(z) of this chapter.

b. Administrative Costs.—These will be virtually the same regardless of how many materials are included in the stockpile. The administrative organization should be so structured as to include the following elements: information gathering, information analysis, policy decisions, and operations. It is estimated that annual administrative costs for an economic stockpile would be $500,000.

3. Estimation of Operating Costs

This section describes the factors in the Operating Cost Model and presents calculations for each of the stockpiling policies. The quantity of material used and the options selected for each of the factors in the calculations used to specify the stockpile nature were selected by materials experts as being reasonable approaches. These calculations should not be taken as definitive, but rather as illustrative of the method of calculating the operating costs of an economic stockpile.

a. SP–1: Discourage or Counteract Cartel or Unilateral Political Actions Affecting Price or Supply.

(1) Stockpile of l/z billion barrels Of petroleum.

(2) Acquisition sources.—Although there has been some discussion about bartering wheat or other surplus agricultural products for petroleum, it is assumed that acquisition would be by direct purchase, partly from foreign sources and partly from domestic sources.

(3) Form of material.—This stockpile may consist wholly of crude oil, wholly of petroleum products, or of a combination of the two. In turn, petroleum products may be entirely of one specific type, for example, gasoline of a certain octane rating or of a mixture of many products in innumerable combinations. For the purpose of this stockpile it is assumed that only crude petroleum would be inventoried, as the basic refinery feed stock from which all petroleum products could be derived for specific applications. Assuming a mixture of both foreign and domestic crude, it would be such as to pose an average acquisition price of $10.30 per barrel, including an increase of 30 cents per barrel resulting from the stockpile acquisition.

(4) Location.—To provide the maximum inhibiting effect of a crude oil stockpile on cartel or cartel-like actions, it would be desirable to locate this material close to consumers (refineries), thus limiting transportation costs and time to availability when needed.

(5) Storage. —Five options for storing petroleum have been suggested as follows: shut-in oil wells, conventional steel tanks, onshore salt domes, offshore salt domes, and offshore nuclear-created rock caverns. On the basis of availability, leadtime, and costs, onshore salt domes are selected as the most feasible method. The one-time acquisition cost for salt dome storage facilities is estimated at $5 per barrel. Annual cost estimates range from $0.60 to $1 per barrel; the high figure is chosen for the purposes of this assessment.

(6) Rotation. —The absence of loss by deterioration of crude oil precludes the need for inventory rotation.

(7) Summary of operating costs,—Taking into account the factors described above, operating costs for this stockpile are estimated as follows, for the first 2 years of its operation:

77-119 0-76-12

First year $ billion

OC = IC = Cf + C i Q = $0.5 million+ ($5)X500 million barrels	= 2,5
+AC = C_UQ = $10.30 (500 million barrels)	‘5.2
+HC = $(s+dc_u+icu)Q$ = [$1+0 +0.08 ($10.30)]1.5 billion barrels	=0,9
+DC	=0.O
-CG	=0.0
	8.6

Second year
OC-CiQ-AC = $912.5

b. SP–2: Cushion the Impact of Nonpolitical Import Disruption

(1) Stockpile of 100,000 short tons of zinc.

(2) Acquisition sources.—The acquisition of zinc could involve purchase, transfer from the strategic/critical material stockpile, or barter for surplus agricultural commodities. It is assumed that the zinc from this stockpile would be purchased, from both domestic and foreign sources.

(3) Form of material.—To achieve maximum flexibility in the use of this material, when it is disposed of, it should be in the form of slab zinc,

(4) Location .—Proximity of the stockpile to using plants is more significant than is nearness to producing plants, The former would facilitate the flow of zinc to using plants in temporary shortage situations. While the stockpile is being accumulated, time would be available to move material from producing plants to the stockpile site.

(5) Storage.—Zinc could be stored as slabs stacked in the open on Government-owned land.

(6) Rotation.—Zinc slabs do not deteriorate in quality from exposure to the elements and a rotation program is not necessary.

(7) Summary of operating costs.—Taking into account the factors described above, the first year's operating costs for this stockpile are estimated as follows:

$ million

OC = IC = Cf+CiQ = $0.5 million+ (0) 100,000 tons	= 0 . 5
+AC = C_UQ = $720(100,000 tons)	= 72.0
+HC = (S+dcu+.icu)Q = [$0.10+0+0.08($720)] 100,000 tons	= 5.8
+DC	= 0.0
-CG	= 0.0
	78.3

C. SP–3: Assist in International Materials Market Stabilization.

(1) Stockpile of 20,000 long tons of tin.

(2) Acquisition sources.—The acquisition of tin could involve purchase, transfer from the strategic/critical material stockpile, or barter for surplus agricultural commodities. It is assumed that tin for this stockpile would be purchased entirely from foreign sources; production of tin from domestic resources is negligible.

(3) Form of material.—Tin would be stockpiled in the form of pig tin, allowing flexibility in its end uses.

(4) Location.--Since this material would be purchased from abroad, the stockpile location would be significant only with respect to proximity to consumers.

(5) Storage.—Pig tin would be stacked in the open on Government-owned land.

(6) Rotation.—Although there could be some quality deterioration in pig tin, it would not be significant and rotation would be minimal.

(7) Summary of operating costs.—Taking into account the factors described above, the first year's operating costs for this stockpile are estimated as follows:

$ million

OC = IC = Cf+ CiQ = $0.5+ (0)20,000 tons	= 0.5
+AC = C_UQ = $7,588(20,000 tons)	= 152.0

(1) Stockpile of 1,000 short tons of contained tungsten trioxide in ores and concentrates.
(2) Acquisition sources.—Tungsten would be purchased from domestic sources only. This stockpile is designed to assure that tungsten is both produced and consumed at a rate which differs from that which results from a market not thus influenced by Government intervention.
(3) Form of material.—Tungsten would be stockpiled in the form of ores and concentrates, permitting flexibility in its conversion to various forms of tungsten intermediate and end products.
(4) Location.—In view of the relatively long period of time involved in the life of this stockpile, its location is not important in relation to proximity to producers or users.
(5) Storage.—Tungsten ores and concentrates would be stored in cans placed in Government-owned warehouses.
(6) Rotation.—Tungsten ores and concentrates stored in cans in enclosed warehouses do not deteriorate and require no rotation.
(7) Summary of operating costs.—Taking into account the factors described above, the first year's operating costs for this stockpile are estimated as follows:

		$ million
OC =	$IC = C_f + C_i Q$ = 0.5 million + (0)1,000 tons	= 0.5
	$+AC = C_u Q$ = \$9,011 (1,000 tons)	= 9.0
	$+HC = (s + dc_u + ic_u)Q$ = [\$2.50 + 0.08(\$9,011)] 1,000 tons	= 0.7
	+DC	= 0.0
	-CG	= 0.0
		10.2

e. SP–5: Provide a Market for Temporary Surpluses and Ease Temporary Shortages.

(1) Stockpile of 500,000 short tons of copper.
(2) Acquisition sources. -copper for this stockpile would be purchased from domestic producers during periods when surpluses develop for which market demand is depressed or otherwise insufficient at market prices,
(3) Form of material.--Copper would be stockpiled in the form of copper ingot or wire bar, forms which provide maximum flexibility in fabrication into mill shapes or for conversion into "specification ingots" in combination with other materials, for use by foundries.
(4) Location.—Because of the short-term acquisition and disposal aspects of this stockpile it would be desirable to locate the copper at locations reasonably accessible to both producers and consumers.
(5) Storage. -Copper would be stored in ingots or wire bars stacked in the open on Government-owned land.
(6) Rotation. -Copper ingots and wire bars stored in the open do not undergo quality deterioration and rotation of this material would not be necessary.
(7) Summary of operating costs.—Taking into account the factors described above, the first year's operating costs for this stockpile are estimated as follows:

		$ million
OC =	$IC = C_f + C_i Q$ = \$0.5 million + (0)500,000 tons	= 0.5
	$+AC = C_u Q$ = \$1,089(500,000 tons)	= 544.5
	$+HC = (S + dc_u + ic_u)Q$ = [\$0.39 + 0 + 0.08(\$1,089)] 500,000 tons	= 43.8
	+DC	= 0.0
	–CG	= 0.0
		588.3

Chapter VII

ALTERNATIVES TO ECONOMIC STOCKPILING

Chapter VII

ALTERNATIVES TO ECONOMIC STOCKPILING

The impacts analysis in chapter V indicates that the economic net benefits would be positive for three of the five stockpiling policies and negative for the other two. Certainly for the latter, and to a lesser extent for the former, alternatives must be considered since they might provide net benefits even greater than stockpiling. Moreover, there may be certain overriding considerations which could lead to the conclusion that any or all of these stockpiling policies should not be implemented and that alternative approaches should be taken. These overriding considerations could include adverse social and political impacts, as well as excessive operating costs and the lack of available information.

A complete assessment of economic stockpiling should include a cost/benefit analysis of each alternative and a comparison of the results with the total net benefits of the related stockpiling policies. Such a quantitative analysis was beyond the scope of this assessment, but it would be the proper function of an agency established to implement an economic stockpiling program. What is presented here is a qualitative analysis of three general categories of alternatives to stock piling.

A. REASONS FOR CONSIDERING ALTERNATIVES TO STOCKPILING

Just as economic stockpiling is conceived as primarily a governmental program requiring either direct or indirect industry participation, the emphasis on alternatives is also likely to be in the Government sector, Industry self-interest can be expected to lead to some kinds of protective actions in order to overcome both short- and long-term supply problems. Nevertheless, it could be necessary for the Government to provide some type of incentive for encouraging the improvement of supply capabilities. Similarly, it could be necessary for the Government to mandate use limitations in order to help achieve a balance between supply and demand. In every instance, effective Government-industry cooperation would be essential to achieve the same goals which might be attained by economic stockpiling, Thus, it appears that if future shortages of material are to be avoided, some degree of governmental intervention into the normal marketplace may be required.

While economic stockpiling may be viewed by many as unwarranted intervention in the marketplace, it must be recognized that some intervention is already present in a number of aspects of materials production and distribution. To some degree almost every one of the alternatives described below is already in practice. The concern here is to what extent, if any, there should be broader use of those alternatives which are already in existence and which, if any, ought to be added, In some instances, as in the case of Government assistance to industry to help increase the supply of materials, more than one alternative has been applied simultaneously. Given the various forms of Government intervention already in existence, economic stockpiling could be found to be less a source of market intervention than the introduction of new alternatives or the extension of present ones.

In recent years intervention by Government in the marketplace has not always prevented shortages and, in some cases, may actually have caused shortages, as is alleged in the supply of natural gas, Efforts to enhance the supply of materials has taken such forms as depletion allowances, expensing of development costs, subsidization, favorable tax incentives for investment, and stockpile purchases to initiate or sustain production of certain minerals and materials. Despite these efforts by the Government, some shortages have occurred. What an economic stockpile may do is alleviate the impact of a future shortage of material, provided that particular material is stockpiled in adequate quantity.

The present assessment envisions the use of an economic stockpile to achieve certain social benefits thru the prevention of materials shortages. But since an economic stockpile is an intervention in the marketplace, the social benefits from implementation of a stockpile must be measured against the economic costs and the relative desirability of alternatives to achieve the desired social benefit.

Virtually all the alternatives presented below were mentioned in some of the interviews as being preferable to the 11 stockpiling policies. However, the preference for alternatives was less true with respect to stockpiling policies aimed at overcoming import disruptions than for the other policies,

B. ALTERNATIVE METHODS TO INCREASE SUPPLY

Materials supply could be increased through the following means, each of which is discussed in subsequent order:

- Direct subsidies to producers working marginal resources,
- Tax incentives to encourage production from marginal resources,
- Research and development to increase production from marginal resources or to process substitute materials,
- Tax concessions to favor capital formation and investment in mineral supply,
- Low interest loans and investment guarantees to encourage exploration and production,
- Tariff concessions to raw-material-producing countries,
- Increased recycling of secondary materials, and
- Production from public lands.[1]

[1] S. Victor Radcliffe, in the Henniker Report, lists the following methods of increasing supply;

1. Advances in the understanding of mineral formation and the techniques for exploration, and of plant biochemistry.
2. Creation of new materials or processes that open up new resources (e.g., synthetic polymers, new mining techniques for minerals on land and in the oceans).
3. Improving the physical efficiency of the extraction of resources (e.g., increased energy efficiency in processes for aluminum and steelmaking. or wood products).
4. Develop lower cost alternatives for existing materials (i.e., substitution of materials or systems to provide the same performance or function), including the possibilities for greater use of the more abundant materials, such as manganese and silicon, or of renewable materials, including current organic wastes such as lignin. All other references used from this conference will be cited as Henniker *Report*.

1. Direct Subsidies to Producers Working Marginal Resources

Direct subsidies would provide. for payment to producers in amounts sufficient to cover the difference between costs (including a reasonable rate of return) and market prices for each material involved, Such a program has been used in the past as part of the strategic and critical materials stockpiling program for defense, Under this program, substantial quantities of asbestos, beryl, chromite, columbium, Fluorspar, manganese, mercury, mica, and tungsten were purchased at higher than market prices, This program had the added purpose of supporting domestic production of certain materials in order to maintain the mobilization base, However, much of the material produced was of relatively low quality and was not adequate for defense stockpiling purposes, The program included premium price plans for copper, lead, and zinc in World War II, as well as floor and ceiling contracts during the Korean war.

Although these subsidy programs were directly related to the strategic and critical stockpile, they are examples of Government support which could be provided irrespective of the existence of a stockpile. Two such examples, copper and titanium, are discussed below,

Under Title III of the Stockpiling Act of 1946, provision was made for various methods of capacity expansion of materials, including Government floor-price purchase contracts to stimulate private companies to increase mine production. Under these contracts the Government agreed to purchase specified amounts of output at the guaranteed floor price if the market did not take up these quantities at that price or a higher price.

a. Government Subsidies and Copper.—In 1951 and 1952 the Defense Production Administration approved 10 projects for Government assistance in the production of copper, In most of these projects, a floor price was guaranteed in a long-term purchase contract. Some of these 10 projects also involved accelerated tax amortization, Government loans, or both, as authorized by the Stockpiling Act of 1946. It was estimated at the time that the annual increase in output from the mines opened by these projects would total about 250,000 tons of copper, that about 100,000 tons would be available in 1954, and that the full output would come in by 1955. An additional nine projects were subsequently approved, bringing the total number of projects within that program to 19, and increasing the potential commitment to 1,191,240 tons of copper. However, since copper prices were relatively good during the contract delivery period, the bulk of the output (949,354 tons) was sold to industry and only 231,959 tons were delivered to the Government. Obligations to deliver 9,927 tons to the Government were canceled,

There was also a small program for the maintenance of production at some existing mines which could not produce copper at the Government ceiling price of 24.5 cents per pound for electrolytic copper ($490 per short ton). Contracts were therefore consummated for 30,434 tons at an average subsidy of $127.39 per ton. These contracts were terminated when price regulations were removed from copper in March 1953. Under this program, slightly over half of the contracted amount (16,201 tons) was delivered to the Government.

The program under title III achieved its objective of increasing copper production for the defense program. With the help provided by the subsidies and additional incentives of rapid tax amortization, several copper properties operating today had their inception in this expansion program,

b. Government Subsidies and Titanium.—In the case of titanium, Government assistance has gone through two major phases, The domestic industry had been started in 1950 through Government aid in the form of guaranteed purchase contracts, coupled with loans, loan guarantees, and research contracts, More recently, the collapse of the SST program, in particular, put the titanium sponge industry in jeopardy in the last half of 1971.

As a result of serious concern on the part of the Office of Emergency Preparedness, Congress, and other interested agencies, a stockpile purchase/buyback program was adopted to support the titanium industry. In January 1972 the GSA was authorized to acquire 7,000 tons of domestically produced titanium sponge from the three existing producers, although the smallest subsequently dropped out of the program. The purchase of this tonnage was to be paid for with other materials excess to the stockpile, in lieu of cash. All the 6,500 tons which were to be supplied by the two other producers have been delivered to the Government. This program helped sustain the titanium industry during the period of uncertainty prior to an upsurge of demand in 1973 and 1974.

c. Future Subsidy Programs.—The future of a direct subsidy program under peacetime conditions would depend upon the willingness of Congress to provide the funds. In order to do so, however, Congress would have to determine that the activation of marginal and submarginal mineral deposits would be in the best interests of the country. Political support in mining areas would have to offset broader concerns about the optimum use of national resources, unless the loss of foreign supplies were to become a fact or a serious threat. If such an incentive as a direct subsidy program were implemented, it would have to be supplemented by an allocation program for distribution to customers and could involve additional costs of upgrading the material to meet consuming industry specifications.

In summary, direct subsidization has worked effectively to initiate production, to develop marginal resources, and to maintain an ailing industry. These programs were frequently joined with stockpiling, but may be extended in lieu of any stockpiling by direct payments rather than by purchase of material.

2. Tax Incentives To Encourage Production From Marginal Resources

Tax adjustments or incentives, such as rapid tax amortization allowances, have been used in the past under the defense program to stimulate capital investment in mining and processing facilities, and have been successful in increasing the mobilization base. Concessions could also be made through selective depletion allowances for low-grade resources,

The National Commission on Materials Policy, in referring to depletion allowances, made the following statement which is presented here in its entirety:

> Although the gamble in exploration is governed by scientifically determined odds, the stakes are so high and the risk so great that it is necessary to take specific action to share the costs to compensate those who take these risks, The primary methods of providing encouragement has been through percentage depletion allowances in tax laws. For the very expensive and highly risky search for oil and gas, charging the first year's drilling costs to expenses rather than to the capital account is also allowed.
>
> Although the equity of depletion allowances is questionable, lawyers and economists have found no other generally acceptable mechanism to cover fairly the risks of developing a mineral reserve.
>
> Depletion allowance is applied to the gross income from the property, which means that an operator must have taxable income above expenses in order to have anything from which to deduct this authorized depletion percentage. Minerals that have been discovered in paying quantities in the ground area capital asset, but as they are produced, that asset is used up. Percentage depletion, therefore, is the best method yet devised to permit a mineral resource owner to recover at least a part of his capital so that it can be used to develop additional mineral deposits, and to provide incentive to potential investors. On the other hand, percentage depletion is of no value whatever to those who take the risk of exploration but find little or nothing, since there must be income above expenses in a tax year in order to receive the depletion deduction.
>
> Because of its speculative nature, exploration cannot be financed by bonds or by bank loans. Funds can come only from those who are willing

to risk a succession of failures in confidence that they will enjoy eventual success.

The traditional means of providing this stimulation has been through the substitution of percentage depletion for cost depreciation in the tax structure and the privilege of charging exploration costs against other income.

This principle has been subject to public attack, but criticism has not produced better alternatives, and in our brief tenure, we have not been able to do better than the critics.[2]

Following that analysis, the National Commission then made the following recommendations:

- . . . Congress continue the percentage depletion provisions of our tax laws as a time-tested major incentive to discovery and development of mineral resources. These provisions should not be further reduced unless and until a better incentive system can be developed,
- . . . the total cost of mineral exploration be allowed as a tax-deductible item, as intangible oil and gas well drilling costs are today,

As in the case of direct subsidies, the future of tax incentives, including depletion allowance, is uncertain, All such tax concessions would face fiscal problems in light of growing budget deficits and questions of equitability in the tax treatment of various national resources. In the case of petroleum, the depletion allowance of 22 percent was eliminated on March 29, 1975, except for small producers with 2,000 barrels per day output or less, The 22-percent allowance will apply to succeedingly smaller daily outputs each year until 1980, when it will cover producers with 1,000 barrels per day or less. After 1980 the percent allowance on 1,000 barrels per day or less will decline each year until 1984, when it will amount to 15 percent and remain at that figure thereafter. Average annual output in the United States in 1974 was approximately 8,740,000 barrels,

Tax incentives, such as depletion allowance, from goods or marginal resources are a very important means of increasing the supply of materials, but they do not prevent shortages of material due either to suddenly increased demands or unexpected interruptions in the supply of foreign source materials. The question of an adequate supply of materials enhanced by such tax incentives may not lead to the accumulation of a sufficient industrial inventory to alleviate the need for an economic stockpile, On the other hand, too great an extension of subsidies or tax incentives to marginal producers may have the effect of discouraging private investment in good resources. A tax-incentive program for the support of research and development is mentioned in the following section.

[2] *Materials Needs and the Environment Today* and Tomorrow, National Commission on Materials Policy, June 1973.

3. Research and Development To Increase Production From Marginal Resources or To Process Substitute Materials

Research and development could take various approaches: (1) one financed and operated by the Government, (2) one jointly financed and operated by Government and industry, or (3) one operated by industry under the impetus of a tax incentive, Government grants-in-aid could also be made to research organizations, universities, and companies possessing competence in research,

The potential domestic production of oil from shale and aluminum from nonbauxitic materials stand out as examples in which research and development may in the future increase the United States supply of these basic materials. Such activity could also include technical assistance to foreign producers to help improve their efficiency and broaden their markets.

a. The Importance of Research and Development.—Richard W. Roberts, then Director of the National Bureau of Standards, mentioned five technical options in materials research which can be used alone or in consort to improve materials performance. These options would in general have the ultimate effect of increasing supply: (1) development of new materials, (2) development of new processing techniques, (3) improvement in manufacturing and fabrication techniques, (4) improvement in nondestructive evaluation techniques, and (4) improvement in design theories and concepts.[3]

Dr. John Morgan, Jr., Assistant Director of the Bureau of Mines, cites the following five areas which require "accelerated development of new and improved technology and rapid introduction thereof": (1) exploration, (2) mining and petroleum and natural gas products, (3) processing, (4) use, and (5) recovery and recycling.[4]

Julius J. Harwood, Director, Physical Sciences, Scientific Research Staff, Ford Motor Co., suggests a four-part strategy to increase the research and development efforts directed toward "materials substitution, recycling, solid waste disposal and materials processing to provide new sources of materials, reduce scrap generation and increase productive utilization of available materials to offset tight supply and increasing costs of materials. "[5] The four-part strategy encompasses the following points:

(1) Alert, as early as possible, the outside market to any major upward shift in specific materials usage. . . . clearly recognize that 2-to 3-year leadtimes or more may be required for materials producers to effect significant capacity expansion;

(2) The extended leadtimes emphasize the need for establishing early-on, continuous liaison and communication among product planning/engineering, manufacturing and supply activities concerning product assumptions and materials requirements to ensure availability of required materials to support our future vehicle programs;

(3) Maintain periodic updates of availability, supply, and economic projections to establish a monitoring and early warning system; and

(4) Explore feasibility of alternate markets to provide flexibility to compete in shifting materials supply markets,

b. NCMP R&D Recommendations.—The National Commission on Materials Policy (NCMP) made a number of far-reaching recommendations dealing with research in energy and nonenergy materials and related subjects. These recommendations are presented as follows in summary form.[6]

(1) Regarding research on new sources of energy and the environment, NCMP recommended that

.,. the Government sponsor a massive research effort to improve the use of fossil fuels and develop new sources of energy, to improve slurry transport of coal, to develop processes of obtaining synthetic oil and gas from coal or from such raw materials as shale and tar sands;

. . . research into fuel cell development be pursued;

,,, greater priority be assigned to efforts to develop the breeder reactor;

. . . research in high-temperature materials be accelerated;

. . . research be undertaken in economical, clean sources of automotive power for private and public transportation;

. . . the Government support extensive R&D on the dynamics of environment ecosystems; and on the impact of major human activities and their effect on human, animal, and plant life. The R&D will emphasize the detection and study of substances in low levels of concentration, and studies of their life cycles and chronic, additive, or delayed effects on public health;

. . . development of additional techniques to repair environmental damage from surface and underground mining and similar activities, and methods for reducing pollutants from various effluents to a more desirable level; and

. . . research and development be supported, with the participation of industry, on alternative efficient technologies that produce materials without undue sacrifice on environmental quality.

.,, consideration be given to such measures as:

sHenniker Report.
4Henniker Report.
5Henniker Report.

6NCMP, *Material Needs and the Environment.*

- review of the potentially inhibiting effects of antitrust procedures on joint industry-wide research, e.g., antipollution efforts, and modification of present procedures where appropriate,
- sharing between the Government and industry the costs inherent in demonstrating, at the pilot plant level, promising developments protective of environmental quality, e.g.,hydro-metallurgical processes, formed-coke production methods (bypassing the high-emission coke ovens in coke manufacture), and extension of vacuum technology in extractive metallurgy, cooperative ventures of the Government and industry for developing technologies, exemplified by the wartime synthetic rubber program, by the recent cooperative blast furnace research of the Bureau of Mines, by research into nonpolluting coking methods which is now being undertaken jointly by the Office of Coal Research and industry, and by the current Technology Incentives Programs of the National Science Foundation and the National Bureau of Standards; and

,.. Government support be provided for studies, particularly at universities, which will stimulate rapid development of the geosciences and their application to problems of mineral exploration.

(2) Regarding waste utilization and materials conservation, NCMP recommended that

... the Federal Government cooperate with State and municipal governments and industry in developing technologies for utilizing industrial and urban waste as a source of fuel and raw materials;

... support be offered to universities, private institutions, and industry to further research into development of feedstocks for polymer production from renewable raw materials, and to encourage continued research into extraction of mineral values from low-grade ores; and

... R&D be sponsored on improvements in resistance to corrosion and other degradation; in nondestructive testing methods; in techniques of characterization; in new composites; and on other topics relating to materials effectiveness. This R&D, supported in the past by the Department of Defense, National Aeronautics and Space Administration, and Atomic Energy Commission, should also be pursued by other agencies with materials responsibilities, and should be complemented by efforts to translate knowledge into practice.

(3) Regarding technology research and development and education/training, NCMP recommended that

... the agencies assigned substantial responsibilities in the materials and resources field be instructed and enabled to take steps to build up commensurate research and development to generate new knowledge and technology, and also to enhance the exploitation of available knowledge. Their activities should include:

- in-house research capabilities sufficient to insure adequate support for their entire research and development program;
- appropriate basic research in the physical, biological, social, economic, and political sciences as relevant to materials;
- cooperation between national laboratories and industry, including shared research, personnel, and information;
- sponsorship of coupling programs involving the Government, industry and nonprofit and university laboratories in joint research and development directed at serving national needs; and
- deliberate, explicitly funded efforts on the part of agencies generating new technology to alert the public to the potentials of applying this knowledge and to stimulate its transfer to industrial use.

... a continuing analysis be carried out, Preferably by NSF, of the numbers of graduates to be needed by the materials industries in various specialties, with allowance for sufficient lead time;

.,. support of education and training in the materials field take into account the need to modify those aspects concerned with materials extraction and processing to give them sufficient prominence in the materials engineering curricula; and to incorporate up-to-date knowledge from materials fields and from physical sciences and engineering;

... cooperative efforts be fostered among Federal, State, and local agencies, private industry, and labor for the development of uniform national codes. These standards should be based upon performance requirements designed to increase efficiency in the use of materials, to encourage introduction and acceptance of superior materials, and to enhance recovery or disposition of materials from worn-out products; and

. . . the Government review present policy with respect to the vesting of patent rights when undertaking joint research with the private sector.

Research and development by industry and/or Government will continue as part of normal operations. The emphasis on particular materials will shift as new developments occur. Direct Government assistance will be' limited by funds and the criticality of particular situations. The fallout of research and development from both industry and Government, including that dealing with defense matters, will accrue to other areas as it has in the past.

4. Low Interest Loans and Investment Guarantees To Encourage Exploration and Production

Actions in the investment area include low interest loans and investment guarantees such as those provided by the Overseas Private Investment Corporation, That agency provides incentives to United States private investors to encourage investments in many developing countries by insuring against losses which might result from social, political, or economic problems in the developing country and by reducing the need for government-to-government lending programs in supplying capital through private investment channels. Other governmental or intragovernmental organizations, such as the Export-Import Bank and the International Bank of Reconstruction and Development, are also sources of capital for the construction and operation of facilities. The National Commission on Materials Policy recommended that the U.S. Government reestablish and adequately fund a financial institution, possibly modeled after the Reconstruction Finance Corporation or the Defense Plant Corporation, which can arrange for low-cost investment capital for industry, if a clear national need can be shown, "[7]

Although the Office of Minerals Exploration in the U.S. Geological Survey (the successor to the Defense Minerals Exploration Administration) exists to provide low-cost loans for minerals exploration, it has ceased making new loans due to a lack of funds. A total of 36 minerals have been covered, mostly for loans of up to 50 percent of exploration costs and some up to 75 percent. At the present time, unexpired contracts exist only in gold and silver. This experience of the Office of Minerals Exploration does not suggest greater Government involvement in granting loans for exploration, but this situation could change if supplies of critical imported materials were to become a threat or an actuality. With further regard to financing problems, NCMP recommended the relaxation of antitrust laws to permit "special industry groups to form joint venture corporations for the production of critical industrial materials under economies of scale that cannot be attained by individual companies, and under conditions that do not restrain trade. "[8]

Low interest loans and investment guarantees are an alternative to stockpiling of scarce domestic resources, recycling, and new technology, i.e., those policies which would not counteract long-term shortages,

5. Tariff Concessions to Countries Producing Raw Materials

Tariff concessions to countries producing raw materials could increase supplies to the United States. However, the effect of these concessions would be limited by the fact that import duties on most materials in which the United States is heavily import dependent are already low or nonexistent. Nevertheless, some favorable developments from the standpoint of improving the overall economic situation in developing countries and from reducing costs to United States consumers could flow from the current tariff and trade negotiations under the General Agreement on Tariffs and Trade (GATT) agreement.

[7] NCMP, *Material Needs and the Environment.*

[8] NCMP, *Material* Needs and the Environment,

The Interior Department, in its report "Critical Materials: Commodity Action Analyses, " March 1975, takes another view on tariffs as a means of increasing supplies. According to the report, higher tariffs would, by raising U.S. prices and costs, presumably encourage increased domestic productive capacity, Given the historical trend toward lower tariffs and the need to compensate through GATT for higher tariffs in one commodity with tariff or trade concessions in another, the probability of higher tariffs seems rather remote.[9]

Tariff concessions as an alternative to stockpiling might be effective if changes are made so as not to penalize imports of raw material or destroy domestic production. As an alternative to stockpiling, these concessions could aid in maintaining foreign supply but could adversely affect domestic production. It is probable that tariff changes are not an alternative to any stockpile policy.

6. Increased Recycling of Secondary Materials

The recovery of secondary materials has the effect of renewing nonrenewable resources. Much of the metal and some of the secondary glass generated in producing plants is reused at the manufacturing site. The recycling industry, with about 8,000 establishments, collects economically recoverable wastes, processes them where necessary, and sells them to consumers of secondary materials. While it is already being carried out on a large scale by established industries, recycling on an increased scale, particularly from municipal waste, could augment the supply of usable materials. Recycling could be stimulated by Government by such actions as direct subsidy payments, tax concessions to producers and/or consumers, research and development in recovery and use technology, adjusted freight rates to provide more comparable rates between recycled and primary materials, and grants to State and local governments to assist in solid waste recovery programs,

Municipal waste recovery has become the subject of much discussion as well as work. Seymour L. Blum, Director, Advanced Program Development, The Mitre Corp., lists the following alternatives for consideration:

- Resource recovery technology, to include
  - front end separation,
  - incineration, and
  - comporting;
- Energy recovery, to include
  - steam,
  - oil pyrolysis,
  - gas pyrolysis, and
  - direct firing;
- Disposal technology, to include
  - land fill, and
  - incineration;
- Collection procedures;
- Transport procedures;
- Storage procedures; and
- Separation economics.[10]

As a means of increasing the recycling of secondary materials, NCMP made the following recommendations:

> ,,. the Federal Government offer loans at low rates of interest to private firms for recovery of resources from municipal waste;
>
> ,,. the Federal Government offer subsidies for solid waste handling to municipal or county efforts to levy user charges that will enable the operations to pay all costs;
>
> ,,. the Federal Government give users (scrap consumers, e.g., steel mills) of materials economic incentives in the form of tax credits for expanded use of recycled materials;
>
> . ◦ . the Federal Government offer tax credit for investments in new plants and equipment specifically geared to the production of marketable products from recycled materials, with 5 year amortization deductions for companies that install ancillary equipment that will allow them to process larger quantities of scrap than at present;

[9] In "Critical Materials: Commodity Action Analysis" (March 1975), p. 2, the Interior Department presents an analysis of materials supply problems for aluminum, chromium, platinum, and palladium and concludes that stockpiling is more cost-effective than either a tariff or a subsidy in most cases, but that a combination of these three options is the overall optimal policy,

[10] Henniker Report.

. . . the Federal Government take the necessary steps to correct the existing freight rate differentials between secondary and primary materials;

. . . the Federal Government exercise leadership by using its purchasing power to provide a market for products made from recycled materials;

, , , the Federal Government help reduce the flow of solid waste by establishing, within Federal purchasing departments, performance standards rather than composition standards that discriminate against secondary materials;

. . . the Federal Government remove any labeling regulations, unrelated to consumer protection, that discourage consumers from buying products that contain secondary materials;

. . . the Federal Government accelerate research and development and technology transfer on resource recovery, especially to encourage recovery of resources in municipal wastes;

. . . the amount of solid waste requiring disposition be increasingly reduced where possible by methods of recycling, reuse, and recovery;

. . . industry develop and expand technology and markets that will allow for practical use of all bulk waste; and

. . . industry dispose of waste, including mine tailings, in a manner to facilitate eventual recovery of valuable resources.[11]

An economic stockpile to aid recycling may be unnecessary if any of the foregoing recommendations are enacted. The problems of recycling are not only economic or technological, but largely arise due to institutional problems between private enterprise and local, State, or Federal Government. A more viable alternative to a national stockpile to aid recycling might be one set up on a local or regional basis with some Federal help in initial financing and organization.

In view of the great interest in the recovery of usable solid materials from municipal waste and the accompanying use of energy materials in that waste, progress in that direction can be expected for the future within the limits of quantity, quality, and costs. A technology assessment on resource recovery, materials recycling and reuse was requested by the House Committee on Science and Technology and is currently being carried out by the Office of Technology Assessment.

7. Role of Public Lands in Increasing Domestic Supply

Much of current production comes from claims originally filed on public land. Access to minerals on public land is increasingly being restricted by policies arising from concern with alternative land use and environmental impact. Supply from public land can logically be considered as a component to various alternatives to stockpiling. Its importance as an issue in itself justifies separate discussions, however. The use of public lands as a means of increasing supply of materials was discussed by NCMP as follows:

> The Government has a responsibility to oversee exploration of mineral resources within public lands. Development of these resources is in the public interest, for they can add substantially to the Nation's reserves. This benefit should be weighed against the negative effects of possible ecological disturbance or insult to the natural environment,
>
> We recognize the need to protect public monuments, unique and irreplaceable natural wonders, and parks. Vast areas of public domain, however, have been so restricted, with their status so uncertain, that the risk of exploration cannot be economically justified by the prospect of success. Without entry to these lands and without assurance of tenure in the event of a discovery, no mining group can calculate the relative costs and benefits which would permit determination of the most effective use of the land. There are indeed numerous examples of places where better use of the land has been made after mineral extraction than was made before,
>
> As the Congress develops the urgently needed legislation governing public lands, we recommend that
>
> United States statutes recognize without equivocation that final judgments on the value of publicly owned lands cannot be made until the subsurface has been explored thoroughly, and that the laws assure:

[11] NCMP. *Material Needs and the Environment.*

- land be used in a way that will optimize its future material contribution; and
- in the future when values change, a tract of land may be used for purposes far different from the present.

The exploration of wilderness tracts is likewise discussed in the NCMP report as follows:

> The opposing objectives of protecting wilderness tracts and expanding mineral reserves can be reconciled at their points of difference. Such possibilities include rationale regulation of the movement of aircraft over wilderness areas and the entry of other suitable forms of transportation where they are now prohibited.
>
> The exploration, without evident damage, of pristine tracts is now permitted by Federal land agencies. The need for such regulated exploration was recognized in principle by the Wilderness Law which permitted a period for determining the value of mineral deposits before further access was denied. The failure to provide the U.S. Geological Survey and the Bureau of Mines resource evaluation programs with funds for these explorations has frustrated Government efforts to assess these potentialities. At the same time, private exploration has been prevented by regulations intended for other purposes, Normal prudence prohibits financial entities from spending money where constantly changing regulations could turn an economically sound venture into a losing proposition.

Following that analysis, NCMP recommended that

> . . . Congress include, in legislation governing land, permission to explore under regulations which will prevent irreparable damage to the protected areas and hold disturbances to the lowest level possible;
>
> . . . Congress provide for:
>
> - the development of mineral properties by private industry where there will be minimal impairment of recreation or biological functions, or where plans are provided in advance to restore or improve original conditions when extraction is terminated;
> - evaluation of the costs and benefits of mining development, by methods such as those used in the environmental impact statements of governmental projects: and
> - strict sanctions against violation of protective regulations.

A technology assessment of constraints and incentives affecting domestic minerals accessibility on public lands is currently being conducted by the Office of Technology Assessment.

C. ALTERNATIVES TO MAINTAIN STABLE LEVELS OF SUPPLY

Maintaining stable levels of supply could involve four principal approaches: (1) inventory management, (z) extended futures markets, (3) standby capacity, and (4) international commodity agreements.

1. Inventory Management[12]

Departures from traditional inventory management patterns in order to provide relative stability at all phases of the business cycle and overcome unusual interruptions in supply could require Government incentives in the form of tax adjustments. Industrial firms, including both producers and consumers of materials, tend to maintain normal working inventories which vary from material to material, depending on such factors as the degree of integration within individual companies, the form of the material, seasonal factors, and assurances of supply sources.

The current Swedish tax system, which permits accelerated writeoffs of inventories to encourage private stockpiling by allowing changing acquisition costs to be spread over long periods of time, has frequently been cited as a pro to type, nongovernment economic

12 Inventory management in response to indirect incentives, is here treated as an alternative to stockpiling in contrast with the holding of stocks by industry on contract to the Government which is treated as stockpiling in ch. IV,

77-119 0-76-13

stockpile. For that reason it is discussed here in some detail.

The government of Sweden maintains stockpiles of raw materials for strategic purposes and is currently examining the possibility of implementing an economic stockpile. It also provides tax incentives which encourage industry to maintain adequate inventories. The rules governing the taxation of corporate income in Sweden apply to three special areas: (1) inventory valuation; (z) depreciation and (3) reserves for future investment. The Swedish tax rules in these areas have increased the ability of Swedish industry to compete in world markets. By providing substantial incentives to industry and commerce, the Swedish Government has encouraged the use of private capital to deal with economic fluctuations and the business cycle. An essential feature of these devices is the degree of control they give business taxpayers over the amount of profit to be reported. The corporation has the option of taking larger or smaller deductions in any particular year. To that extent, corporate and other taxpayers are permitted a substantial degree of latitude in leveling out their annual results and in building up reserves.

a. Inventory Valuation.—Sweden's tax provision governing the valuation of inventories are designed to eliminate taxation of merely inflationary profits and permit the strengthening of corporate resources against the possibility of inventory price declines. Under this system the basic rule is that the valuation of the inventory entered by the taxpayer in his account books shall govern for tax purposes. However, the right to value inventories in the taxpayer's business discretion is subject to certain limitations established by the tax laws.

The main rule governing valuation is complemented by two supplementary rules. The first of these is the rule of "comparable value." If the value of the inventory at the end of a corporation's fiscal year-at cost or market, and after deducting obsolete or unsalable items—is less than the average of the value of the inventory at the close of the two prior years (average value termed the "comparable value"), the corporation may write its inventory down by 60 percent of that comparable value, rather than by 60 percent of the value at the end of the income year in question.

The second supplementary rule relates to the valuation of raw materials or staple commodities in the inventory. The corporation has an option to value these inventory assets at the lowest market price in effect during the income year or in any of the nine previous years, and then to reduce that figure by 30 percent to give an inventory valuation equal to 70 percent of the 10-year low. If the corporation chooses to value raw materials or staple commodities in this way, it may not also take advantage of the rule of "comparable value" outlined above, In any event, a corporation may always write its inventory down to its actual value, despite the foregoing rules, and take appropriate deductions from taxable income. So far as the company's books are concerned, it is immaterial whether the amount of an authorized writeoff is deducted directly from the cost or market value of the inventory price decline on the liability side, The latter method is customarily used, however, when the use of the "comparable value" rule results in a negative inventory value.

b. Depreciation.—The second area of incentives granted industry by the Swedish Government is depreciation. The main rule dealing with depreciation provides that a taxpayer, after first writing off all obsolete or unsalable items in full, may write down the balance of the inventory by 60 percent to a floor of 40 percent of cost or market value, whichever is lower. Cost is determined on a first-in, first-out basis. The amount of this inventory writeoff is deductible from taxable income.

c. Reserves for Future Investment.—The third area of incentive in the Swedish system is the establishment of reserves for future investment. A special provision enacted in 1964 permits a Swedish parent company selling inventory assets to a foreign subsidiary for future resale on the foreign market to defer tax on profits attributable to goods which remain unsold in the hands of the subsidiary at the end of the parent's fixed year. The parent may take a deduction from taxable income by an amount not exceeding the difference between the price at which the parent sold these goods to the subsidiary (minus any amount of inventory writeoff deducted by the subsidiary), and the parent's cost of these goods. The allocation must be restored to taxable income during the following fiscal year; at the end of that year the question of a deduction for a renewed allocation is considered in view of the then existing circumstances.

While the tax system of Sweden was not designed to create a national stockpile, but rather to support a healthy industrial economy in good rapport with Government, it has tended to obviate the need for a national stockpile by encouraging industry to maintain inventories large enough to meet emergency situations. On the one hand, the inventories thus supported include items which are of a strategic and critical nature, as well as those which are not. On the other hand, the materials coverage becomes much greater than would be possible if the Government were to purchase and store only those items which it could afford and which were deemed vulnerable enough to warrant the Government effort. In brief, then, the Swedish tax rules, as they apply to inventories and other tax measures, are designed to increase the efficiency of Swedish industry as a competitor in world markets. The creation of a "Swedish stockpile" is more or less a byproduct of those rules,

2. Futures Markets

The extension of futures markets for materials in which they do not already exist could provide a means of greater market stability, despite the problems which would be raised by speculation in these materials. Among the metals, there are futures markets in the United States (such as the Commodity Exchange in New York) and abroad (such as the London Metal Exchange) in copper, gold, lead, mercury, platinum group, silver, tin, and zinc.

A commodity futures market is any exchange or association of persons engaged in buying or selling a commodity or receiving it for sale on consignment.[13] Contracts, called "futures," are made at a mutually agreed price between buyers and sellers or their agents for delivery of commodities at some future specified date. The commodity futures market provides a vehicle through which buyers and sellers hedge against losses which may be incurred because of price changes in the future. For example, the buyer in a long-term contract could hedge his purchase by selling forward; i.e., by taking a short position in the futures market. If the price were to fall in the interim before actual delivery is made to him, he would offset his short position on the futures market, making a profit on the closed-out position, thus compensating for the loss incurred under his long-term contract for accepting delivery on an overvalued commodity. Transactions could also be made to offset the effect of possible future price increases and apply to sellers as well as buyers. In short, gains in a rising market and losses in a falling market could be compensated for by opposite gains or losses resulting from physical delivery under a long-term contract.

Commodities which are traded on a futures market should meet certain criteria. Uniformity of specifications is a prime consideration. Since there must be certainty that the grade and quality named in the contract can be delivered with little variation from the standard, the commodity should therefore be interchangeable and homogeneous. Another requirement is that the freight cost should be small in comparison with the delivered value of the commodity. High freight-to-value ratios could require a number of storage warehouses at strategic locations and would make it

[13] See "A Study of Ferrous Scrap Futures," United States Department of Commerce, June 1974.

difficult to operate a central commodity exchange with a sufficient number of floor traders to keep the contracts liquid. In relation to the location of inventories, there should be enough stock available on the cash or spot market to allow a short position to be offset by delivery rather than by "buying in" the contract. A workable commodity exchange should either carry adequate inventories against actual delivery contracts or have ready access to inventories of others through adequate spot trading. The possibility of making or demanding delivery tends to keep the futures price levels of the nearest delivery month in close alignment with the spot price. Finally, a commodity with a large number of active buyers and sellers is necessary in order to supply the hedging contracts and the large volume of trading needed to keep the market liquid. The absence of a large number of traders on both sides of the market could reduce the competition required to avoid restrictive action by an individual or group on supplies or prices.

Although there has been consideration from time to time regarding the development of a futures market in commodities not now so handled, and although some of the materials which might be selected for consideration in an economic stockpiling program might qualify, there is no present indication of an extension of such markets in those directions. Nevertheless, this alternative should be kept in mind as a possible means of market stabilization if future developments warrant it.

3. Standby Capacity

Standby capacity to produce materials would require Government financing or tax incentives to encourage the construction of facilities for future use when needed. Standby capacity is a deferrable and/or mothballed mining and/or industrial capacity capable of producing in quantity critical and strategic materials in time of scarcity. Its major advantages are that it provides a quick reaction capability to scarcity problems and requires a relatively short leadtime to be put into use.

The major disadvantages of standby capacity, according to Buttner, are

> high capital tieup, rapid depreciation of capital through obsolescence, and deterioration of plants standing in idleness. The losses in mothballed plants are so great that the temptation has been overwhelming to run the plants instead, and that, like a night out on the town, results in a DPA-like, stockpile hangover. In addition, the deferral of "existing equipment and manpower from other less critical activity is disruptive to industry and usually requires special Government bodies set up to manage it equitably. To rely 100 percent on standby capacity to combat scarcity would incur exorbitant costs.[14]

The stockpiling of technology—in the form of standby capacity--can occur either as standby production plants or excess plant capacity, by subsidizing the operation of higher cost production plants or excess plant capacity, or by subsidizing the operation of higher cost production processes which permit the use of nonvulnerable resources, Compared with maintaining stocks of materials, the costs incurred in stockpiling technology are very large and it appears doubtful if the insurance provided would be worth it. A major relevant issue of science and technology policy is whether the Federal Government should underwrite research and development for alternative technologies, substitute materials, or raw material supplies. However, such an issue is really more concerned with long-term impacts than with short-term needs. Instituting standby capacity as an alternative to stockpiling, costly as it would be, is a doubtful development under peacetime conditions.

4. International Commodity Agreements

International commodity agreements with developing countries have been put forth as a potential means of achieving international market stability for two mutually beneficial purposes: materials supply/price stability for the United States and market/price stability for

[14] Henniker Report.

the materials-producing countries,[15] Under such agreements, floor and ceiling prices could be established to protect both producers and consumers. Without an economic stockpile as a repository for materials obtained through such international agreements, some types of allocations of supplies to consumers would probably be necessary. International commodity agreements would be expected to have limited effect on cartel or unilateral political actions which, because of their political nature, do not make the countries involved amenable to international agreements, However, the possibility y of such agreements should not be ignored,

The analysis of international commodity agreements in this chapter does not obviate the consideration of such an agreement as an economic stockpile. It is placed here as an alternative simply because it is clearly not a national stockpile and because it involves defined foreign-policy decisions,

One potential problem with international commodity agreements was cited by several of the persons interviewed, namely, that many countries might not consistently adhere to an international agreement during periods when it might not be to their best economic advantage,

Heavy investment costs of mineral development and processing plants have helped to promote the growth of large, vertically integrated firms and, more recently, of multinational corporations which have to a large extent organized and controlled markets and trade in minerals, The current picture is changing, however. The power and influence of the multinational mining corporations have been declining and will probably continue to diminish in the future, as their facilities, are nationalized, as foreign governments intervene in their operations and marketing, and as hostility toward foreign investment grows.

[15] "Prospects for International Cooperation in Critical Materials: The Case of International Commodity Agreements." A paper by John E. Tilton, Department of Mineral Economics, Pennsylvania State University, June 1975.

Since multinational corporations no longer appear to be serving the interests of producer (exporter) or consumer (importer) countries, other avenues are being considered. From the standpoint of importing countries, particularly the United States, there is a growing concern over future access to mineral supplies, and a fear of possible political confrontation over mineral policy issues, as well as of sharply higher prices. These countries are therefore looking more favorably on international commodity agreements and other alternative arrangements for organizing international mineral markets, In May 1975, Secretary of State Henry Kissinger indicated a willingness by the United States to consider international arrangements for individual commodities on a case-by-case basis, And, in fact, the U.S. has recently signed the International Tin Agreement and submitted it to the Senate for ratification,

a. Functions of International Commodity Agreement.—In certain respects, international commodity agreements might serve the interests of both importing and exporting countries in four ways. First, buffer stocks which stabilize the price and output of mineral commodities around their long-run trend might benefit both sets of nations, Second, buffer stocks might stabilize export earnings, Third, they might transfer earnings from developed countries to developing countries, if this were found to be desirable, Finally, they could provide gains in political good will and result in a type of materials detente,

N. E. Promisel lists the following services which an international organization could perform:

- Provide a forum for international discussion and debate of critical issues, followed by joint planning for action;
- Provide a recognized mechanism for cooperative programs in research and development and other sectors of materials and processes technology;
- Provide an adequate and rapid means for information and technology transfer, for mutual education, and for exchange of

materials scientists and engineers. Included would be international publications and jointly planned conferences and symposia;

- Stimulate the advancement of materials science and engineering on a global basis and promote professional growth in this field;
- Promote a better understanding and appreciation of materials science and engineering and its importance by key executives and administrators in many countries;
- Insure a mechanism for proper inputs and response to the many other international bodies in other fields and thus to insure adequate consideration (now mostly lacking) of materials science and engineering in many global, critical issues; and
- The organization would not deal with proprietary industrial technology or the market place per se although the impact of materials science and engineering on economics would be included.[16]

Whatever the agreement or disagreement regarding these possible benefits of an international stockpile, the international community should strive to achieve at least two additional objectives: (1) minimize the potential for political conflict arising from mineral trade, and (z) encourage production efficiency. Exploration, development, and production should not be encouraged in high-cost areas while lower cost areas are neglected, And material substitution should not be stimulated before relative production costs make such changes desirable, As Tilton points out

> International commodity agreements which attempt to set prices above the long run market clearing level are unlikely to achieve either of these objectives. Once importing states agree that exporting countries are entitled to monopoly profits, disagreements over just how high prices should be almost ensures continual confrontation. In addition, the incentives of producers and users are distorted in a manner that may promote serious production inefficiency. For these reasons, importing states should resist the strong pressures of exporting states for artificially high prices, Although a transfer of income and wealth from the importing countries, which tend to enjoy high standards of living, to the less developed, exporting countries may be highly desirable, it should be done in a manner which improves international relations and production efficiency, Moreover, a number of mineral exporting countries, such as Canada and Austria, already enjoy high standards of living, while some of the world's poorest countries have little mineral wealth to export. If a redistribution of income among nations is considered desirable for equity and humanitarian reasons, then a country's level of development, rather than its mineral endowment, seems a more appropriate criterion for receiving assistance.[17]

International buffer stocks have also been discussed by F. H. Buttner of Battelle Columbus Laboratories. Such a stockpile, he insists, would "replace national buffer stocks, for the main purpose of reducing the amplitude of world price fluctuations encountered in economic cycles."[18] Buttner would call this stockpile an International Trade Inventory (ITI) to avoid the "nationalistic and aggressive connotations" of the term "stockpile." He points out the following potential advantages of an international materials stockpile:

To Consumer Countries, An inventory would:

(1) Relieve the disruption of hand-to-mouth material procurement,

(2) Avoid economic damage of sudden scarcity, Bypasses a "decelerator effect, " (The decelerator effect occurs when a scarcity idles consumer's manufacturing capacity requiring him to carry higher costs,)

(3) Stabilize prices, preventing them from penetrating ceilings that add to costs; i.e., idle-equipment costs, which reduce profit margins and create an increment of inflationary pressure.

(4) Introduce de facto currency support by virtue of a nation's ownership of part of the inventory, thus strengthening its currency convertibility and valuation,

(5) Introduce de facto expansion of currency via extending credit against ITI stocks, thus relaxing need for IMC to be prepared to lend

---

16 Henniker Report,

170p, Cit.

laHenniker Report,

money to nations faced with sudden rises in demand for foreign currency,

To Producing Countries. An inventory would:

(1) Become an inventory-customer to stand in for disappearing consumer-customers in times of depressed demand and prices.

(2) A~oid economic damage of sudden high demand bypassing the "accelerator effect. " (Accelerator effects occur when an increased demand pushes producer beyond his capacity, requiring him to raise his investment. A five percent increase in output, above capacity, would as a rule, raise the investment/spending budget by perhaps 50 percent.) The Inventory would absorb the shock or a sharp discontinuity in demand, and relieve pressures on that investment/spending budget; also allow for an orderly expansion over time if demand proves to be continuous.

(3) Stabilize prices (of inelastic commodities) preventing them from penetrating floors that reduce revenues at a time when (1) idle capacity may be increasing unit costs due to lower productivity and (z) reduced revenues, and profits bear hardship on producer country.

(4) Introduce de facto currency support of producer-country currency in foreign exchange. Currency convertibility increases with knowledge that valuable raw material is available in its ITI account to holders of the producing country's currency,

(5) See (15) under "Consuming Countries, "

b. **International** Tin Agreements,—The ITA is currently the only formal international commodity agreement for a metal, For a complete discussion of the ITA, see appendix B; "Case-Study: The International Tin Council, "

D. ALTERNATIVE METHODS TO RESTRICT DEMAND

As an alternative to economic stockpiling, restricting demand is in part a negative approach, contrary to the other alternatives which are aimed for the most part at increasing supply. The distribution of materials could be achieved in at least three ways: (1) conservation, (2) substitution, and (3) export controls. Conservation and substitution are long-term solutions to the materials problems for which an economic stockpile is being considered, while export controls provide a short-term solution.

S, Victor Radcliffe lists the following methods for reducing demand for new supply:

- Better integration of materials selection with component design to develop manufacturing processes that reduce materials loss during manufacturing;
- New or improved materials to permit engineering designs that reduce the amounts of material required to perform a given function (e.g., miniaturization, as in solid-state devices, or improved reliability);
- Conservation in use through improved materials performance that provides increased service life (e.g., reduction in rates of deterioration by corrosion and wear); and
- Improved recovery or direct reuse of materials during processing, manufacturing, and after completion of the useful life of capital or consumer goods.[19]

1. Conservation

On the domestic side, conservation—whether voluntary, mandatory, or induced by higher prices—would be a means of reducing demand and therefore import dependence. Such conservation measures would have to be accompanied by allocation techniques in order to provide equitability among consumers, Conservation could also be achieved in a reduction of materials waste. A prime current example of conservation as an alternative has been the U.S. response to OPEC.

Ira Grant Hedrick identifies three certain mechanisms which can help promote more conservative designs in the use of materials:

[19] Henniker Report.

- A shift in customer appeal. Simply, this is getting the customer to choose products because they conserve materials. This could be quite a chore with the private and commercial customer.
- A reordering of the "Dollar Economy." The introduction of a carefully considered system for assessing the true value of a material to our society such that the price of a product would better reflect its total materials impact,
- The application of artificial constraints and controls such that the traditional principles of maximum appeal at minimum cost are forcefully 'overridden' in favor of resource conservation.[20]

The National Commission on Materials Policy recommended that the public be alerted to materials savings by

- Publicity campaigns mounted by public and private consumer protection agencies or other appropriate means;
- Publicizing the results of public or private product testing laboratories; and
- Development of product performance specifications by trade organizations and technical and professional societies, with public participation and encouragement of compliance by their respective industries,

The Commission also recommended that "the Department of Commerce fund a comprehensive survey"

- To determine losses sustained in the United States from corrosion, friction and wear, fracture, and high temperatures, service failure in the various industries, and to calculate the amount of savings that can be affected by application of established measures;
- To assess adequacy of present research in these fields and to fund additional research, if necessary; and
- To recommend improved methods for dissemination of pertinent data.

The Office of Technology Assessment currently has a study underway on materials conservation.

[20]Henniker Report

2. Substitution

Also on the domestic side, substitution of other available materials—whether voluntary or under Government order—would tend to reduce demand for materials in short supply. The major advantages of substitution are, first, that it relieves critical-material demand by replacing them with noncritical materials offering equivalent effectiveness in given uses; and second, that once underway, it pays for itself as it goes, except where the replacement material is inferior and requires paying an incremental cost to make up for that margin of difference. The major disadvantage of substitution is that it cannot take the economy far enough to combat broad and deep scarcity situations. Substitution technology is not that well developed, and it will require long lead-times to develop it. That is not to say that substitution is not done in industry. It is, as Buttner points out, but on a relatively small "nutritional" scale, so to speak, not on a sufficient scale to provide the large-scale "therapy" we would need to combat real or sudden scarcity. "Even though further technical development appears worthwhile and should take further technical development appears worthwhile and should take us a long way," he continues, "it would be visionary to expect a 100 percent substitution to solve all scarcity problems. One can foresee at its best exorbitantly high cost, and, for technical reasons, a significant short fall of the '100 percent' goal."[21]

The extent of substitution maybe limited by performance standards, relative costs, and the supply of substitutes, Substitution could be increased by the imposition of high tariffs, resulting in increased prices and reduced demand for the material involved, but such higher tariffs are not likely. Substitution of one scarce material for another would obviously change the problem but not solve it, Where alterations in processing methods and investment in new equipment are involved, substitu -

[21]Henniker Report.

tion is a more feasible solution for long-term supply problems than those of likely short duration. For example, the shortage of certain raw materials during World War II and the Korean war led to rather extensive substitution in the component elements of alloy steel and tool steel making. A major change occurred in the use of molybdenum in lieu of less plentiful materials, such as tungsten and vanadium,

The Office of Technology Assessment currently has underway a study on substitution.

3. Export Controls

On the foreign side, Government-imposed export controls or voluntary industry actions reducing exports would shift supplies to domestic consumers. These export limitations could apply directly to materials, or they could achieve much the same result by being applied to the products made from those materials. Except under wartime conditions or under extraordinary peacetime conditions, the imposition of Government export controls is-unlikely. Over the past 10 years, such controls have been virtually limited to serious short-supply conditions in nickel, copper, ferrous scrap, and petroleum products. In 1974, for example, the United States discontinued the export controls it had imposed in July 1973 on ferrous scrap. This program was instituted as a result of the rising price of ferrous scrap associated with a surge in U.S. exports and a domestic short supply. As these conditions changed, the United States acted quickly, in consultation with its foreign trading partners and domestic suppliers and users of scrap, to terminate export controls.

E. SUMMARY OF ALTERNATIVES AND IMPACTED SECTOR GROUPS

1. Alternatives to Economic Stockpiling Policies

The following matrix (table VII-I) identifies alternatives which could principally apply to each of the five stockpiling policies studied in depth. The greatest number of alternatives—12 of the IA-offer possibilities in overcoming the problems of import disruption/price actions by cartels. Not all the alternatives shown for any single stockpiling policy would be required to achieve the purpose of that policy, nor are they all of equal value. A judicious choice of alternatives, based on a quantitative cost/benefit analysis of their advantages and disadvantages, is needed and could be performed by an agency responsible for economic stockpiling. Such an analysis of alternatives was beyond the scope of this assessment.

2. Sectors Impacted by Alternatives to Economic Stockpiling

Table VII–2 identifies the various sectors in the economy which are principally impacted by the three sets of alternatives discussed in this assessment. The identification of the sectors is derived in large part from the Relevance Trees.

Table VII–l—Alternatives to economic stockpiling policies

ALTERNATIVES	SP 1—Discourage or Counteract Cartel or Unilateral Political Actions Affecting Price or Supply	SP 2—Cushion the Impact of Non-political Import Disruptions	SP 3—Assist in International Materials Market Stabilization	SP 4—Conserve Scarce Domestic Materials by Reducing Current Consumption	SP 5—Provide a Market for Temporary Surplus and Ease Temporary Shortages
Direct Subsidy	x*	. . .	. . .	x	
Tax Incentives for Capital Investment & Production	x*	. . .	. . .	x	
Research & Development	x *	. . .	. . .	x	
Loans and Investment Guarantees	x *	. . .	x		
Tariff Concessions	x*				
Recycling	x*				
Production from Public Lands	x *				
Tax Incentives for Inventory Maintenance	x	x	x	. . .	x
Extended Futures Markets	x	x			
Standby Capacity	x	x	. . .	. . .	x
International Commodity Agreements	x	. . .	x	. . .	x
Conservation	x*				
Substitution	x .	x			
Export Controls	x	x			

● These are long-term alternatives which are not effective in the short run, but which may be effective in the long run.

Table VII–2.—Sectors impacted by alternatives to economic stockpiling

Sectors	Sets of alternatives		
	Increase supply	Stabilize supply and price	Redirect distribution
Government	x	x	x
Consumers	x	x	x
Producers—primary materials	x	x	x
Processors—primary materials	x	x	x
Processors—secondary materials	x	x	x
Scrap collectors	x	x	. . .
University labs	x	. . .	x
Research labs	x	. . .	x
Private R&D groups	x	. . .	x
Resource investors	x	. . .	. . .
Traders	. . .	x	. . .
Importers	. . .	x	. . .
Exporters	. . .	x	. . .

Chapter VIII

LEGISLATIVE CONSIDERATIONs REGARDING ECONOMIC STOCKPILING

Chapter VIII

LEGISLATIVE CONSIDERATIONS REGARDING ECONOMIC STOCKPILING

There are two general courses of action open to the United States in dealing with current or anticipated materials problems. On the one hand, the United States could allow the existing market system to continue solving these problems and hope that future dislocations will not further exacerbate the situation. On the other hand, the United States could implement some national policy in an attempt to overcome the current problems and avert similar problems in the future. If the latter course of action is chosen, two options are available: (1) to establish an economic stockpile as a means of achieving whatever policy objective(s) are deemed most beneficial; or (z) to implement (either separately or in conjunction with a stockpile) some alternative means other than stockpiling to achieve the policy objective(s).

Although the emphasis of this assessment has clearly been directed toward an analysis of economic stockpiling, it is important in the development of legislation to present the full range of options available for congressional consideration, Accordingly, this chapter includes the following sections:

- Options for considering economic stockpile legislation,
- Institutional considerations for establishing an economic stockpile, and
- Major public policy issues related to establishing an economic stockpile.

A. OPTIONS FOR CONSIDERING ECONOMIC STOCKPILE LEGISLATION

There are a number of options for Congress and the President to consider in determining whether or not establishing a national economic stockpile, or participating in an international economic stockpile, would be in the best public interest. This section is a presentation of four such options.

1. Evolution of Current Public and Private Systems Without Enacting New Legislation

The first option is for Congress and the President to forgo establishing an economic stockpile, letting the current market system, with its existing support mechanisms, attempt to prevent or correct the damaging impacts of supply disruptions and price increases, An essential consideration related to this option is whether or not the existing market system has the power and the flexibility, either to discourage such supply disruptions as those caused by the Organization of Petroleum Exporting Countries (OPEC) or counteract such disruptions after they occur. A further consideration is whether or not the market system will discourage or counteract supply disruptions in a manner beneficial to the public welfare, as opposed to the private welfare of individual industries or sectors either involved in or impacted by the supply disruptions.

It is especially important to understand the extent to which economic stockpiling is interrelated with the existing U.S. market system as well as U.S. foreign policy, particularly as the needs of the industrial nations are influenced by the growing demands of the less developed nations, In that sense, the decision as to whether or not the current public and private systems can be expected to deal effectively with materials problems becomes the starting point for further analysis,

2. Congressional Options Without Enacting New Legislation

The second option is for Congress to act without drafting new legislation, It could initiate such action in three ways:

a. To Provide Information Regarding Economic Stockpiling Within the Legislative Branch--Congress, through its various offices and agencies, can either initiate new action, or strengthen action already begun, in order to analyze and disseminate data and information throughout the legislative branch. Such data and information might concern the potential for future supply shortages, the expected damage of such shortages, and the estimated benefits and costs of economic stockpiling to avert or counteract such shortages. The major agencies which could be involved in this information transfer are the Congressional Budget Office, the Congressional Research Service, the General Accounting Office, and the Office of Technology Assessment.

b. To Provide Information Regarding Economic Stockpiling Within the Executive Branch.—Congress also has the option of disseminating data and information regarding economic stockpiling to the executive branch. Such action can be initiated through hearings, the use of oversight and investigative powers, as well as joint resolutions. It should be emphasized that while such actions may be faster and easier to initiate than drafting legislation, they neither bind the President legally nor guarantee that he will take executive action.

c. To Provide Information Regarding Economic Stockpiling Within the Private Sector.—Not only can congressional Members issue policy statements, hold investigations, and exercise oversight functions in areas related to materials, but Congress as a whole can encourage the various Government agencies to increase and improve their working relationships with private sectors which have interests in the materials field. While such action may enhance the market system's capability to deal effectively with supply disruptions and price increases after they occur, it will in no way guarantee that such problems will not recur.

3. Executive Options Without Enacting New Legislation

The third option is for the President to take executive action without proposing new legislation. Such action could be accomplished in several ways: (a) issue a Presidential proclamation to set overall policy direction, (b) issue an Executive or agency order, and (c) make research and development grants available for analysis of materials problems. While it is certain that a combination of these Presidential actions will improve the executive branch's capabilities to understand and deal with materials problems, it is not equally certain that such actions will provide the necessary impetus for Congress and the private sectors to do so.

4. Options Through Enacting New Legislation

The fourth option in the consideration of economic stockpiling presumes that the first three options will not be sufficiently effective in dealing with current or anticipated materials supply problems and price increases. New authorizing legislation based upon a complete assessment of the impacts of an economic stockpile will clearly be more comprehensive and possibly more effective in combating materials problems-especially if such legislation is a deliberated component of a more comprehensive national materials strategy.

The following discussion centers first on the legal authority for economic stockpiling, then examines the possible components of an economic stockpile program and their relationship to past and current legislation.

a. Authority for Economic Stockpiling.—Authority for economic stockpiling, as for other Federal actions, must be found in the Constitution. Several specific clauses of the Constitution, such as the General Welfare Clause, the Property Clause, the Spending Clause, and the Commerce Clause, coupled with the Necessary and Proper Clause, establish a broad foundation for the exercise of legislative power in achieving national objectives which can be seen as being in the broad public interest.

b. Economic Stockpiling: Its Components and Relationship to Existing Legislation.—The establishment of an economic stockpiling program would impact a wide range of policies embodied in current legislation, and such stockpile legislation should attempt to identify, accommodate, and harmonize these policies. In this section, 10 components of an economic stockpiling program are outlined and analyzed in light of existing legislation.

Each of these components has an analog in previously enacted legislation; and the recently enacted Energy Policy and Conservation Act of 1975 pulls them all together for oil and gas (For a detailed discussion of the act, see ch. I, sec. A (3).) Prior to this act, the closest analogs were the programs under the Defense Production Act of 1950 and those administered by the Federal Energy Administration (FEA) under the Federal Energy Administration Act of 1974, the Emergency Petroleum Allocation Act of 1975, and the Energy Supply and Environmental Coordination Act of 1974. The FEA's authorities are generally of limited duration, generally around 2 years. This no doubt reflects a concern that governmental intrusion into the marketplace should be limited to the minimum time necessary to deal with the problem at hand.

The same concern would exist with respect to an economic stockpiling program, but it would have to be dealt with differently, since the nature of such a program precludes its being time limited on a short- or medium-term basis. Such a program would require some institutional mechanisms for insuring at least a minimal amount of monitoring and a minimal level of readiness to respond to disruptions, Furthermore, the program should have well-defined and carefully circumscribed "trigger points" for invoking standby emergency authorities, much as the Selective Service System maintained manpower mobilization capability on a standby basis.

The 10 components which should be included in both active and standby stockpiling authorizations are as follows:

(1) Definition and distribution of authority.—Implementation of an economic stockpiling program will both subserve and impact upon a wide range of national interests. These include national defense, foreign policy, conservation of domestic resources, environmental quality, full employment, reduction of the need for governmental intervention, and maintenance of an open and strong U.S. economy.

To the maximum extent possible, these policies should be explicitly identified and integrated into a legislative statement of findings and purposes in order to provide guidance to those entrusted with implementing the stockpiling program. They should also be reflected in the list of delegated functions and authorities. Although the delegated authority must be broad enough to encompass all activities necessary for successful implementation of a stockpiling program, it should be accomplished by specific designation of the scope and distribution of component functions, such as authority to buy, store, process, sell, allocate, contract, limit exports, issue rules, regulations and orders, etc., together with delineation of procedures and guidelines for coordinating these functions among themselves and with respect to broader national policies. Particular care must be taken to coordinate the strategic and economic stockpiling policies. In addition, specific standards and criteria should be established to control the exercise of specific functions, Such specificity not only avoids constitutional difficulties related to excessive delegation of legislative authority, it also minimizes future administrative and mitigative conflicts. The danger of such conflicts is particularly acute when functions are distributed to more than one agency.

Assuming sufficiently explicit statements of standards and criteria, the choice of a vehicle becomes of lesser importance, However, multiple choices of a vehicle exist, including the President, with power of delegation and redelegation; a department or agency; a Government corporation; a quasi-Government corporation, or a combination of these. Discussion of these choices is included in chapter VI,

The most detailed exposition of materials policy at the present is contained in the Mining and Minerals Policy Act of 1970, 30 U.S.C. 21a, which covers only mineral materials. The National Materials Policy Act of 1970, 42 U.S.C. 325 (note), covers all materials but is much less detailed. Both acts emphasize the environmental consequences of materials policies but do not provide specific guidelines for resolving conflicts between materials development and conservation policies and the environmental policies embodied in such statutes as the National Environmental Policy Act of 1969, 42 U.S.C. 4321-4347; the Federal Water Pollution Control Act, 33 U,S.C. 1251-1376; the Clean Air Act, 42 U.S.C. 1857-1857; and the Endangered Species Act of 1973, 16 U.S.C. 1531-1543.

The need to consider the impact of materials policy on other national policies is recognized in such statutes as (1) the Comprehensive Employment and Training Act of 1973, 29 U.S.C. 801-992, which directs the Secretary of Labor to make a study of the impact of energy shortages, including fuel rationing, upon manpower needs; (2) the Federal Energy Administration Act of 1974, 15 U.S. C. 761-786, which requires the Administrator to provide the Cost of Living Council at least 5 days to approve or disapprove any proposed rule, regulation, or policy relating to the cost or price of energy before promulgating the same, and- to afford the Administrator of the Environmental Protection Agency at least 5 days to provide written comments on any proposed rule, regulation, or policy which will affect the quality of the environment; and (3) the Energy Supply and Environmental Coordination Act of 1974, 15 U.S. C, 791–798, which relaxes certain air-quality standards for plants required to convert to coal as a major fuel source and authorizes priority allocation of low sulfur coal to areas most needing the same for environmental reasons,

(2) Acquisition of information.—There are several precedents for required reporting of information needed to implement materials oversight and management programs. Section 705 of the Defense Production Act of 1950, 50 U.S.C. App. 2061–2169, contains provisions relating to mandatory recordkeeping, reports, confidentiality of records, and related matters. The most comprehensive reporting requirements are those related to energy information contained in the Federal Energy Administration Act of 1974 and the Energy Supply and Environmental Coordination Act of 1974, supra. These acts require the Administrator to collect, assemble, evaluate, and analyze energy information of sufficient comprehensiveness and particularity to permit fully informed monitoring and policy guidance with respect to the exercise of his functions and to assure the Federal and State governments and the public access to reliable energy information. They require any person engaged in any phase of energy supply or major energy consumption—including the production, processing, refining, transportation by pipeline, or distribution (at other than the retail level) of energy resources—to submit reports and writ-

ten answers to interrogatories and other requests for reports or other information, including all information in whatever form on fuel reserves, exploration, extraction, and energy resources (including petrochemical feed stocks); projections as to source, time, and methodology of development; production, distribution, and consumption of energy and fuels; and corporate structure proprietary relationships, costs, prices, capital investments, assets, and other matters directly related to energy and fuels. The acts grant the Administrator subpoena powers enforceable by the Federal courts under their contempt power; give him authority to make onsite physical inspections, inventories, and sampling and to examine, copy, and question; and make violation of any rule, order, or regulation requiring such information an offense punishable by law.

The Federal Energy Administration Act further provides the Comptroller General with access to all information in the possession or control of the Administrator, together with independent authority to require disclosure of similar information on his own. Information acquired by either the Comptroller General or the Administrator is available to other Federal agencies and to Congress. These provisions for exchange or release of information should be compared with those of the Federal Reports Act, 44 U.S.C. 3501–3512, Access of the public to such information will be discussed below under subsection 10, Public Access and Participation.

(3) Stockpile management.—The mechanics of stockpiling per se can be modeled on the provisions of the Helium Act of 1925, 50 U.S.C. 167–167n; the Strategic and Critical Materials Stockpiling Act, 50 U.S.C. 98 to 98h; and the Defense Production Act of 1950, supra.

(9) Control of domestic distribution.-If a material is in very short supply, stockpile operations will have to be coordinated with a mandatory allocation program for nongovernmental as well as governmental supplies of the material to assure its availability for priority uses such as national defense and to avoid severe dislocations in the economy or any particular sector thereof, Precedent for such allocation authority can be found in the Defense Production Act of 1950, the Emergency Petroleum Allocation Act of 1973, and the Energy Supply and Environmental Coordination Act of 1974, supra, A possible obstacle to domestic control is the Connolly Hot Oil Act of 1935, 15 U.S.C. 715–15m, which gives Federal protection to State regulation of production. As materials controls become more extensive, there is a danger that certain aspects of such controls may be construed as takings of private property for which compensation would have to be paid under the Constitution,

(5) Control of exports.—The need to limit or prohibit the exportation of materials in severely short supply in the domestic economy is recognized in the Export Administration Act of 1969, 50 U.S. C. App. 2401-2413, which declares that it is the policy of the United States to use export controls to protect the domestic economy from the excessive drain of scarce materials, to reduce the serious inflationary impact of foreign demand, to achieve foreign policy and national security purposes, and to secure the removal by foreign countries of restrictions on access to supplies where such restrictions have or may have serious inflationary impact, cause severe domestic shortage, or were imposed to influence U.S. foreign policy. The act authorizes Presidential actions, including, but not limited to, imposition of license fees to implement these policies, See subsection(T), International Trade, for additional information.

(6) Control of imports; access to foreign supplies.—It maybe desirable either to restrict imports to encourage domestic production or to adopt a policy of purchasing stockpile inventories from foreign sources to preserve domestic supplies, Either approach has foreign policy implications. The basic authority for the imposition of tariffs or duties is contained in the Tariff Act of 1930, 19 U.S.C, 1202–1654,

77-119 0-76-14

while trade agreements and foreign assistance are authorized by the Trade Expansion Act of 1962, 19 U.S. C. 1801–1991; the Foreign Assistance Act of 1961, 22 U.S.C. 2151–2434; and the Trade Act of 1974, 19 U.S.C. 2101–2487.

The Trade Expansion Act and the Trade Act authorize the President to suspend, withdraw, or prevent the application of benefits of trade agreement concessions to a foreign country which engages in discriminatory or other acts (including tolerance of international cartels) or policies unjustifiably restricting U.S. commerce; and to increase or impose duties, impose quantitative import quotas, or provide financial assistance to firms or workers when an article is being imported in such increased quantities as to be a substantial cause of serious injury, or the threat thereof, to the domestic industry.

The Foreign Assistance Act restricts the stockpiling of defense materials for foreign nations and authorizes the President, when he determines it is in the national interest, to furnish assistance under the act, or to furnish defense articles or services under the Foreign Military Sales Act, pursuant to an agreement with the recipient which provides that the recipient may obtain such assistance, articles, or services only in exchange for any raw natural substance controlled by such recipient which is in short supply in the United States, The President may allocate any such material when received to any appropriate Federal agency for stockpiling, sale, transfer, disposal, or any other purpose authorized by law,

The Agricultural Trade Development and Assistance Act of 1954, 7 U.S.C. 1961–1976, particularly authorizes the exchange of surplus federally owned agricultural commodities for strategic and other materials which can be transferred to a supplemental stockpile of strategic and critical materials. Although the Antidumping Act of 1921, 19 U.S.C. 160-173, and the Buy American Act of 1933, 41 U.S.C. 10a-10d, express a policy of protecting domestic producers from below-market-price foreign goods and requiring purchase of domestic goods for public use, respectively, neither of them should be a barrier to purchase of foreign materials at the lowest possible price for a domestic stockpile, One statute which may hinder import controls on critical materials, however, is the Strategic and Critical Materials Stockpiling Act, supra, which prohibits the President from prohibiting or regulating importation into the United States of any strategic and critical materials from non-Communist-dominated countries as long as importation from Communist-dominated countries is not prohibited by any provision of law,

(7) International trade.—Temporary control of imports or exports to prevent or relieve critical shortages in the domestic economy is recognized as a valid measure under international law by the General Agreement on Tariffs and Trade (GATT), although in the recently enacted Trade Act of 1974, supra, Congress has directed that discussions on GATT and other foreign policy discussions emphasize much more strongly both the principle of access to supplies and the use of temporary measures to ease adjustment to disruptions in the domestic market as principal negotiating objectives of the United States, Imposition of certain controls may be viewed by foreign nations as grounds for retaliatory action.

(8) Domestic economic impact.—The concern with maintaining an open and strong domestic economy is reflected in such past and present statutes as the Economic Stabilization Act of 1970, 12 U.S.C, 1904 note, and the act of December 30, 1947, 50 U,S.C, App. 1911–1919, More particular policies are embodied in the Small Business Act, 15 U.S.C, 631-647, and the Antitrust Acts, 15 U.S,C, 1–33. Protection of small-business interests, maintenance of free competition, and stabilization of the economy through allocation of scarce supplies are primary components of the policies, functions, and procedures established by the Emergency Petroleum Allocation Act of 1973 and the Federal Energy Administration Act of 1974, supra. The FEA Administrator is required, to the greatest extent practicable, to evaluate and

consider the potential economic impact of proposed actions, making such analyses explicit whenever possible and consulting with other Federal, State, and local agencies to the extent possible. The mandatory petroleum allocation regulation is subject to required review by the Justice Department and the Federal Trade Commission for antitrust impacts, and a carefully limited exemption from the antitrust laws is provided for activities required under the FEA statutes. A similar exemption appears in the Defense Production Act of 1950, supra.

(9) Fiscal incentives.—Taxes, loans, contracts, and other fiscal matters affect and are affected by materials programs. The act of August 21, 1958, 30 U.S.C. 641-646, provides for a program of participating financial assistance toward exploration by private industry to establish additional domestic mineral reserves, excluding organic fuels. Loans and loan guarantees under the Export-Import Bank Act, 12 U.S.C. 635 et seq., and the Defense Production Act of 1950, supra, can be used to finance expanded materials production abroad. The latter act has been used to support a considerable expansion of domestic capacity through loans, loan guarantees, and Government guarantees to purchase surplus produced materials at attractive prices. The income tax laws, title 26 of the U.S. Code, provide depletion allowances for the production of almost all minerals as well as various investment credits, depreciation provisions, and exploration and development expenditure deductions. The Tax Reduction Act of 1975, 89 Stat. 26, repealed the oil and gas depletion allowance for major oil producers, provides for a gradual reduction of the allowance for independent producers, and reduces or eliminates several tax breaks tied to foreign operations. This change in tax breaks makes foreign production now somewhat less attractive to U.S. and multinational firms.

(10) Public access and participation.—Various statutes provide generally for citizen access to information concerning and participation in Federal planning and program implementation. The Administrative Procedure Act, subchapter II of chapter 5 of title 5 of the U.S. Code, provides for public participation in rulemaking and hearings. Section 552 of the act, popularly known as the Freedom of Information (FOIA), provides for access to information in the possession of Federal agencies, with certain exemptions for confidential information, internal predecision documents, and the like. The Federal Advisory Committee Act, 5 U.S.C. App. 1-15, provides for general public access to the meetings and records of agency advisory committees and requires that such committees be fairly balanced in terms of points of view represented and functions to be performed. The policies embodied in these acts have been strongly emphasized in recent acts such as the Federal Energy Administration Act of 1974 and the Energy Supply and Environmental Coordination Act of 1974, supra, which have incorporated their requirements and added even further provisions to insure public access and participation, These acts adopt the usual exclusions of trade secrets and other confidential information, as specified in the FOIA and 18 U.S.C. 1905, which makes it a crime to disclose such information except as authorized by law.

The National Environmental Policy Act of 1969, 42 U.S.C. 4321-4347, enhances citizen input on environmental matters by requiring the preparation and circulation of a detailed environment impact statement for any major action significantly affecting the quality of the human environment. This requirement does not apply when time will not permit. It was held, for example, not to apply to the FEA's required promulgation of emergency petroleum allocation regulations within 15 days of enactment of the Emergency Petroleum Allocation Act of 1973, supra.[1] And certain statutes have relaxed the requirements, although they have not eliminated them completely, where they

[1] *Gulf Oil* Corp. v, Simon, 373 F. Supp. 1102 (DDC 1974).

would unduly delay economic and resource adjustment programs.[2]

Finally, it may be desirable to provide special procedures for judicial review of administrative decisions under an economic stockpiling program in order to minimize mitigative disruption, while maintaining a forum for valid challenges and efforts at clarification. An example can be found in the judicial review procedures under the Federal Energy Administration Act of 1974, supra, which requires petitions for review of FEA actions to be filed within 30 days in certain designated courts.

c. Conclusions Regarding Legal Impacts.—Implementation of each of the stockpiling policies will require consideration of the 10 listed components, although for each separate policy the relative importance of the different components will vary. For example, the standby authorities, such as the authority to allocate supplies and to prohibit the import or export of certain materials, may be critical to the success of SP–1 (Discourage or Counteract Cartel or Unilateral Political Actions Affecting Price or Supply), but it may be completely unnecessary for SP–5 (Provide a Market for Temporary Surpluses and Ease Temporary Shortages),

B. INSTITUTIONAL CONSIDERATIONS FOR ESTABLISHING AN ECONOMIC STOCKPILE

It is not the objective of this assessment to develop economic stockpiling policy for the United States, but rather to assess the impacts of alternative options for Congress to consider in implementing such policy. However, it is pertinent to suggest here alternative decision-making and reporting mechanisms for the Congress to consider in formulating such policy.

As presented in chapter I, the history of the strategic stockpile and the defense production inventory has been one of diverse pressures imposed from several directions—the executive branch, the legislative branch, the producing industries, and the consuming industries. The success of an economic stockpiling program will therefore depend in large part upon the type of organization established to administer it, especially its ability to operate independently in the national interest, free of influence by special-interest groups, whether inside or outside the Government,

1. Management Considerations

Implicit in the consideration of alternative institutional arrangements for establishing an economic stockpile are several questions. Among these are: (1) What powers and authority would an economic stockpile be granted? (2) How would it operate? (3) How would it be structured? and (4) Where would it be located? Because the U.S. operation of (or participation in) an economic stockpile can be expected to generate much interest, both nationally and internationally, the answers to these questions are fundamental to its success. For a detailed discussion of the management considerations pertinent to establishing an economic stockpile, see chapter VI.

2. Institutional Arrangements

Six general institutional arrangements which should be considered in the development and establishment of an economic stockpile have been identified. The arrangements are listed below and discussed immediately following:

- A unilateral economic stockpile con-

[2] See the Energy Supply and Environmental Coordination Act of 1974, *supra*.

trolled and operated by the U.S. Government,

- A unilateral economic stockpile controlled by the U.S. Government, but operated by U.S. industry,
- A unilateral economic stockpile controlled and operated by a public-private corporation,
- United States participation in a multinational or international economic stockpile,
- United States participation in an economic stockpile operated by producer/consumer councils,
- A unilateral economic stockpile controlled and operated by the U.S. Government, but in accordance with international guidelines.

It is assumed that, regardless of the overall institutional arrangement selected for implementation, the stockpile agency will possess three capabilities: (a) the expertise to set policy and manage both program and congressional relations, (b) computer analysis and computer resources, and (c) the materials expertise responsible for day-to-day operations such as acquisition, disposal, and storage. In addition, the professional and support staff in each of the Government agencies with responsibilities related to or affected by the economic stockpile program could be used. The experience of the Strategic Stockpile program in the above activities under the Office of Emergency Preparedness (OEP) is enlightening and is drawn upon in the analysis presented in chapter VI.

a. Arrangement **1**: Economic Stockpile Controlled and Operated by the U.S. Government.— Both the legislative analysis in chapter I and the institutional analysis in chapter VI present considerations which are relevant to the establishment and operation of a unilateral U.S. economic stockpile. Such a stockpile might be established as another component of the present strategic stockpile, or it could be established as an independent stockpile whose operations are carefully coordinated with those of the strategic stockpile. Regardless of which action may be taken, the option of establishing an economic stockpile which is controlled and operated by the Federal Government might be the quickest of the six general arrangements to implement. And given the fact that economic stockpiling is at best a temporary solution to short-term problems, such an advantage is quite important.

b. Arrangement 2: Economic Stockpile Controlled by the U.S. Government, but Operated by U.S. Industry.—The advantage of this arrangement would be twofold: first, it would forgo some of the acquisition and initialization costs required for the Federal Government to establish and operate its own economic stockpile; and second, it would strengthen the working relations between the Federal Government and U.S. industry, thereby demonstrating that an economic stockpile is intended to be an adjunct to, not a replacement of, normal industry operations, A disadvantage of such a policy might be that it would take too much time to implement and that its operations might give preference to the interests of powerful industry groups in lieu of the public welfare.

c. Arrangement 3: Establish Unilateral Economic Stockpile Controlled and Operated by a Public-Private Corporation.—Such a corporation would be funded by the Federal Government, vested by Congress with a mandate and guidelines on U.S. stockpile purposes, and given independent authority to acquire and maintain national stockpiles without direct control but with provisions for Executive consultation.

Since annual appropriations for operating expenses and the stockpile corporation requests for any needed additions of the revolving capital fund would be reviewed only once a year by the President and Congress, the corporation would be able to maintain a certain degree of political independence (comparable to the Federal Reserve System on monetary matters).

d. Arrangement 4: U.S. Participation in Multinational or International Economic Stockpile .—This is the first of two collective arrangements which might provide benefits to the United States. An economic stockpile operated by two or more nations, either multinational or international in nature, could be formed along such existing political or organizational lines as the Organization of American States (OAS), the European Economic Community (Common Market), the United Nations, or just with friendly nations having materials requirements similar to those of the United States. At present the United States is conducting several discussions/negotiations which do consider this arrangement: the UNCTAD discussions within the United Nations, and the International Energy Agency. The cost of establishing and maintaining such a collective stockpile would be spread among the participants and would thus be less for any one government. The stockpile would not take as much material out of use as would separate national economic stockpiles which might further exacerbate the spiraling world shortage. The stockpile might have less effect upon specific materials prices. than separate unilateral actions. And, finally, the participating nations would have to work closely together in order to make the stockpile work successfully, The greatest disadvantage would be the possible loss of control and sovereignty over the U.S. resources and actions.

e. Arrangement 5: U.S. Participation in Producer/Consumer Council Economic Stockpile.—Another form of collective stockpiling could be achieved by the creation or expansion of producer/consumer councils like the International Tin Council which is run by both producers and consumers and maintains its buffer stock to help stabilize the supply and price of tin. The benefits and costs of arrangement 5 are the same as for arrangement 4, but in addition to these there is another important benefit: an economic stockpile operated by a producer/consumer council attacks the basic cause of the materials availability problem and thereby could provide a long-term solution to specific materials problems by developing policies which are acceptable to producers and consumers, exporters and importers, developed countries and lesser developed countries. In this sense, option 5 requires even stronger cooperation among international participants than option 4. Also like option 4, though, such agreements could take a considerable amount of time to implement,

f. Arrangement 6: Economic Stockpile Controlled by U.S. Government, but Operated According to International Guidelines.— This arrangement could combine the advantages of arrangements 1, 2, and 4. As with option 1, the only time constraints in implementing this sixth option would be those required to create the legislation and acquire the optimal quantity of materials. Moreover, certain elements of options 2 and 4 could be introduced by specifically defining the use of the economic stockpile in the form of an "international code of operations for economic stockpiles. " This code could be introduced as the announced policy of the United States and expanded on an international basis as needed. Option 6 would recognize the fact that some national economic stockpiles are being created, but that some countries like Germany have not implemented them because of serious concern regarding their impact on domestic and world market systems. An international code of operations might help reduce this concern, as well as develop effective mechanisms for alleviating U.S. supply problems without increasing the world shortage.

C. PUBLIC POLICY ISSUES RELATED TO ESTABLISHING AN ECONOMIC STOCKPILE

Whatever position regarding economic stockpiling is taken by Congress and the President, the detailed consideration necessary to develop that position will highlight a number of important and interrelated public policy issues which merit careful attention. Not only will the implementation of a national economic stockpiling policy involve significantly large amounts of public money, the impacts of such a policy will be unevenly distributed throughout the U.S. economy. While the existing market system will in most cases be able to deal effectively with materials problems, it is simply unable to compensate for supply disruptions and price increases which could be imposed by an international political organization like OPEC.

Based on the overall impacts analysis, the public policy issues summarized below suggest both the diversity and the intensity of conflict which could be aroused and which would have to be resolved if an economic stockpile were implemented as part of a national materials strategy,

(1) Should an economic stockpile be implemented in concert or in conflict with other United States materials policies? For example, how should the planning of an economic stockpile be coordinated with the International Tin Council, which the United States has just joined, or with the long-term grain agreements with the U. S. S. R., or with the discussions now underway with the lesser developing nations regarding materials supply and prices?

(z) What agreements with other industrialized, as well as less developing, nations will be required in order for an economic stockpile to provide the greatest benefit to U.S, citizens?

(3) How can an economic stockpile be designed and operated so that it will not be misused for financial advantage by special-interest groups? How can it be sufficiently insulated from the political process to obviate its misuse, yet insure that it will achieve the public benefits for which it was established?

(4) What measures can be taken to insure that an economic stockpile will not be used to accomplish public policy objectives other than those for which it was established? For example, a stockpile established to deter cartels should not be used to stop domestic labor strikes or to control domestic prices.

(5) Under what conditions, and to what degree, is it justifiable for the Federal Government to intervene in the market place in the form of an economic stockpile? Should such intervention be used to require that industry disclose private, proprietary information to the Federal stockpile managers? And if so, what assurances will be taken to protect the privacy of such information?

(6) What is the real potential for future supply disruptions and price increases? What is the expected impact (i.e., benefits and costs) of such economic dislocations upon the U.S. economy in general and sectors of U.S. society in particular? What is the cost of insuring against such dislocations? For example, will the acquisition of large amounts of materials like petroleum or chromium compensate for such shortages, or will it stimulate the already spiraling inflationary rate? Second, are the expected benefits of an economic stockpile sufficiently greater than the cost to warrant the expenditure of large amounts of public money and if so, how will this money be obtained?

(7) What measures will be taken to ensure public participation in the planning of an economic stockpile? Is such involvement necessary? Further, if the public is involved, what measures will be taken to maintain the

confidentiality of U.S. strategic economic information?

(8) What is the long-term outlook for growth in the United States? For example, will the United States maintain, increase, or decrease its present consumption patterns? How will future supply disruptions affect these consumption patterns, and vice versa? How will they affect the environment?

Chapter IX

GLOSSARY

Chapter IX

GLOSSARY

A. ORGANIZATIONS AND TERMS-ABBREVIATIONS

AEC	Atomic Energy Commission
ANMB	Army-Navy Munitions Board
BDSA	Business and Defense Services Administration (Department of Commerce)
BEA	Bureau of Economic Analysis (Department of Commerce)
CIEP	Council on International Economic Policy
CIPEC	Council Intergovernmental des Payes Exportateurs de Cuivre (Inter-Governmental Council of Copper Exporting Countries)
CSP	Candidate Stockpile Policy
DMA	Defense Materials Administration (Department of the Interior)
DMO	Defense Mobilization Orders
DMPA	Defense Materials Procurement Agency (General Services Administration)
DMS	Defense Materials System
DOD	Department of Defense
DPA	Defense Production Act
EEC	European Economic Community
EPA	Environmental Protection Agency
ERDA	Energy Research and Development Agency
FEA	Federal Energy Administration
GATT	General Agreement on Tariffs and Trade
GSA	General Services Administration
IBA	International Bauxite Association
ICC	Interstate Commerce Commission
ICSID -	International Convention on the Settlement of Investment Disputes
IMAC -	Interdepartmental Materials Advisory Committee
ITC -	International Tin Council
JCS -	Joint Chiefs of Staff
LDC -	Less-Developed Countries
MB -	Munitions Board
MNC -	Multinational Companies
NCMP -	National Commission of Materials Policy
NRPB -	National Resources Planning Board
NSRB -	National Securities Resources Board
OCDM -	Office of Civil and Defense Mobilization
ODM -	Office of Defense Mobilization
OEM -	Office of Emergency Management
OEP -	Office of Emergency Planning (September 22, 1961-October 21, 1968)
OEP -	Office of Emergency Preparedness (October 21, 1968–July 1, 1973)
OP -	Office of Preparedness (General Services Administration)
OPEC -	Organization of Petroleum Exporting Countries
OPIC -	Overseas Private Investment Corporation

OTA - Office of Technology Assessment

PAW - Petroleum Administration for War (Department of the Interior)

RFC - Reconstruction Finance Corporation

RFF - Resources for the Future

WPB - War Production Board

B. DEFINITIONS

Stockpiling Policy—An economic stockpiling policy which has as its purpose the solution of a specific materials-related problem. Eleven such policies are covered by this assessment,

Consumer Surplus—The difference between consumers' willingness to pay for a good or service and its market price,

Decision Criteria Model—Formulations which can be used to determine optimal stockpile acquisition and release, These formulations include cost functions, benefit functions, and net benefit determinations,

Economic Stockpile—A stockpile of materials acquired, held, and released as required to achieve an economic objective, such as supply assurance or price stabilization, which the market would not otherwise accomplish.

External Costs--Costs incurred by the economy (society) which are not borne by the direct consumers of the specific materials under consideration.

Impacts and Issues—The economic, social, political, environmental, legal, and other effects of economic stockpiling under various assumed scenarios.

Landscape of Scenarios—The landscape is a set of scenarios, designed around assumptions which illustrate a range of specified trends.

Materials—For the purposes of this assessment, "materials" means "natural resources intended to be utilized by industry for the production of goods, excluding foods. "

Materials Selection Criteria—Standards established for each candidate stockpile policy to determine which materials should be stockpiled to meet its problem-related objectives.

Producer Surplus—Economic rents accruing to factors of production, or the difference between what a factor earns and what it could earn in its next best alternative use,

Relevance Tree—A hierarchical structure in which the entries at each successive level in the aggregate describe completely the next immediate level above. It is a tool for depicting the organization of relationships among groups, interests, or activities related to the rationale proposed for the initiation of stockpiling and for identifying various areas of impact (political, social, economic, legal).

Risk Aversion Factor—A measure of society's reluctance to be exposed to damaging events.

Scenario—A plausible, self-consistent narrative concerning a future time period. Major determinants of change are examined through delineation of past trends and plausible changes in future population levels, technological developments, demand patterns, gross domestic product, public preferences, and government policies,

Technology Assessment—Projection of an existing physical, economic, social, political, etc., environment and related technologies to some future, and assessment of the impacts and related issues, both independently and as part of the total structure, Techniques and methodologies used to accomplish technology assessments include studies of cost/benefit, materials management, information systems, and operations analysis.

Weighting Matrix—A device for presenting in tabular form a series of assumed relationships between impacts on stockpiling and the groups which are affected or the policies which produce impacts. The impacts are identified from the most specific area of impact (domain) provided by relevance trees. The impacts are weighted according to their relationship to particular policies, The most important impacts for one or more stockpiling policies are then weighted according to their importance to particular interest groups. The summation of impacts in this matrix gives the total impact on all interest groups for a particular set of candidate policies within a particular scenario. In this way, sensitivity evaluation can be arrived at quantitatively for each candidate policy, Chapter X

REFERENCES

Chapter X

REFERENCES

A. STOCKPILING

A Deterministic Stockpile—Management Model, by R. H. Kupperman and H. A. Smith. Working Draft: Technical Memorandum TM–111, National Resource Analysis Center. Washington, D. C,, Office of Emergency Preparedness, 1969.

Agricultural Act of 1956 (P.L. 540, 84th Congo).

Agricultural Trade Development and Assistance Act of 1954 (P.L. 480, 83d Cong.).

An Introductory *Model for* Estimating Market Value *of* Stockpiled Commodities, by John K. Borkman. Working Draft: Technical Memorandum TM-119, National Resource Analysis Center. Washington, D. C., Office of Emergency Preparedness, 1969.

Annual Reports of the Office of Emergency Preparedness and predecessor agencies to the Joint Committee on Defense Production, 1951–1974.

Borrowing Authority, Report of Office of Preparedness, General Services Administration, OP5–annually June 30.

Critical Materials and Commodity Action Analysis, the Interior Department, March 1975.

Defense Materials Inventories, Summary of General Services Administration, March 3, 1975.

Defense Production Act of 1950 (64 Stat. 798, 50 U.S.C. Sec. 2061, et seq.), as amended.

Defense Production Act Progress Report No. 36. A study of supply and distribution of nickel. Report dated December 31, 1956, by the Secretary of Commerce, Joint Committee on Defense Production, 85th Cong., 1st sess., January 8, 1957. Washington, D. C., Government Printing Office.

Draft Report of the Hearings of the National Stockpile and Naval Petroleum Reserves Subcommittee of the Senate Committee on Armed Services (Symington Hearings), 1962-64,

Emergency Economic *Stabilization*—Economics of National Security series, Industrial College of the Armed Forces, Washington, D, C., 1964,

Final Report *of* the Reconstruction Finance Corporation: Secretary of the Treasury–Pursuant to Sec. 6(c), Reorganization Plan Number 1 of 1957, Washington, D, C., GPO, 1959.

Industrial Mobilization *for* War, Volume I, Program and Administration, Civilian Production Administration, 1947.

Inventory *of* Stockpile Material, Office of Stockpile Disposal, GSA, October 31, 1975.

Management *of* Selected Aspects *of* the Strategic and Critical Stockpile, GAO Report to the Congress (B-125067), December 9, 1971.

Numerous past and present reports and working papers of draft legislation of

77-119 0-76-15

congressional committees on stockpile matters. These include the Committees: Armed Services and their subcommittees, interior and Insular Affairs, etc.

OEP's Stockpile Report to the Congress, Semiannual, especially period 1960-74. These include reports of the activities of the General Services Administration, Department of Commerce, State, Defense, Agriculture, and Interior.

Selected Minutes of the Program Advisory Committee to the Director of the Office of Preparedness (and Predecessor Agencies), 1947–73.

Special Stockpile Advisory Committee (The Pettibone Committee), Stockpiling for Defense in the Nuclear Age, A Report to the Director of the Office of Defense Mobilization, January 1958. Washington, D. C., ODM.

Stockpile Objectives of Strategic and Critical Materials Should Be Reconsidered Because of Shortages, GAO Report to the Congress (LCD–74–440), March 11, 1975.

Stockpile Report to the Congress, Semiannual reports issued by the Munitions Board, July 23, 1948, to August 5, 1953. Washington D. C., GPO.

Stockpile Report to the Congress, Semiannual reports issued by the Office of Emergency Preparedness (and predecessor agencies,) July 1953 to June 1975. Washington, D. C., GPO.

Stockpile Report to the Congress, Statistical Supplement (Semiannual January–July, July–December), General Services Administration Office of Preparedness.

Stockpiling for the Future, by F. H. Buttner, Sc.D. Senior Fellow, Battelle Columbus Laboratories. A paper presented August 16, 1974, at the Henniker Conference III. Henniker, New Hampshire.

Stockpiling Strategic Materials, by Glenn H. Snyder. New York, Chandler Publishing Co., 1966.

Strategic and Critical Materials Stockpiling Act of 1946 (60 Stat. 596, 50 U.S.C. Sec. 98).

Strategic Materials: More Vulnerable Bottlenecks Ahead? by Simon D. Strauss, ASARCO, paper delivered at National Security Affairs Conference, July 8–10, 1974.

Summary of Disposals, Defense Materials (DM–80), March 31, 1975, General Services Administration.

The Compensation Criterion for Stockpile Disposal, by Henry M. Peskin. Technical Memorandum TM-112, National Resource Analysis Center. Washington, D. C., Office of Emergency Preparedness, 1969.

The history and policy and other papers of the War Production Board, the Defense Production Administration, the National Production Authority, and other agencies as appropriate, from the National Archives.

The Stockpile Problem. American Mining Congress, June 1973.

War and Defense Economics, by Backman, Basch, Fabricant, Gainsbrugh, and Stein. New York, N. Y.: Rinehart & Co.

B. MATERIALS ASSESSMENT

"A Study of Ferrous Scrap Futures," U.S. Department of Commerce, June 1974.

A Declaration of Policy, American Mining Congress, October 6, 1974.

Aluminum—From Shortage to Surplus in '74 reversing the pattern of '73, by Sidney Blumenreich, Engineering & Mining Journal, March 1975.

Borrowing Authority. See listing under "Stockpiling."

Comments and Suggestions on the policy recommendations in " Meeting America's Resource Needs, " American Mining Congress Journal, November 1971.

Commodity Data Summaries. Washington, D. C., U.S. Department of the Interior, 1975.

Copper—A Materials Survey, Bureau of Mines IC 8225, Department of the Interior, 1965.

Critical Imported Materials, by U.S. Council on International Economic Policy,. December 197+1. Washington, D. C., Government Printing Office, 1974.

Defense Materials Inventories, Summary of GSA. See listing under "Stockpiling."

Eight Mineral Cartels: The New Challenge To Industrialized Nations, by Clarfield, Kenneth W.; Jackson, Stuart; Keeffe, Jeff; Noble, Michaele Ann; and Ryan A Patrick. Metals Week, 1975.

Emergency Preparedness for the Interruption of Petroleum Imports into the United States, National Petroleum Council, December 1973.

Engineering & Mining Journal, Annual Surveys and Outlook Issues. New York: McGraw-Hill.

Final Report on the Reconstruction Finance Corporation. See listing under "Stockpiling."

International Economic Report of the President, transmitted to the Congress, March 1975.

Material Needs and the Environment Today and Tomorrow, Final Report of the National Commission on Materials Policy, June 1973.

Materials and Man Needs, Summary Report of the Committee on the Survey of Material Sciences and Engineering, National Academy of Sciences, 1974.

Materials Shortage Workshop, DOD, January 14–16, 1975, Metals and Ceramics Information Center, Battelle Columbus Laboratories, February 1975.

Materials Shortages Workshops. Report on U.S. Department of Defense, January 14–16, 1973, 1975, 1976.

Materials Shortages. U.S. Congress. Senate. Committee on Government Operations. Hearings. 93d Cong., 2d sess., September 11-12, 1974, Pts. I, II-III. Washington, D. C., Government Printing Office, 1974.

Materials Shortages: Selected Readings on Energy Self-Sufficiency and the Controlled Material Plan. U.S. Congress. Senate Committee on Government Operations. Committee Print. 93d Cong., 2d sess., Aug. 1974. Washington, D. C., GPO, 1974.

Materials Shortages: Workshop on Resource Management. U.S. Congress. Senate Committee on Government Operations. 94th Cong., 1st sess., February 1975 Washington, D. C., Government Printing Office, 1975.

Proceedings of the Department of Defense Materials Shortages Workshop, January 14–16, 1975, by Battelle Memorial Institute. Ceramics Information Center. Report No, MCIC SR–75-01, Columbus, Ohio, Battelle, 1975.

Materials Technology in the Near-Term Energy Program, National Academy of Sciences, 1974.

Meeting America Resource Needs: Problems and Policies. U.S. Congress. House. Committee on Banking and Currency. Ad Hoc Committee on the Domestic and International Monetary Effect on Energy and Other Natural Resource Pricing Report. 93d Cong., 2d sess,, November 19741. Washington, D.C., Government Printing Office, 1974.

Meeting America's Resource Needs, Report on, American Mining Congress journal November 1975.

Mercury—A Materials Survey, Bureau of Mines IC 7941, Department of the Interior, 1959.

Metal Statistics, 1974: The Purchase Guide to the Metal Industries. New Jersey: The American Metal Market, 1974,

Mineral Commodity Summary Tables, 1973 Data Base, Bureau of Mines, U.S. Department of the Interior, 1970,

Mineral Facts and Problems, 1960, by U.S. Department of the Interior, Bureau of Mines Bulletin 585. Washington, D.C., Government Printing Office, 1960,

Mineral Facts and Problems, 1965, by U.S. Department of the Interior, Bureau of Mines Bulletin 630. Washington, D. C., Government Printing Office, 1965.

Mineral Facts and Problems, 1970, U.S. Department of the Interior, Bureau of Mines Bulletin 650. Washington, D. C., Government Printing Office, 1970.

Minerals Yearbooks, prepared by the U.S. Department of the Interior, Bureau of Mines. Washington, D. C., Government Printing Office.

Mining and Minerals Policy, 1975 Annual Report of the Secretary of the Interior under the Mining and Minerals Policy Act of 1970.

National Commission on Materials Policy, reports of, Washington, D.C.

National Materials Policy. Proceedings of a Joint Meeting of the National Academy of Sciences and National Academy of Engineering, October 25–26, 1973. Washington, D. C., National Academy of Sciences, 1975.

Oil and Gas Journal, August 11, 1975, pp. 36–37.

Problems and Issues of a National Material Policy, paper delivered at an Engineering Foundation Research Conference on National Materials Policy, Inc. 1970, U.S. Government Printing Office, Washington, D. C., 1970,

Project Independence Report, Federal Energy Administration (Washington, D.C., U.S. Government Printing Office, 1974), pp. 369-377.

Prospects for International Cooperation in Critical Materials: The Case of International Commodity Agreements, a paper by John C. Tilton, Department of Mineral Economics, Penn State University, June 1975.

Raw Materials in the United States Economy: 1960-1969, U.S. Department of Commerce and the U.S. Department of the Interior.

Requirements for Fulfilling a National Materials Policy, Proceedings of an Engineering Foundation Conference held at Henniker, New Hampshire, August 1974. N.B. All other references to articles from these proceedings will be cited as the Henniker Report.

Reports by the National Materials Advisory Board, various materials.

Resources and Man, Committee on Resources and Man—National Academy of Sciences–National Research Council. San Francisco: W. H. Freeman.

Selected Reports of the National Materials Advisory Board, National Academy of Sciences, various dates, 1968–72.

Senate Report 327, 19th Cong., 1st sess., 24 (1975). Naval Petroleum Reserve No. 4 in Alaska is estimated to contain 10 to 33 billion barrels of oil, but unlike Elk Hills the capability for immediate production does not exist in NPR 4.

Special Report: Critical Imported Materials, Council of International Economic Policy, December 1974.

Strategic and Critical Materials: Descriptive Data, General Services Administration, December 1975.

Strategic Materials: More Vulnerable Bottlenecks Ahead ? Simon D." Strauss. See listing under "Stockpiling."

Summary and Analysis of the Fifth International Tin Agreement, Department of State, July 30, 1975.

Summary of Disposals of Defense Materials (DM-880. See listing under "Stockpiling. "

The Aluminum Industry Price and Availability, S.M. Blumenreich, 1975.

The Domestic Mining Industry of the United States in World War II, John Davis Morgan, Jr. Washington, D, C., GPO, 1949.

The Economic Value of Ocean Resources to the United States, U.S. Senate Committee on Commerce, December 19741.

Titanium—A Materials Survey, Bureau of Mines IC 7791, Department of the Interior, 1958

U.S. Life Lines, OP Nov-09D-Pl (revised), June 1971, U.S. Navy, Office of Chief of Naval Operations,

Wall Street Journal, August 13, 1975.

Workshop on Resource Management, Committee Print of the Permanent Subcommittee on Investigations of the Committee on Government Operations, U.S. Senate, 1975.

World Outiook for Critical Materials in the 1970's, by Dr. John D. Morgan, Jr,, Associate Director, Bureau of Mines, Department of the Interior, 1975.

C. TECHNOLOGY ASSESSMENT

Annual Report to the Congress by the Office of Technology Assessment, March 15, 1974.

A Study of Technology Assessment, Report to the Committee on Public Engineering Policy, National Academy of Engineering, July 1969,

Perspectives on Benefit-Risk Decision Making, Report of a colloquium conducted by the Committee on Public Engineering Policy, National Academy of Engineering, April 26–27, 1971. Washington, D, C., The National Academy of Engineering, 1972,

Second-order Consequences : A Methodological Essay on the Impact of Technology, by Raymond A, Bauer, Richard S. Rosenbloom, Laure Sharp, et al. Cambridge, Mass.: MIT Press, 1969.

Society and the Assessment of Technology: Premises, Concepts, Methodology, Experiments, Areas of Application, by Francois Hetman, Organization for

Economic Cooperation and Development, Washington and Paris.

Some Methods and Techniques for Comprehensive Impact Assessment, Joseph F. Coates, Technological Forecasting and Social Change 6, 341-357 (1974).

Technology and Public Policy: The Process of Technology Assessment in the Federal Government, by Vary Taylor Coates, Program of Policy Studies in Science and Technology, the George Washington University, Washington, D. C., July 1972.

"Technology Assessment, " by David M, Kiefer, Senior Editor, Washington, D. C., Chemical & Engineering News, October 5, 1970.

Technology Assessment, A Quarterly Journal of the International Society for Technology Assessment (ISTA).

Technology Assessment and Public Wisdom, Joseph F. Coates, J. Wash, Academy of Science, vol. 65, November 1, 1975.

Technology Assessment for the Congress, Staff Study of the Subcommittee on Computer Services of the Committee on Rules and Administration, U.S. Senate. Bibliographic Review of Technology Assessment (reprinted from Technology Assessment, vol. 1, no. 1), Technology Assessment, by Genevieve J. Knezo,

"Technology Assessment: More Talk Than Action, " by David M. Kiefer, Senior Editor, Washington, D, C., Chemical & Engineering News, January 3, 1972.

"Technology Assessment: The Benefits . , , the Costs . . the Consequences, " by Joseph F. Coates, The Futurist, December 1971.

Technology Assessment: Understanding the SociaJ Consequences of Technological Applications, Raphael G, Kasper, ed, New York, N. Y.: Praeger, 1972.

"The Assessment of Technology, " by Harvey Brooks and Raymond Bowers, Scientific American, vol. 222, no. 2, February 1970, p. 131.

The Relationship of Technology Assessment to Environmental Management, by Louis H, Mayo, Program of Policy Studies in Science and Technology, George Washington University, SDP06, October 1969.

D. CARTELS

Cartels and]nternationai Patent Agreements, Legislative Reference Series, Library of Congress. Washington, D. C., June 1944.

"Cartels, the Menace of Worldwide Monopoly, " The New Republic, March 27, 1944,

Control of Cartels and Monopolies, by Corwin D. Edwards, New York: Oceana, 1967.

Controling World Trade: Cartels and Commodity Agreements, by Edward S, Mason. New Jersey:" McGraw-Hill, 1946.

History of the Combined Raw Material Board, Office of the (WPB) Vice Chairman for International Supply, file 083:208, 194245.

International Cartels, by Ervin Hexner, Connecticut: Greenwood Press, 1945,

International Conference on Monopolies, Mergers and Restrictive Practices—Papers and Reports, Cambridge, England, 1969.

The Bottlenecks of Business, by Thurman W, Arnold. New York, N, Y.: Reynal & Hitchcock, 1940.

The Law of International Cartels, by Heinrich Dronstein. New York: Cornell University, 1973.

"OPEC: The Economics of Oil Cartels". Business Week, January 13, 1975, pp. 77-81.

"The U.S. Now Must Deal With the Other Cartels". New York Times, June 1, 1975, Sec. 4, p, E4,

E. INPUT-OUTPUT MODELS

A Short-Run Forecasting Model of the United States Economy, Ray C. Fair, Lexington, Mass.: D.D. Heath & Company, 1971. And An Introduction to Econometrics, Lawrence R. Klein, Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962.

" 'Appraisal' Model, " L.L. Fischman, Inter-Office Memorandum, Resources for the Future, Inc., July 17, 1974.

"How Accurate Are Economic Forecasts, " Stephen K. McNees. New England Economic Review, November-December 1974, pp. 2–19.

Matrix Methods in Economics, Almon, Jr., and Clopper. Reading, Mass.: Addison-Wesley Publishing Corn., 1967.

1985 Interindustry Forecasts of the American Economy, Almon, Jr., Clopper, et al., Lexington, Mass.: D.C. Heath & Co. 1974.

1973–1985 in Figures, Almon, Jr,, Clopper, et al., Lexington, Mass.: D.C. Heath & Company, 1974.

"The BEA Quarterly Model," Albert A, Hirsch et al., Bureau of Economic Analysis Staff Paper 22, July 1973.

The Data Resources Model, Uses, Structure, and Analysis of the U.S. Economy, Otto Eckstein et al., Economic Studies 15 Lexington, Mass.: Data Resources, Inc.

"The Predictive Accuracy of Econometric Forecasts," Stephen K, McNees, New England Economic Review, September-October 1973, pp. 3-27.

The Wharton Annual and Industry Forecasting Model, Ross S, Preston, Philadelphia, Pa.: Economic Research Unit, University of Pennsylvania, 1972.

The Wharton Econometric Forecasting Model, Michael K. Evans and Lawrence R, Klein. Philadelphia, Pa.: Economic Research Unit, University of Pennsylvania, 1967.

F. GENERAL

Economics of National Security, 2d edition, New York: Prentice-Hall, 1954.

Economic Problems of War, George A, Steiner & Associates. New York, John Wiley & Sons, Inc., 1942.

IndustriaJ Mobilization for War, Civilian Production Administration. Washington, D. C., GPO, 1947.

Joint Committee on Defense Production, Activities of, Annual report, Washington, D. C., GPO, 1951 to 1975.

Resources for Freedom, Volumes I, II, and V, President's Materials Policy Commission, Washington, D. C,, June 1952, GPO, 1952.

The President's 1975 State of the Union Message, January 15, 1975.

Wartime Production Controls, Novick, Anshen, and Truppner, New York: Columbia University Press, 1949.

APPENDICES

Appendix A

HISTORY, MANAGEMENT, AND PROBLEMS OF STOCKPILING IN THE UNITED STATES

A. INTRODUCTION

The stockpiling experience of the United States involves a number of separate programs, each with a goal of its own. The Stockpiling Act of 1946 had as its objective the accumulation of an inventory of strategic and critical materials. The Defense Production Act (DPA) of 1950, as amended, aimed at improving the mobilization posture of the United States by encouraging and assisting the creation of productive capacity where needed. The right to deliver materials to the Government if the market could not absorb them at acceptable prices was an inducement in a number of DPA contracts. The barter program under the Agricultural Trade and Adjustment Act of 1954 (P.L. 480) was designed to exchange perishable surplus agricultural commodities for strategic and critical metals and minerals, and thereby assist in stabilizing the markets for these materials.

Although not its purpose, the Defense Production Act of 1950 developed into an economic balance wheel by providing markets for metals, minerals, and other materials when prices were low and the market needed some support and later selling materials under disposal programs, presumably when there were shortages and prices were higher. Whether by intent or accident, these disposals did actually provide some financial support to the Vietnam war.

B. LEGISLATIVE HISTORY OF STOCKPILING

Although the national stockpile was acquired basically under Public Law 520, 79th Congress, the Strategic and Critical Materials Stockpiling Act of July 23, 1946 (60 Stat. 596, 50 U.S.C. Sec. 98d), the concept of such a stockpile was first put forth after World War I, when shortages of materials had frequently upset production schedules and delayed essential programs, The Army General Staff subsequently considered material requirements in its planning and in 1921 drew up a list of 42 materials required for military operations. This was known as the Harbord List.[1]

It was not until 17 years later, however, that the first official step was taken toward stockpiling, This was an appropriation of $3.5 million to the Department of the Navy for the accumulation of reserves of strategic raw

[1] Munitions Board, Stockpiling Report to the Congress, Jan. 23, 1950. Washington, D. C., Government Printing Office, 1950, pp. 16 & 18.

materials.[2] (For comparative purposes, this amount may be set alongside the $3,013 million appropriation of stockpiling funds in the fiscal year 1951 or the $906 million expenditure of stockpiling funds in the fiscal year 1953.)3

Meanwhile, the Army-Navy Munitions Board (ANMB),[4] supported by other agencies, made recommendations to Congress which culminated in the Stockpiling Act of 7 June 1939 (53 Stat. 811). This act, which was the first official recognition by Congress of the need for a stockpile, authorized $100 million, and Congress appropriated $70 millions Under this act the Treasury was authorized to accumulate stockpiles over a 4-year period. (Again, for comparative purposes, obligations of stockpiling funds incurred during the 4-year period, July 1, 1950, through June 30, 1954, aggregated $3,515 million; and expenditures during the same period totaled $3,051 million.)[6]

As the prospect of U.S. involvement in World War 11 increased, it became clear that more money and broader authority were needed. The act of July 25, 1940, gave the Reconstruction Finance Corporation (RFC) broad authority to produce, acquire, and transport materials for defense. The RFC conducted most of the Government procurement activity in strategic materials during World War II through the Rubber Reserve Company, the Metals Reserve Company, and the Defense Supplies Corporation.

At the time of the 1939 Stockpiling Act, the ANMB developed three separate lists of materials based on accessibility: strategic, critical, and essential. In 19%1 new definitions of strategic materials were drawn up based on the need for stockpiling as against other measures, p Three criteria were to be used:

1. Deficiency or insufficient development of natural resources to supply the industrial, military, and naval needs of the country for common defense;
2. The acquisition and retention of stocks of these materials within the United States and encouragement of conservation and development of sources of these materials within the United States; and
3. The reduction and prevention wherever possible of dangerous and costly dependence of the United States upon foreign nations for supplies of these materials in time of national emergency.

Postwar additions to the residue of wartime stockpile were initiated under the Surplus Property Act of 1944, which authorized the transfer of materials not required for defense or other essential purposes.

The producers of mineral raw materials recognized the threat of dumping surplus mineral stocks on postwar markets at the close of World War II, This stimulated considerable interest in a national stockpiling program, On June 3, 1943, a bill (S. 1160) was introduced in the Senate. The purpose of the bill was "to stimulate production of strategic and critical minerals for the present war effort and to assure an adequate supply of such minerals for any future emergency by continuance, intact, in the postwar period of all stockpiles surviving the present War and by necessary augmentation thereof primarily from domestic sources, and for other purposes, "[8]

After public hearings on the bill, a revised version (S. 1582) was introduced on December

2Backman. Jules. et al. *War and Defense Economics*. New York, Rinehart, 1952.

3General Services Administration. Stockpile Report to the Congress, Statistical Supplement, *July—December* 1974. Washington, D. C.. General Services Administration, 1974. p. VI.

4The Army-Navy Munitions Board was renamed the Munitions Board in 1947. but for convenience and to avoid confusion the initials ANMB are used throughout. This board was abolished in 1953 when its functions were transferred to the Office of Defense Mobilization (ODM). a predecessor to the Office of Emergency Preparedness (OEP).

5Munitions Board. *Stockpile* Report to the Congress, Jan. 23, 1950. Washington, D. C., Government Printing Office, 1950. p. 16.

6General Services Administration, Stockpile Report to the Congress, Statistical Supplement, *July-December 1974*. Washington D. C., General Services Administration, 1975, pp. 16, 17.

7*Ibid*.

8U. S, Department of the Interior, Bureau of Mines, Minerals Yearbook, 1953. Washington, D. C., Government Printing Office, 1953.

8, 1943. Wide differences of opinion developed on many features of these bills, but there was substantial support for two of the objectives of the proposed legislation: (1) the creation of stockpiles for national defense, and (2) the freezing of stocks at the end of the war to provide the nucleus for permanent stockpiles and prevent undue dislocation of postwar markets, g

The discussions on the bill brought out the divergent interests of the minerals industries. The producers feared the potential competition of postwar surpluses, and the consumers hoped to secure bargains in raw materials. From the viewpoint of the producers, the freezing of surplus stocks of minerals and metals at the end of World War II was a prerequisite to any program designed to cushion the effects of sudden termination of war production. The industry supported this position by referring to World War I and claiming that lack of controls on the disposal of stocks of metals and scrap at that time brought on a deflation of the metal markets and resulted in widespread unemployment due to forced curtailment of production from 1920 to 1922.[10] Consumers, on the other hand, maintained that there should be no restraints on raw material supplies if industry were to meet the tremendous demand that many expected to follow the end of the war, They argued that the freezing of war stocks might retard the production of goods for civilian consumption or induce inflationary tendencies in the raw material markets inimical to the maintenance of postwar stability .11

Subsequently, other bills along similar lines were introduced in Congress. The executive departments also initiated studies in an attempt to develop a program which would reflect the views of the executive branch, As of July 1, 1944, however, no positive action had been taken by either branch of the Government, Pressures for legislation to assist industry in its problems of reconversion from wartime to peacetime production received priority in the competition for congressional attention. For the moment the possible effects of disposals of Government stocks on recovery of the minerals industry were not considered.[13]

C. LEGISLATIVE AND EXECUTIVE AUTHORITY FOR STOCKPILING PROGRAMS

The authority for the accumulation of stockpiles of strategic and critical materials was derived from the following statutes:

- The Strategic and Critical Materials Stockpiling Act (Public Law 520, 79th Cong., 60 Stat 596, U.S.C. 98d), approved by the President, July 23, 1946, as amended by Reorganization Plan No. 3, effective June 12, 1953, This law provided the basic authority for the acquisition and retention of strategic and critical materials to decrease and prevent, wherever possible, a dangerous and costly dependence of the United States upon foreign nations in time of emergency.
- The Defense Production Act of 1950 (Public Law 774, 81st Cong,) (64 Stat 798, 50 U.S. C. 2061), as amended, provided broad authority for the expansion of productive capacity including the making of purchases or commitments to purchase metals, minerals, and other materials and for the encouragement of exploration, development, and mining of critical and strategic minerals and metals.

9 *Ibid.*

10 *Ibid.*
11 *Ibid.*
12 *Ibid.*

- The Agricultural Trade Development and Assistance Act of 1954 (Public Law 480, 83d Cong.), of which title I provided for the creation of a supplemental stockpile of strategic and critical materials; and title III provided for barter of agricultural commodities for strategic materials which entail less risk from deterioration and spoilage, as well as substantially less storage cost.

- The Agricultural Act of 1956 (Public Law 540, 84th Cong.), Section 206, further facilitated barter of surplus agricultural commodities by stipulating that materials acquired by barter in excess of the needs of other programs should be transferred to the supplemental stockpile.

- Certain specialized minerals legislation including the Domestic Minerals Program Extension Act of 1953 (Public Law 206, 83d Cong.), and the Domestic Tungsten, Asbestos, Fluorspar, and Columbium-Tantalum Production and Purchase Act of 1956 (Public Law 733, 84th Cong.) which authorized the acquisition of specific amounts of certain named minerals.

1. Agency Responsibilities[13]

Public Law 520, 79th Congress, the basic act supporting the present stockpiling program, designated the Secretaries of War, Navy, and Interior, acting jointly through the agency of the Army and Navy Munitions Board, to determine which materials should be stockpiled and the quantities and qualities of each. In making these determinations the Secretaries of State, Treasury, Agriculture, and Commerce were required to designate representatives to cooperate with the Army and Navy Munitions Board. The responsibilities of each Federal agency under Public Law 520 are listed below:

a. The Treasury Department, Procurement Division, was charged with the responsibility of purchasing the materials for the stockpile, so far as practicable, from supplies of materials in excess of current industrial demand and in accordance with the Buy American Act. It was also responsible for the storage, security, and maintenance of strategic and critical materials; for the rotation of inventories where necessary; and for the disposal, under certain safeguards, of those materials which had become deteriorated or obsolescent.

b. The Interior and Agriculture Departments were charged with responsibilities toward research on the materials within their areas, These assignments of responsibilities were amended by Reorganization Plan No. 3, effective June 12, 1953. These amended responsibilities provided that—

(1) The National Security Council was responsible for establishing broad defense policies, including those applicable to materials.

(2) The Office of Emergency Preparedness (OEP) (and predecessor agencies) was responsible for coordinating all mobilization activities of the executive branch of the Government, including programs intended to assure an adequate supply of materials in time of emergency. The agency was also responsible for stockpiling certain medical supplies and items for survival and rehabilitation,

(3) The Department of the Interior was responsible for recommendations on means for insuring adequate supplies of metals, minerals, and fuels to meet mobilization requirements. This included recommendations for the appropriate level of the domestic production component of the mobilization base, This Department also had a responsibility for research and development of strategic minerals pursuant to section 7(a) of the Stockpiling Act. It was also responsible for the mineral purchase

[13] Senate Armed Services Committee, *Subcommittee Hearings on National Stockpile*, July 24, 1957. Washington, D. C., Government Printing Office, 1957.

program under Public Law 733, which authorized the acquisition of specific amounts of certain named minerals.

(4) The Department of Agriculture was responsible for recommendations on actions in regard to supplies of agricultural commodities, including food. This Department was also responsible for the barter activities in connection with the disposal of surplus agricultural commodities. It also had a responsibility for research on and development of agricultural materials pursuant to section 7(b) of the Stockpiling Act.

(5) The Department of Commerce was responsible for recommendations as to actions on all other materials. It also developed requirements estimates for the industrial and civilian elements of the economy. It was responsible for the administration of the Export Control Act.

(6) The Department of Defense was responsible, among other things, for providing estimates of military requirements.

(7) The General Services Administration had responsibility for acquiring materials for the strategic stockpile and for the negotiation, consummation, and administration of necessary contractual arrangements for expanding supplies under the Defense Production Act. It also had responsibility for the storage of Government-owned materials.

Other agencies from time to time became involved in specific materials situations.

2. Organization of OEP Interdepartmental Committees

Within the OEP (and predecessor agencies), responsibilities with respect to materials were centered in Assistant Director for Production and Materials, To facilitate his working relationships with the various agencies, he and his staff called upon a number of interagency advisory groups in formal session or in day-to-day communications with the various members as necessary or appropriate.

At the working staff level, seven interdepartmental committees reviewed basic supply-requirements data for specific materials and recommended necessary action to the OEP staff, who prepared reports which were usually included in the OEP's proposals as reviewed by the Interdepartmental Materials Advisory Committee (IMAC). These reviews covered the following materials:

- Light metals;
- Nonferrous metals;
- Nonmetallic minerals;
- Iron, steel, and ferroalloys;
- Chemicals and rubber;
- Forest products; and
- Fibers.

An eighth committee, the Stockpile Storage Committee, advised on the effective deployment of stockpile inventories, including technical advice on the storage, custody, preservation, and security of stockpile materials.

At the Deputy Assistant Director's level, advice was obtained from the IMAC on OEP staff and commodity committee recommendations to insure consistency with overall governmental policies and programs. The Deputy Assistant Director for Production and Materials submitted his recommendations to the Director of OEP through the Assistant Director for Resources and Production.

At the Director's level, there was the Civil and Defense Mobilization Board (CDMB), consisting of heads of the agencies having defense mobilization responsibilities, which advised on the broader aspects of defense programs and policies—not only in the production and materials field, but in all mobilization areas. The CDMB, for example, reviewed mobilization plans to insure coordination between current defense programs and actions required in the event of any of a number of types of emergencies.

D. SELECTION OF STOCKPILED MATERIALS

The determination as to what and in what quantities materials must be stockpiled could be made only after careful consideration of certain criteria. Materials could be designated as strategic and critical if they were required for essential military or war-supporting uses during an emergency and if supplies were estimated to be insufficient to meet the requirement. Such supply problems could arise from insufficient domestic natural resources, inadequate domestic processing facilities, dangerous dependence on vulnerable foreign sources of supply, and potential transportation hazards,

Computation of the stockpile objective for any material involved consideration of three general factors:

1. The estimated duration of the emergency;
2. The estimated annual requirements during the emergency;
3. The estimated year-by-year supply from sources other than the stockpile. These sources included: (a) domestic production, including such expansion thereof during the emergency as might be deemed practicable and desirable during war conditions; and (b) imports, to the extent they might safely be assumed to be forthcoming, including such increases above normal levels as would result from stimulation of foreign production prior to and during the emergency,

1. Determination of Objectives

Following the decision as to what to stockpile, a decision had to be made as to how much of each material should be stockpiled. Obviously, the objective (quantity) had to be based on the gap between wartime requirements and wartime supply, and adjusted for potential reductions which could result from losses in transport, sabotage, political interference, or other hazards which could reduce available supply. In determining stockpile objectives, the total national requirements for each strategic and critical material for mobilization was compared with the estimated total (factored) supply. If a shortage was indicated, a stockpile objective was recommended,

Stockpile objectives were of two types: (a) basic objectives and (b) maximum objectives. The basic stockpile objective was developed from the deficit remaining after allowing for U.S. production and imports from free world sources, the latter discounted for estimated strategic risks involved in securing the material in time of war. The maximum objective was based on discounting completely all offshore sources of supply.

A stockpile objective which varied to a considerable extent from the calculated deficit might be established if there were significant considerations which could not be accounted for in the statistical analysis. Such considerations might include excessive concentration of domestic productive or processing capacity, rotation problems, potential substitutability of alternate materials, or the likelihood that subsequent calculations could result in substantially different objectives.

2. Supply Considerations

Supply data were usually developed by subcommittees of the OEP working committees, generally composed of representatives of the Department of State, the GSA, and either the Department of the Interior (in the case of metals, minerals, and fuels), the Department of Agriculture (in the case of agricultural products), or the Department of Commerce (in the case of other materials). Future supply estimates were usually based on historical data; the existing supply situation was analyzed with due regard to known or foreseeable changes in both foreign and domestic supplies in times of emergency, Consideration was given to potential changes in market patterns, especially for foreign sources of supply. The estimates of supply were submitted to the OEP working committees for review, exchange of supplementary knowledge of events and factors which might tend to modify the estimates, and final revision.

3. Factoring of Supply

After review and approval by the working committee, the OEP member of the working committee would discount the estimates of foreign supplies in accordance with factors developed on the basis of advice of the Department of Defense, the Department of State, and other agencies. These discounts were intended to apply safety factors to estimates of supply for possible losses. Domestic supply estimates were also factored for possible loss of heavily concentrated industries.

4. Estimates of Mobilization Supply

These included potential primary production in the United States, secondary recovery from scrap materials, and imports from foreign sources of supply. Although this was a general pattern, each material was considered as a separate situation.

In preparing estimates of supply for purposes of determining stockpile objectives, it was customary to prepare some historical data on country-by-country production, together with imports into the United States from each country. While this was intended to form some guidance as to the capability of each producing country, it could sometimes be misleading. High output in some previous year could have been achieved at the expense of future capacity to produce. Low past production might merely reflect lack of markets. Despite these pitfalls, however, it was necessary to use historical data. It was up to the working committee to recognize the conditions underlying unusual phenomena with regard to output of materials in foreign areas.

5. Production Estimates

Historical data on domestic primary and secondary production would be easier to interpret. One only needed to be aware of past strikes, inventory recessions, price fluctuations, foreign spurts of economic activity, and other factors which could influence production and affect markets. Next, a series of estimates of production for the current period and for the immediate future was presented. This was usually based on known expansion programs and the most recent experience modified to reflect the economic outlook. Finally, estimates of potential foreign output and its availability to the United States under mobilization conditions were prepared, primarily on the basis of information secured by the Departments of State and Interior.

When the estimates of mobilization supply were prepared, it was generally assumed that all economic facilities would be operated at capacity, that prices would be approximately at or slightly above current prices, and that labor would be available and stable. It was also assumed that economic stabilization would hold the general price and wage line. Expansion of domestic producing capacity was assumed only where plans and schedules for expansions of Government or industry were known. In making estimates of secondary supply, the committee tried to recognize the factors which would tend to restrict the generation of old scrap, as well as those factors which could contribute additional supplies. When the estimates of domestic and foreign mobilization supply were presented, notes were submitted by the committee explaining the factors contributing to the estimate,

77-119 0-76-16

E. MOBILIZATION REQUIREMENTS

1. Military Requirements

Direct military requirements require no definition; for stockpiling purposes, however, the data represented a second translation. The first, prepared by the DOD, translated the military programs for the production of planes, missiles, ships, weapons, material, and equipage into the required fabricated steel, copper, aluminum, and other mill products, The second, required for stockpiling purposes, translated the requiremenys for mill products into requirements for basic raw materials such as refinery products.

2. Indirect Requirements

The mill-product requirements for direct military needs were developed from bills of materials whenever possible. The bills of materials also listed requirements for component units, such as electrical motors, fasteners, wheels, and other units purchased in the manufactured state. Although these components were just as essential to the aircraft, weapons, and equipage in which they were installed as the mill products required for “direct military” purposes, they were classified as “indirect military. ” These “indirect military” requirements estimates were obtained from industry through the Department of Commerce industry divisions. In this manner total requirements for all electrical motors, for example, were obtained at one time through one source,

3. War Industries Requirements

The third category of material requirements represented the war-supporting industries which supplied machine tools and other items without which the direct military requirements could not be produced, These, too, were developed through the Department of Commerce industry divisions,

4. Civilian Requirements

Frequently, there is a tendency to look upon civilian requirements during wartime as a luxury. On the contrary, it would be a serious ‘error to overlook the essential civilian requirements. Power, communications, water, and transportation facilities have to be maintained, repaired, and operated or else the mobilization manpower supply would suffer and absenteeism rise.

5. Export Requirements

Finally, allowances had to be made for exports of raw materials to our allies. Export requirements for direct military, war-supporting, and essential civilian requirements were subject to the same screening process as domestic requirements.

The determination of the material requirements in these classes posed a variety of problems. During a wartime emergency, the determination was relatively easy, since current data on inventories, recent shipments, and order books were usually available in claimant applications for material allocations. For purposes of estimating requirements for stockpiling, however, the benefit of such recent and current experience was not available in peacetime.

6. The Time Factor

From the beginning of postwar stockpiling in 1944, it had been assumed for the purposes of computing stockpile objectives, that a future war would last 5 years and that the stockpile would have to be large enough to cover all material shortages for such a period.[14] The military officers in the Munitions Board who originally had established this guideline had assumed that a future war would be like World War II and then added approximately another year, just in case.

This was a rough assumption with no supportive judgment to justify it. It was assumed that the estimate of duration would be super-

[14] Snyder, Glenn. *Stockpiling Strategic Materials*. San Francisco, Chandler, 1966.

sealed by a more carefully developed estimate. Yet this assumption remained the basis for stockpiling for the next 14 years.

Section 2 of Public Law 520, the Strategic and Critical Materials Stock Piling Act of 1946, provided that—

> the Secretary of War, the Secretary of the Navy, and the Secretary of the Interior, acting jointly through the agency of the Army and Navy Munitions Board, are hereby authorized and directed to determine, from time to time, which materials are strategic and critical under the provisions of this Act and to determine, from time to time, the quality and quantities of such materials which shall be stockpiled under the provisions of this Act. In determining the materials which are strategic and critical and the quality and quantities of same to be acquired, the Secretaries of State, Treasury, Agriculture, and Commerce shall each designate representatives to cooperate with the Secretary of War, the Secretary of the Navy, and the Secretary of the Interior in carrying out the provisions of this Act.

7. The Interior Department and Mobilizations

While Interior was like all other departments in seeing national security as the reason for the stockpile, the route the Department would follow to attain it was different in several fundamental ways, Unlike State and the military departments, Interior favored a large stockpile. Materials would cover a wide area of need. The assumed period of disruption would be long. The period of hostilities protracted.

Emphasis would be placed on domestic purchasing. This, of course, would enhance national security by building up the mobilization base through development of a healthy domestic industry. The same objective would be supported by tight restrictions on stockpile disposal and the transfer of all war surplus materials to the stockpile. Clearly, tight restrictions on disposal minimized the threat of depressed prices and injury to domestic industry,

During the first 4 years of the program, Interior wanted the objectives to be about twice as high as the military departments thought necessary, A compromise was reached by adopting two sets of goals: minimum objectives, which were worked out and preferred by the staff of the Army-Navy Munitions Board (ANMB); and the maximum established after the war, This is consistent with the suggestion for monetization of stockpile reserves mentioned in the RFP,

From the foregoing, it appears that most of the basic policy issues which surround a materials stockpile were debated at length in the period between the end of World War II and July 1946 when the Stockpiling Act was signed into law,

F. THE STOCKPILE POLICY CONTROVERSY[16]

In general, stockpile legislation reflected the “tight control” advocates, The stockpile’s purpose was to protect national security, the act had a national emergency setting, the military was prominent in its administration, and the constraints on disposal were strong.

Nonetheless, it soon became apparent that actions under the stockpile program had important economic effects—whether intended or not. Thus, it was argued that national security would be best served by acquiring a balanced program; i.e., spreading procurement over a wide spectrum of materials. Opponents pointed out that stockpile dollars would stretch further if procurement were delayed for materials for which demand equaled or exceeded supply. Industry would not be

[15] Snyder, Glenn. *Stockpiling Strategic Materials.* San Francisco, Chandler, 1966.

[16] *Ibid.*

deprived of the quantity purchased for stockpile and pressure on prices would be relieved, Of course, the converse was true if prices were depressed by supply goals advocated by the Department of the Interior. However, the ANMB people tended to ignore the compromise, They believed that national security in stockpiling could only be expressed in a single objective based upon objective calculations of probable supplies and requirements in wartime. As far as the Munitions Board was concerned, the only function of the maximum objective was to permit the free transfer of surplus materials from other agencies to the stockpile where such transfers would raise the inventory of a material above the minimum objective, When it became apparent that the ANMB was ignoring the maximum objectives, Interior challenged the objectives and demanded they be raised.

1. ANMB and Interior: A Difference of Opinion

The differences of opinion between the ANMB and the Interior Department from early 1947 until 1950 were concerned principally with the question: How much material should be assumed to be available to the United States from foreign sources during a global war?

a. The Military Position.[17]—The ANMB used a set of strategic assumptions, e.g., military accessibility, shipping losses, and concentration of supply, Under military "accessibility, the Joint Chiefs of Staff (JCS) indicated which countries and regions would be accessible to the United States during the war and which would not, Estimates of shipping losses were applied as percentage reductions of the rate of normal peacetime shipments of materials from each accessible source. Ten percent was the maximum discount for this factor. The JCS recommended that if all or nearly all of the supply of a commodity were concentrated in a single source outside the Western Hemisphere, that supply should be discounted completely,

b. The Interior Department Position.[18]—The JCS made no specific evaluation of nonmilitary factors which might limit the availability of foreign supplies during war. The Department of the Interior challenged the assumptions of the JCS and the ANMB, It pointed to the loss of access to the principal peacetime sources of tin, rubber, manila fiber, and other materials, as well as to the loss of access to the Mediterranean Sea and other areas, The Interior Department did not consider the Western Hemisphere to be a safe source of supply either, Interior also warned of the unpredictability of the political allegiance of foreign countries, In brief, Interior felt that no supplies of materials should be expected from outside the Western Hemisphere in time of war and that the Western Hemisphere should be discounted by 75 percent to take account of shipping losses, shortage of ships, and possible political developments adverse to the United States, Where supplies of a material came from a single source, that source should be discounted completely,

c. The Debate.—While the ANMB ignored the industrial support of the military, the Interior Department argued for full consideration of the need to support war-supporting industrial requirements, Interior also argued that accumulation of a large stockpile should be looked upon as a capital asset rather than an expense, It also pointed to the long-range upward trend of minerals prices, indicating a potential profit. Interior also maintained that a large stockpile would reduce or eliminate the need to use costly or inefficient substitutes for scarce materials in wartime production, Interior pointed out that stockpiling materials also stockpiles energy, labor, and transportation, thereby releasing these for other wartime needs, It would also release military forces from the job of guarding sea lanes and source areas, Acquisition of a larger stockpile would contribute to the economy of our friends and allies abroad, stimulate the development of the domestic mining industry, and contribute to

17 Ibid.

18 ibid.

the self-sufficiency of the United States in strategic materials.

The ANMB argued that there was no justification for taking less of a "calculated risk" in stockpiling than in other defense programs. Larger stockpile objectives would require larger appropriations, and the stockpile appropriations would be carried in the national defense budget. Congress would be more likely to accept the stockpiling program if it were presented in terms of moderate reasonable figures. The strategic assumptions of the JCS and the ANMB were based on strategic plans for fighting the war, and felt that it was unnecessary and illogical to stockpile more than was necessary on the basis of these plans and assumptions.

The ANMB also claimed that a stockpile of the size proposed by Interior would have a damaging inflationary effect on the national economy, and the existence of such a large stockpile would create uncertainty and instability in world commodities markets.

The advisory members of the Strategic Materials Committee became involved in the debate, A formal vote was taken for each source area on the percentage discounts to be applied in estimating probable wartime supplies. In most cases Interior was supported by the majority in favor of maximum discounts. Thus, there were to be no supplies assumed during wartime from any source outside the United States, Canada, and Mexico. The ANMB and the State Department members protested against the total writeoff of supplies from South and Central America, but apparently were only mildly opposed to the 100-percent discounting of Eastern Hemisphere supplies. A small discount was voted for Canada and a larger discount for Mexico.

Decisions of the Strategic Materials Committee were not authoritative. After the Committee had taken its vote on supply discounts late in 1947, the results which favored the Interior position were submitted to the Joint Chiefs of Staff for comment. The JCS replied in the spring of 1948 indicating their disapproval of the Committee's figures by simply ignoring them and by issuing a new set of strategic assumptions which differed in no significant respect from those already in use.

d. The Compromise Position.[19]—In an attempt to reach some sort of compromise, the ANMB prepared an "interpretation" of the new JCS assumptions which, in effect, changed them considerably toward the Interior viewpoint.

The JCS judgment about which countries would be militarily accessible was unaltered, except that certain areas were considered totally inaccessible. Where a single source accounted for more than half of the total accessible supply of material, supplies from that source were discounted completely if outside the Western Hemisphere, and fractionally if in South America or the Caribbean area. For purposes of making this concentration discount, a source was defined not as a country, but as an area. In addition, the interpretation called for a further partial discount of all remaining Asian supplies because of the uncertainty as to whether such supplies would be available even if militarily accessible. Furthermore, shipping losses considerably larger than those estimated by the JCS were assumed. The new formula was approved by the ANMB and the JCS. Interior, however, was not satisfied.

e. The NSRB Decision[20]—The impasse was finally turned over to the National Security Resources Board (NSRB) for solution with the explanation that the JCS–ANMB assumptions would provide "reasonable" national security, with a certain "calculated risk, " while Interior's formula would provide greater security at greater cost. The NSRB was also told that the rates of acquisition in the near future would be the same under both plans, since these would be governed by availability of funds.

The NSRB, late in September 1948, decided in favor of the JCS–ANMB. The NSRB indi-

[19] *Ibid.*
[20] *Ibid.*

cated that strategic estimates, in stockpiling as elsewhere, was a military responsibility, although the concurrence of Interior was still required on stockpile goals with respect to the nonmilitary aspects" of their formulation.

f. Further Problems.—Now that the strategic aspect of the stockpile was decided, new problems arose with respect to the degree of wartime expansion of production and the level of civilian requirements. The ANMB assumed substantial expansion of wartime production. Interior maintained that except in special cases, expansion of production should not be assumed because it would use up valuable energy, resources, and manpower at a time when these were required to fight a war. On the contrary. ANMB argued that manpower could be lost from civilian production to increase the availability to the military.

In order to estimate requirements, the ANMB proposed substantial increases in military requirements, such as peak year of World War II plus one-third and multiplied by 5. War-supporting industries were also to be increased by one-third. Civilian requirements, however, were to be established generally at WWII levels with additions only enough to account for population growth. Interior opted for the year 1970, whereas the ANMB preferred to use the year following the year in which the objective was reviewed. The 1970 date would have substantially increased the requirement estimate—and the stockpile objective.

The problems were resolved in favor of Interior's position on domestic production and essential civilian requirements, and in favor of the ANMB on the assumed date of the outbreak of the war.

g. New Objectives Established.[21]—With these issues out of the way, the review of stockpile objectives under the Industrial Feasibility Test (JCS Plan 1725/22) proceeded smoothly, and by June 30, 1950, new objectives had been established for 34 materials and staff work completed on 20 more, In 26 cases an increase was established or recommended, 12 objectives were reduced, 10 remained unchanged, and 5 were removed from the stockpile list,

h. Problems of Precision.—The practical application of the strategic assumptions of the JCS uncovered a number of problems of ambiguity which bothered the civilian agencies. These problems pertained to the application of discounting factors to estimates of supplies from sources which could be affected by such contingencies as sabotage, political unreliability, concentration of supply, and accessibility. During these first reviews the NSRB had become involved in the effort to establish a workable stockpile program, specifically seeking precision in the assumptions leading to the establishment of objectives. The NSRB was supported in this effort by the Bureau of the Budget because of the Bureau's basic interest in administrative efficiency and the effect of stockpile goals on annual appropriation planning, In general, the Department of State did not take an active stand in the debates on stockpile policies, but rather seemed to defer to the military positions.

In response to pressures for increased precision, the ANMB asked the JCS for a new set of assumptions which, would provide more specific evaluations of non-military contingencies. In May 1950 the JCS provided a new set of guidelines which included only an appraisal of military accessibility and shipping losses. The guidelines specifically excluded political considerations and other factors relating to conditions within source countries.

2. Establishment of Interdepartmental Stockpile Committee[22]

In order to fill the gap which the JCS guidelines created, a subcommittee of the Interdepartmental Stockpile Committee was set up under the chairmanship of the State Department. This subcommittee included, in

[21] *Munitions Board, Stockpile* Report to *the* Congress, January 23, 1950. Washington, D. C., Government Printing Office, 1950. p. 7.

[22] Snyder, Glenn. *Stockpiling* Strategic *Materials*. New York, Chandler, 1966.

addition to the State Department, the Department of Commerce and the Central Intelligence Agency. The subcommittee considered general political orientation, sabotage, labor dependability, and governmental stability. On the basis of these four considerations, the subcommittee devised a set of “dependability ratings” for about 30 countries. Each factor was rated on a scale of 0–100. the lowest of the four ratings was adopted as the overall dependability rating. The subcommittee also considered the effect of concentration of supply sources and proposed discounts for concentration of more than half of the available supply of a commodity in a given region. The subcommittee further proposed an additional discount representing the extent of U.S. dependency on foreign sources of supply. Although the work of the subcommittee constituted a complete revision of the basic assumptions of supply, the “strictly military” assumptions of the Joint Chiefs were left intact.

3. The Factoring System

The Korean war broke out before the subcommittee had finished its work. The NSRB, anxious for a quick decision on the supply estimates, proposed a system which was more general in nature than the JCS formula. It assumed that no supplies would be available from outside the Western Hemisphere except from Australia, New Zealand, and Africa. It discounted supplies from these three areas by 75 percent; it discounted supplies from the Western Hemisphere except the United States, Canada, and Mexico by 50 percent. It assumed full supplies from these sources, with discounts for materials whose production was especially vulnerable to sabotage or bombing. In effect, the NSRB formula would have eliminated the guidance of the JCS and would have raised the stockpile objectives substantially.

The Interdepartmental Stockpile Committee considered both plans and voted to accept the State Department Subcommittee plan with some minor changes. The adopted plan, which was called the Factoring System, included the following considerations:

- Military accessibiltiy and shipping losses;
- Political dependability, including general political orientation, sabotage, labor dependability, and governmental stability;
- Concentration of supply, including concentration by region and total dependence on foreign sources; and
- Contingency factors.

With the adoption of the factoring system, another major review of stockpile objectives was conducted during the last 6 months of 1950. All but 10 of the objectives were increased, 3 materials were added to the list, and 3 were eliminated.

Thus, the factoring system provided a uniform procedure for calculating objectives. It reduced the range of uncertainty and freedom of choice, and thereby reduced but did not eliminate the vulnerability of the stockpile program to pressures from special interests.

4. Defense Production Act of 1950[23]

Soon after the outbreak of hostilities in Korea, the need for new administrative machinery to control the use of scarce materials was recognized. The Defense Production Act was approved on September 8, 1950. Under this act the President was given authority to require the acceptance of contracts and to allocate materials when, in his opinion, any of these actions would promote the national defense. The President was empowered to authorize GSA, Army, Navy, and other agencies engaged in procuring materials for defense needs to guarantee the contracting firm or public agency against loss when necessary to expedite the flow of materials for defense needs. The President was also

[23] See Case Study, found in App. B on “Expansion of Copper Producing Capacities”, Defense Production Act of 1950, as amended,

authorized to make loans, grant purchase commitments, and encourage the exploration, development, and mining of strategic materials.

One of the major purposes of the Defense Production Act was the expansion of the U.S. mobilization base. In the early 1950's the incentives provided by the act were used to induce private industry to invest funds in the construction of new plants. One of these incentives provided that the Government could negotiate a delivery schedule to permit the company developing the new facility to "put" unsold production to the Government. Such materials were subsequently placed in the Defense Production Act Inventory.

a. Sales from DPA Inventory[24]—Later, the Office of Defense Mobilization (ODM), successor agencies, and eventually OEP administered the DPA program. Materials in the DPA inventory could be sold (or diverted from delivery) by the agency Director without either Presidential or congressional approval.

As a result of the depression of market prices of many materials below Korean war levels, deliveries under DPA floor price purchase contracts were heavy after 1952. During the **1950's** the large DPA deliveries, together with the relative administrative ease with which disposals could be made from the DPA inventory (compared with the difficulties of releasing material from the strategic stockpile). resulted in placing heavy emphasis on the use of the inventory for economic stabilization purposes.

Sales from DPA inventories were made in tight market situations. National security justification usually lay in the development of a healthy domestic industry. Strongly urged by the Commerce Department (as the consuming industry spokesman), sales of copper, nickel, and aluminum were made to industry. Perhaps surprisingly, such sales were sometimes supported by the producing industry as a reasonable price to pay for reducing the threat of the stockpile and dissuading the search for substitute materials.

In November 1959 the U.S. Mint purchased copper from industry at what was deemed to be a relatively high price. This purchase was criticized because there was a substantial quantity of copper in the DPA inventory which could have been acquired at a substantially lower cost.

In May 1960 the Mint requested 10,000 tons of copper to be purchased from the DPA inventory. This was the first of a series of such sales to the Mint. Subsequently, from January 1961 through October 1964, there were eight more sales of DPA copper to the Mint totaling 97,000 tons.

When necessary, materials were transferred to the Strategic Stockpile to meet long-term objectives which were high as a result of a series of pessimistic assumptions relating to accessibility of foreign supply. This removed them as a market overhang.

b. Effectiveness of DPA of 1950.—The Defense Production Act of 1950 served to improve the capacity of the mining industry to meet the heavy demands of the Korean war. Much of this expansion was accomplished with Floor Price Purchase Contracts. While many of the facilities fostered by these contracts became productive in time to enjoy full demand at high prices and thereby released the Government from its obligation to purchase material at floor prices, some enjoyed only partial success, and some came into production after prices (and demand) had already fallen below the floor prices established in the contracts. Consequently, substantial quantities of lead, zinc, and other materials flowed into the DPA inventories. One example of the effectiveness of the Defense Production Act of 1950 in expanding productive capacity is found in the copper industry. For this analysis, see the case study, "Expansion of Copper Producing Capacities under the Defense Production Act of 1950, as amended," as found in appendix B.

[24] See Case Study, found in App. B on "Releases of Copper from the Stockpile."

G. THE MOBILIZATION READINESS PROGRAM[25]

After the change of administration in 1953, the stockpiling program underwent some changes which in effect had some impact on the economy, The Defense Production Administration developed the Mobilization Readiness Program, This was a procedure for estimating mobilization requirements for steel, copper, and aluminum by claimant agency and industry division, along the pattern of the Controlled Material Plan (CMP) used during World War II and the Korean war. Reorganization Plan No. 3, effective June 12, 1953, designated the Office of Defense Mobilization (ODM) to assume the functions of the Defense Production Administration and the NSRB, both of which were abolished by Reorganization Plan No, 6, effective June 29, 1953.

Stockpiling procedures remained essentially as they had been except that a civilian agency was coordinating the program, The GSA continued to purchase the materials and manage the inventory. The DOD became one of the advisory agencies, with responsibility for the preparation of estimates of military requirements and, along with other advisory agencies, to cooperate with the ODM in establishing stockpile goals.

1. Cabinet Committee on Minerals Policy

The ODM had to consider what to do with the materials coming into the DPA inventory, especially those materials for which the objective had already been filled, and what could be done to help the domestic mining industry. The Interior Department, specifically, was requesting a comprehensive "national materials policy. " Therefore on October 26, 1953, the President appointed a Cabinet Committee on Minerals Policy, referring to depressed conditions in the mining industry and specifically mentioned lead and zinc producers. The President charged the Committee with the following tasks:

- To make sure the United States had available mineral raw materials to meet any contingency during the "uncertain years" ahead;
- To make sure the United States could meet the ever-growing minerals requirements of an expanding economy; and
- To preserve the added economic strength represented by recent expansion of facilities by the domestic mining industry, through policies that would be consistent with other U.S. national and international policies.

The Committee recommended the establishment of mineral stockpile objectives which would authorize acquisition of materials beyond levels indicated by existing minimum objectives, The President accepted the recommendation and on March 26, 1954, authorized the ODM to establish new "long-term" procurement goals for metals and minerals, Nonminerals on the stockpile list were excluded, Purchases were to be spread out over a period of time and were to be confined to newly mined metals and minerals of domestic origin. In determining objectives, there was to be no wartime reliance on sources of minerals located outside of the United States, Canada, Mexico, and comparably accessible nearby areas as defined by the National Security Council, Purchases toward the long-term objectives were to take place at "advantageous prices" and at times when they would "help to reactivate productive capacity and in other ways to alleviate distressed conditions in domestic mineral industries that are an important element of the nation's mobilization base. " Provision was also made for upgrading during slack periods in the processing plants.

Acquisitions toward the long-term objectives were to be obtained by direct purchases transfers from DPA purchases and expansion

[25] Snyder, Glenn. *Stockpiling Strategic* Materials. San Francisco, Chandler, 1966.

programs, and from barter of surplus agricultural commodities. Thus, stockpile purchases were to acquire materials for wartime security and to promote the well-being of the mining industry.

2. Lead-Zinc Programs

The lead and zinc programs appeared to receive special attention. The objectives were increased to the level of "at least one year's normal U.S. use of any strategic and critical metal and mineral. " This rule was to be used only when it would yield a higher objective than did the discounting of oversea imports. In practice, the rule applied only to lead, zinc, and, to a lesser degree, antimony,

3. Establishment of Long-Term Objectives

In order to establish and review the minimum objectives, the basic framework of the factoring system as established in 1950 was used. Determination of the long-term objectives involved a recalculation for each metal and mineral, applying the new assumptions contained in the President's directive, notably the assumption of no distant oversea imports and the additional requirement for stocks of lead and zinc for "one year's normal use, "

Public Law 480, the Agricultural Trade and Adjustment Act of 1954, added one more non-national security feature to the stockpile program. This legislation provided for a supplemental stockpile of strategic and critical materials purchased through the disposal of agricultural surpluses in foreign markets. Importantly, through barter arrangements, industrial raw materials were acquired in exchange for perishable farm products to reduce the storage costs for the total holdings. Disposal of materials from the supplemental stockpile was subject to the same constraints as sales from Strategic Stockpile.

4. New Revisions

The Mobilization Readiness Program was revised in 1956 by the ODM and retitled the ODM Second Round Supply-Demand Analysis. It was again revised in late 1957. Under this program an overall estimate of industrial capability was based on an estimated gross national product for an assumed mobilization period. This estimated GNP was then broken down into component shares which were assigned to the military and to supporting industrial areas. Using the experience of 1952 material consumption as the base, the ODM developed new estimates of requirements for CMP mill products. These were then factored to convert to refinery product, with due allowance for alloy content and scrap generation.

For non-CMP materials, relationships were sought between the material in question and consumption of steel, copper, or aluminum, For instance, one part of the zinc requirements is based on the production of galvanized sheet and wire; another part, on zinc content of brass. Some materials are related to automotive production and automotive population; for example, lead for batteries and gasoline. Some materials seem to be without any relationship to other materials. In this case the estimated GNP index may be used,

5. Revisions of Time Factors and Objectives

From the beginning of stockpiling in 1944, stockpile objectives were calculated on the assumption that a future war would last 5 years. By 1954 the assumption was being challenged by the Air Force. Gradually, the military shifted to the idea of a 3-year mobilization effort. On June 30, 1958, the stockpiling policy was revised to assume a 3-year war, This had the effect of reducing all stockpile objectives by about 60 percent and created a number of surplus stockpile situations. The former "minimum" and "long-term" categories of stockpile objectives were renamed "basic" and "maximum," respectively. On June 30, 1958, only 10 materials were still short of the basic goals, and these plus 8 more were below the maximums, The balance of the 75 materials were held in excess of the maximum goals and therefore were not subject to further procurement. [26]

Methods of calculating the basic and maximum objectives were essentially the same as before except for the shorter time period. The maximum objectives were calculated on non-accessibility of supplies from outside the U.S. and Caribbean areas, while basic objectives assumed some imports for other areas.

Under DMO V-3 (dated December 10, 1959) the "six-month rule" was adopted. This rule provided for "basic" and "maximum" objectives. The maximum objective included an additional allowance to take into account the complete discounting of sources of supply beyond North America and comparably accessible areas. The maximum objective was to be not less than 6 months usage by industry in the United States during periods of active demand.

6. Stockpile Declassified

From the time that it was created in 1946, the stockpile was considered to be so related to national security that inventories and objectives were closely guarded secrets.

In 1962 Senator Symington questioned the need for continued secrecy of the stockpile data, the President agreed, and ordered the declassification of information of stockpile objective and inventories.

7. Stockpile Releases

There followed a large number of requests for releases and sales to industry of materials which were in short industrial supply and for which the inventories exceeded the objectives. Copper was one of the most frequent targets.

These requests were resisted consistently. Although a surplus did exist, the determination of the nuclear objectives had not yet been completed, and preliminary estimates indicated a substantial need for more, not less copper. Furthermore, the strategic stockpile was not intended to be an economic balance wheel: in fact, when the Stockpile Act of 1946 was debated in Congress, industry representatives expressed their apprehension over the possible misuse of the stockpile and were promised that the stockpile would never be used as an economic weapon.

In 1964 the copper industry was in a short-supply situation. One brass mill was most persistent in requesting some material from the stockpile inventory. The President complied by ordering the release of a relatively small quantity (20,000 tons) from the DPA inventories for defense and hardship cases. Pandora's box was now open. (A case study on "Releases of Copper from the Stockpile" can be found in appendix B of this assessment.)

It should be noted that some of the releases of copper were not for the purpose of providing assistance to industries, but rather to provide budgetary assistance to the prosecution of the Vietnam war and to relieve upward pressure on prices,

8. Justification for Stockpile Releases

In order to justify releases of material from stockpile inventories, the material to be released had to be either obsolete or surplus to the objectives. This may explain some of the changes in the guidance provided for the calculation of objectives in Defense Mobilization Orders (DMO) 8600.lA and 8600.1B. Each had the effect of lowering the objectives, thereby moving more material into the surplus category available for disposal.

On March 30, 1964, Defense Mobilization Order 8600.1 (formerly DMOV–7) eliminated the 6-month rule and established one objective (maximum) to be adequate for limited or general, conventional or nuclear war, whichever shows the largest supply-requirements deficit for a 3-year period to be met by stockpiling. Furthermore, the order provided that only domestic sources of supply or those in contiguous countries would be considered available during an emergency. The order also provided for discounting of potential wartime

[26] General Services Administration, *Stockpile Report to the Congress, Statistical Supplement, January-June 1958.* Washington, D.C., General Services Administration, 1958.

supplies if such supplies were relatively concentrated, either locally or in North America. Domestic supplies were also to be discounted to reflect vulnerability to sabotage. In cases of excess concentration, provision was to be made for supplies during the estimated time required to restore capacity and operations.

The release of 200,000 tons of copper in March 1966 carried with it the suggestion that productive capacity should be increased. This led to the Second Expansion Program, discussed as a case study in appendix B of this assessment.

DMO 8600.lA (dated December 16, 1968) had the effect of increasing estimates of supply and thereby tended to reduce the stockpile objectives and make more material eligible for disposal. It stated that estimates of supply should be based on readily available capacity and known resources in the United States and such other countries as certified by the Joint Chiefs of Staff and approved by the Director of OEP The usual discounts for concentration, sabotage, etc., were to be applied.

DMO 8600.lB (dated April 11, 1973) provided that the stockpile objectives be limited to meeting estimated shortages of material for the first year of a war. Requirements were assumed to approximate the consumption capacity of industry, taking into account necessary wartime limitation, conservation, and substitution measures.

As a result, accessibility constraints were relaxed, maximum substitution of materials assumed, and a very limited military force accepted as a planning assumption. Above all, however, the 3-year war assumption was discarded, and preparation was made for the first year of war. The rationale offered for this change assumed that the stockpile was needed merely during the transition from a peacetime to a wartime economy. It stated that beginning with the second year of war, the necessary adjustments would have been made and the need for stockpile withdrawals would vanish. This shift in planning assumptions had the advantage of eliminating debates as to the validity of a l-year war assumption. Experience does not lend much support to this view.

The net effect of the above changes in strategic planning assumptions was to create surpluses for most materials in the national inventory available for disposal. This was soon reflected in sales from the stockpile. Compared with the fiscal year 1972 total of $146 million, 1973 sales more than tripled to $558 million, and 1974 sales soared to $2,051 million. [27]

On June 30, 1973, OEP was abolished by Presidential order and its records and remaining functions transferred to GSA.

9. Policies of the 1960's

In retrospect, the decade of the 1960's was marked by the role played by the national stockpile in dealing with some of the economic consequences of the Vietnam war. When a high level of economic activity coincided with burgeoning requirements for the production of military equipment, materials shortages and upward pressure on prices were the inevitable result.

Department of Defense, Atomic Energy Commission (predecessor to the Energy Research and Development Administration and the Nuclear Regulatory Commission) and National Aeronautics and Space Administration contractors and subcontractors all possessed priority authority in the purchase of materials and equipment under the operation of the Defense Materials System. As a consequence, shortages of materials impacted entirely on the nonmilitary industrial and civilian economy, thus magnifying the shortage effects on the concerns not involved in war production.

Stockpile and DPA Inventory sales were made to soften the adverse impact and reduce upward pressure on prices of industrial materials, In some measures, stockpile sales were used to reduce demands for the imposition of wartime material and production con-

[27] Data from General Services Administration,

trols. Sales during the lo-year period ending in 1970 amounted to $3.1 billion. During the 3-year period 1965-67, which marked the high years of materials requirements related to the production of military equipment for the Vietnam war, sales amounted to just under $2 billion.

The OEP Stockpile Report to Congress for the July–December 1966 period had this to say in connection with the long-term contractual arrangement between the General Services Administration and the aluminum industry:

> During the 13-month period ending December 31, 1966, industry purchased a total of 357,294 tons, valued at $175.7 million, to meet the growing demands for aluminum products resulting from the Vietnam war and civilian economy. Of the total, approximately 83,875 tons were committed during the July–December period at a time when growth in productive capacities was unable to keep pace with mushrooming requirements for aluminum.

The huge sales of copper, nickel, tin, tungsten, and aluminum had the same objective. In short, Government policy had evolved to the point where stockpile was being used as a tool for economic stabilization.

10. Future Stockpile Policy

If present rules remain unchanged, the future stockpile program consists of establishing an orderly disposal program. The alternative is to make explicit a number of objectives which have largely been implicitly sought under the cloak of national security. This would permit the use of stockpiling to meet new national objectives and obviate the need for a large, quick disposal program. Experience gained in the evolution of the present stockpile program could be invaluable in guiding such a future program and helping to avoid negative and confusing actions.

APPENDIX B

CASE STUDIES

A. LONG-TERM PROGRAM FOR DISPOSAL OF GOVERNMENT STOCKPILES OF ALUMINUM

1. Introduction

The long-term program for the disposal of Government stockpiles of aluminum ingots has been unique in that it was the only such program established on an orderly, though somewhat flexible, schedule. As with other stockpile disposals, it has economic and political overtones. There were the usual caveats about the avoidance of adverse effects on the international interests of the United States; due regard to protection against avoidable financial loss by the United States; avoidance of adverse effects on domestic employment; and avoidance of partiality in labor disputes. As might have been expected, there were implications of attempts by the United States to influence prices.

In common with other stockpiled materials for which disposal plans were under consideration at the time of the aluminum program's initiation, the Federal Government recognized two factors of importance: (1) a desire to help reduce budget deficits by selling surplus materials; and (2) the supply and inflation problems to all materials, was the desire to reduce the balance of payments deficit by substituting domestic for imported aluminum. This case study discusses the industry position on the aluminum stockpile disposal program and the steps taken by the Federal Government in the disposal programs.

2. Purposes of the Aluminum Program

a. The Existing Aluminum Surplus—The aluminum disposal program was initiated in November 1965 after a series of discussions within the Government and between Government and industry which began as early as 1963. The stockpile objective for aluminum had undergone wide fluctuations in the post-World War II period, ranging from a low of 250,000 short tons in 1949 to a high of 2,500.000 tons in 1954. At the time of the long-term disposal program's inception, the three conventional-war stockpile objective was 450,000 tons, while Government stockpiles totaled 1,898,483 tons. Of this total, 769,499 tons were in the Defense Production Act (DPA) inventory and 1,128,984 tons were in the strategic stockpile. This left a surplus of 1,448,483 tons available for disposal. There had been a disposal program inaugurated in May 1963, covering 135,000 tons, of which 106,000 tons were sold to the three major primary producers through March 1965, The remaining 29,000 tons were set aside for small businesses but not sold.

Plans for a long-term disposal program were developed in February 1965 by the Government committee given the responsibility to provide for the disposal of all the DPA inventory and about 680,000 tons of national stockpile inventory. The latter disposal would, under law, require congressional approval, On February 18, 1965, the General Services Administration (GSA) was officially authorized by the Office of Emergency Planning (OEP) to develop a disposal plan and to reach agreement on it with the interested segments of the aluminum industry.

b. Industry Position on a Disposal Program.—At a meeting between the Government and the aluminum industry on May 10, 1965, industry representatives (ineluding primary producers as well as processors) made the following main points:

- The industry did not need the Government material, but was willing to cooperate to meet a national objective.
- All basic aluminum producers should participate in whatever program was worked out.
- Absorbing more than 800,000 tons over a lo-year period would disrupt employment, but this effect could be tempered by permitting flexibility within the program so long as the ultimate commitments were met, subject possibly to the commitment to take at least half of the 10-year total in the first 5 years.
- The program should be based on a series of firm contracts rather than spot sales.
- A 10-year disposal plan should cover only DPA tonnage (about 770,000 tons), since this material would be readily accessible for sale, whereas the national stockpile material would require congressional approval. If the total surplus were to be disposed of, the program should extend over a 15-year period.
- All sales should be made at market price through normal commercial channels, and should be based on an average aluminum content of 99.5 percent purity.
- Plans should be developed as early as possible to help industry make rational facility expansion plans.
- Consideration should be given to using the surplus in Government-sponsored projects.
- Provisions should be made for small-business set-asides.

c. Subsequent Meetings Regarding a Disposal Program.—A subsequent Government-industry meeting was held on July 7, 1965, with nine primary producers to continue negotiations on a disposal program. Discussions dealt with a long-range program to run about 10 to 15 years to cover the entire 1.4-million-ton surplus, with 100,000 tons to be disposed of in the first year. There were two main areas of disagreement: (1) method of participation: the large companies wanted all primary producers in the program, but some of the smaller producers wanted out; and (2) rate of release: the industry suggested 20 years; the Government wanted 10 years.

Other meetings were held in July and August at the urging of the White House, which was concerned about budget deficits and the inflationary impact of increasing Vietnam War demands. Both sides stepped up their efforts in September and October. They appeared to be near an agreement when price increases announced by various companies in late October and early November precipitated a tug-of-war between Government and industry.

d. Government Alternatives for Disposal of Surplus Aluminum.—On November 6, 1965, the White House released a statement by Secretary of Defense McNamara which referred to the following five alternative formulas proposed by the Government for disposal of surplus aluminum, none of which were accepted by the industry:

1. Disposal of 100,000 tons per year for 14 years; no further sales unless defense requirements in any year exceeded the level of defense requirements in 1965. If so, industry would buy such excess based on allocable shares of the first 100,000 tons.
2. Same as alternative 1, except that if defense requirements reached the above level, the Defense Department would furnish as much as it could as Government-furnished material; the Government would dispose of the rest at market price and industry would process Government-furnished ingots.

3. Disposal of 528,000 tons as follows: the amount by which defense requirements exceeded the 1965 level, plus 100,000 tons per year, both instances on a base of proportional shares, with the obligation not to exceed 150,000 tons in one year.
4. Disposal of 200,000 tons over a l-year period on an allocable-share basis.
5. Disposal of 200,000 tons; the Defense Department would furnish as much as it could as Government-furnished material; the remainder would be disposed of at market price.

e. Further Industry Proposal for Aluminum Disposal.—The industry was reported to have proposed a "complex system" under which they would procure from the stockpile only half of the aluminum used in defense production, with a guarantee of not less than 100,000 tons per year. The industry's proposal would presumably have required a complex system of certificates relating to each contractor and subcontractor, which would not have been possible in the next 12 months. The Government, nevertheless, stated that it would accept the industry's proposal if the industry would be willing to guarantee the purchase of 200,000 tons in 1966, which it did not undertake to do.

Statements by the Chairman of the Council of Economic Advisers and the Secretary of the Treasury, also issued on November 6, 1965, said respectively that the price increases were inflationary and unjustified, and that a stockpile release was needed to help cover military needs and reduce the balance of payments deficit.

Industry consensus was not opposed to the 200,000-ton proposal for 1966, providing adequate provision could be made to cover defense business. Discussions between government and industry about these terms had been limited to four companies, and there was concern about how other producers would fit into a disposal plan. There was some feeling that the 200,000-ton proposal came in response to the industry's action in raising prices.

f. Release of Surplus Material.—On November 9, 1965, OEP directed GSA to release 300,000 tons for sale from the DPA inventory, with no mention of a long-term disposal program. The first 100,000 tons would be offered for sale immediately. However, other events intervened before a sale was made. The price increases previously announced were rescinded, and negotiations were resumed on November 16, 1965, for an orderly long-range disposal program. On November 23, 1965, GSA announced that agreement had been reached with four major producers, with other domestic producers, as well as the Aluminum Co. of Canada (Alcan), eligible to participate. A Memorandum of Understanding was entered into, and contracts issued accordingly. Three of the additional producers did become part of the program in early 1966.

Approval for the disposal of surplus material in the national stockpile was effected on June 21, 1966, and the disposal of this material and the DPA material proceeded. On December 20, 1972, the stockpile objective was reduced to zero as part of an overall review of objectives, and the contracts were amended accordingly.

The history of disposals is contained in the table of Aluminum Stockpile Disposals (table B–l), accounting for all but 17,500 tons of aluminum, which remained after June 1974. This amount has subsequently been sold. Fluctuations in the rate of disposal reflect the flexibility built into the program. The surge in 1973 and 1974 was largely the result of increased civilian demands.

For the entire period, the disposal of approximately 1.4 million tons of surplus aluminum represented about 3.8 percent of the total apparent consumption of primary aluminum (producers' shipments, plus imports, plus stockpile receipts, minus exports). It also accounted for about 45 percent of the ingot equivalent to all defense-rated shipments. To the extent such shipments were covered by

77-119 0-76 -17

Table B–l.—Aluminum stockpile disposals

Period	Defense production act inventory		National stockpile invantory		Total		Cumulative total	
	Quantity short tons	Value ($000)	Quantity short	Value ($000)	Quantity short tons	Value ($000)	Quantity short tons	Value ($000)
Nov.–Dec. 1965	49,455	24,462	—	—	49,455	24,462	49,455	24,262
Jan.-June 1966	223,964	109,959	—	—	223,964	109.959	273.419	134,421
July-Dec. 1966	44,142	21,570	39,733	19,715	83,875	41,285	357,294	175,706
Jan.-June 1967	7,416	3,891	36,295	17,817	43,711	21,708	401,005	197,414
July-Dec. 1967	1,530	771	511	255	2,041	1,026	403,046	198,440
Jan.-June 1968	6,849	3,460	24,363	12,086	31,212	15,546	434,258	213,986
July -Dec. 1968	6,627	3,484	20,074	10,542	26,701	14,026	460,959	228,012
Jan.-June 1969	18,822	10,238	73,823	39,574	92,645	49,812	553,604	277,824
July-Dec. 1969	10,077	5,489	34,588	18,926	44,665	24,415	598,269	302,239
Jan.-June 1970	1,527	857	17,145	9,618	18,672	10,475	616,941	312,714
July-Dec. 1970	—	—	23	13	23	13	616,964	312,727
Jan.-June 1971	—	—	20	12	20	12	616,984	312,739
July -Dec. 1971	750	435	1,500	870	2,260	1,305	619.234	314,044
Jan.-June 1972	—	—	3,857	2,226	3,857	2,226	623,091	316,270
July-Dec. 1972	6,000	3,000	—	—	6,000	3,000	629,091	319,270
Jan.-June 1973	102,750	52,577	201,248	101,282	303,998	153,859	933,089	473,129
July-Dec. 1973	133,991	68,609	369,126	185,792	503,117	254,401	1,436,206	727,530
Jan.-June l974	169,852	100,825	279,626	174,077	449,478	274,902	1,885,684	1,002,432

salescommitments.
Source: Stockpile Reports to the Congress, Office of Emergency Planning and successor agencies.

stockpile aluminum, an equivalent amount was of course made available for civilian business.

3. **Program Provisions**

The disposal was tied into a Government Use Program, under which DOD contractors (and other Government agencies as approved) were required to purchase, directly or through subcontractors, 1 pound of excess stockpile aluminum for every pound of aluminum contained in the items acquired under contracts, with reasonable exceptions for de minimis quantities.

From November through December 1966, the total industry commitment was 150,000 tons; for subsequent years a minimum of 100,000 tons and a maximum of 200,000 tons were established. Within these totals were assigned specific quantities for participating producers based on their proportion of total installed capacity at the end of 1965, taking into account capacity under construction and shipments from Alcan to the United States.

For companies participating in the program, the breakdowns were as follows, with reference to 1967 and beyond. These were, in effect, merely guidelines, rather than firm requirements.

	short tons	
	Minimum	**Maximum**
Alcoa	29,400	58,800
Reynolds	22,400	44,800
Kaiser	20,100	40,200
Olin	3,800	7,600
Revere	1,900	3,800
Harvey	2,700	5,400
Alcan	10,000	20,000
	90,300	180,600

The program was established in 4-year intervals, the first ending in December 1969 and the second in December 1973. To provide flexibility, each participant could purchase more than its obligation in any period and could defer annual obligations within a 4-year period. Contracts were to run until all excess material had been sold. Set-asides for small business, nonintegrated purchases, and other nonparticipating purchases amounted to 25,000 tons in 1966 and 10,000 tons annually thereafter, Quantities set aside for these purposes but not sold were to become part of the industry's overall commitment.

The purchase price was to be each participating purchaser's published price in effect at the date of delivery for the sale of the grade, form, size, and quantity of aluminum involved (including and subject to the standard terms and conditions applicable thereto), less the lower common carrier rate from Government storage location to destination. It was provided that if on the date of delivery the current published price of any other participating company were lower than the participating purchaser's published price, the lower price would prevail.

4. Conclusion

Despite many of the problems incidental to potential serious economic disruptions which could affect a large industry, the aluminum disposal program appears to have accomplished its purpose. The positions taken by the aluminum industry reflect one of the major difficulties encountered with any commodity stockpile disposal program, the fears of market disruption to the detriment of industry.

5. References

Bureau of Domestic Commerce, unpublished memoranda Washington, D. C.: U.S. Department of Commerce.

Farin, P., et al. Aluminum—Profile of an Industry. New York: McGraw-Hill, 1969.

Fifteenth Annual Report of the Activities of the Joint Committee on Defense Production, Washington, D. C., Jan. 17, 1966, (Contains details on stockpile negotiations and price developments in November 1965.)

Hass, J. A., A. M. Poret, and A. H. K. Tan The Aluminum Price Crisis of November 1965—Its Effect on Business-Government Relations. Pittsburgh: University of Pittsburgh Graduate School,

Office of Emergency Preparedness, Semi-Annual Stockpile Reports to the Congress, Washington, D.C.

B. TITANIUM STOCKPILE PROGRAM, 1972-75

1. Introduction

The titanium stockpile program inaugurated in June 1972 was a classic example of the full-scale arrangement—from acquisition to disposal—containing all the elements of mobilization base, economics, and politics. As a move to keep in existence the titanium industry whose future was otherwise threatened by market conditions, the program had the support of the Department of Defense (DOD), segments of Congress and, of course, the industry itself, An added consideration was a quid pro quo with Congress—a titanium stockpile in exchange for the release of other stockpile material bottled up in congressional committee.

To date, the program has run close to its schedule, and it appears to have more than served its purpose of maintaining a titanium industry in this country, From the standpoint of the two producers involved, the results have been favorable in that an approximate doubling of the domestic market price since the inception of the program has resulted in potential financial gains through buy-back privileges at the original price, This case study presents the record of the government-industry titanium program with a discussion of available options aside from stockpiling,

2. Titanium Use in Aircraft Industry

The fortunes of the titanium industry in the United States have been closely tied to the ups and downs of both military and civilian aircraft production, in which about 90 percent of all titanium finds its use due to its high strength-to-weight ratio. The industry was started in 1950 through Government aid in the form of guaranteed purchase contracts, loans, loan guarantees, and research contracts. Although six large companies had begun producing titanium sponge, the raw material for mill products and castings, only one company remained in production by 1960, Increasing markets and Government prodding subsequently led to the entrance of other firms, but the collapse of the SST program in particular put these in jeopardy by the last half of 1971. There were then three integrated titanium producers handling all stages from raw material to finished products. Their situations are summarized in the table below:

Company	Location	**Titanium sponge annual capacity (million lb)**	**Operating** status	**Employees laid off**	**Financial losses 1970 ($ million)**
TIMET[a]	Henderson, Nev.	28	Closed 6-71	500	$5.6
RMI[b]	Ashtabula, Ohio	15	Closed, 12-71	150	6.0
OREMET[c]	Albany, Oreg.	5	Closed, 8-71	125	2.4
		48		775	14.0

[a]50 percent owned by Allegheny Ludlum Steel.
‘Principal stockholders, Armco Steel and Ladish Forge,
‘Jointly owned by U.S. Steel and NL Industries.

a. Titanium Imports.—With imports from the U.S.S.R. and Japan accounting for 30 percent of domestic usage of titanium sponge, the demand in 1971 and that projected for 1972 would be only large enough to permit U.S. producers to operate at no more than 40 percent of capacity. Immediate factors in the closings shown in the above table were not only the decline in sales, but the resulting large inventory accumulations amounting to 9 to 12 months’ supply. Imported material was of the quality required by some domestic mill product producers. In addition to the three integrated producers, there were six nonintegrated producers of titanium mill products, most of whom were using imported sponge.

b. Impact of Titanium Industry Closings.-The plant closings and the unfavorable prospects for a near-term recovery of titanium demand led to serious concern from several areas about the future of the U.S. industry. The DOD was worried about a viable domestic industry for a mobilization base, as was the OEP. The two Senators from Nevada were worried about employment at the plant at Henderson. The industry was naturally worried about its own existence.

Discussions were already being held in Government circles When the chairman of the Joint Committee on Defense Production wrote to the Director of OEP on November 1, 1971, requesting reports on the following: current status of the industry, estimates of future demand, views as to a need for maintaining a domestic industry, and information on any action taken or contemplated in connection with maintaining a domestic titanium industry. At about the same time, industry officials were in contact with both OEP and DOD on the same subject, OEP’s December 22 reply to the Joint Committee summarized the situation and stated that an analysis was being made of the extent to which a domestic titanium industry would be needed to meet mobilization requirements, and that work with DOD would continue in examining alternatives for sustaining the industry to meet national security needs.

In addition to the overall concern about the future of the domestic industry, there were also considerations regarding even the temporary plant closings, which raised questions about the deterioration of plant facilities unused for a number of months and the availability of technicians and skilled labor for reopening these plants.

3. The Available Options

As a result of discussions between OEP, DOD, other interested agencies, and the industry, the following six options were put forth, although the last three were not given serious consideration:

a. Option l.—Government purchase of .7,000 tons of titanium sponge for the national stockpile, all from domestically produced sponge. The total stockpile objective was 33,500 short tons, while the amount in the stockpile was 26,501 tons, leaving the 7,000 tons contemplated for purchase. All the material in the stockpile met stockpile specifications. (There were, in addition, 8,514 tons of nonspecification material.) As part of the arrangement, the participating companies would buy back the material, if and when stockpile surpluses later developed, Of the 26,501 tons of specification quality, 6,000 tons were in the national stockpile, 9,021 tons in the supplemental stockpile, and 11,480 tons in the DPA inventory. The release of the 15,021 tons in the national and supplemental stockpiles under the buy-back provision would require not only a declaration of excess but also approval by Congress for its release, The latter provision was not applicable to the DPA stockpile, The purchase of the 7,000 tons would be paid for with other materials excess to the stockpile in lieu of cash. A previous purchase of 6,000 tons of domestic origin, completed in December 1970, was likewise paid for by surplus materials,

b. Option 2.—A buy-American policy, put into effect by DOD, required all titanium for filling defense contracts to be made from domestic sponge, As part of its review of this option, DOD surveyed titanium product producers and found that four of nine companies would have no problem in using domestic sponge, but that the five others would have problems because of chemical characteristics, requiring the installation of new facilities to adapt to the use of domestic sponge. After considering this option, DOD rejected it as not achieving the purpose intended, that of being a short-run politically feasible solution.

c. Option 3.—Direct DOD funding of (1) new manufacturing technology programs to include additional projects intended to make titanium more economically usable and more adaptable for use in DOD weapons systems; and (2) research on the use of domestic ilmenite ore for titanium sponge products in lieu of imported rutile ores. These, again, are longer term solutions to the problems of the industry. DOD did proceed with its manufacturing technology program, while the ore question became part of other agency research, including that of the Materials Advisory Board.

d. Option Q.-Government financing of layaway or standby costs of one sponge facility which had sufficient productive capacity to meet future defense requirements.

e. Option 5.—Government financing of costs to upgrade the quality of sponge produced in the three U.S. facilities and subsequent implementation of the buy-American provision.

f. Option 6.-Government purchase of one of the current U.S. sponge facilities. The Government would maintain it in operating condition for current and future defense requirements.

4. Acquisition and Revisions

The stockpile purchase/buy-back option was adopted as a feasible solution to the titanium mobilization base problem. On January 16 1972, OEP authorized GSA to acquire 7,000 tons of titanium sponge meeting current purchase specifications in order to fill the deficit in the stockpile objective and to maintain the domestic mobilization base. The procurement would be limited to material produced domestically, subsequent to the effective date of contracts to be made with the producers, and would be achieved over a 2-year period. Payment would be made solely from excess materials authorized for disposal. (A previous authorization to acquire 7,000 tons, made in December 1969 was almost immediately rescinded at the request of the Office of Management and Budget.)

The buy-back of the material by the producers would be at the option of the Government and subject to its being declared excess and available for disposal. Until the total inventory was disposed of, the purchasers had to agree to refrain from any current expansion of facilities for the production of sponge anywhere in the world,

Contract negotiations with the three sponge producers were begun immediately, but were not consummated until June 1972, and then only with the two largest producers—TIMET and RMI. The third company, OREMET, was in financial difficulty, and although time extensions were granted the company, nothing came of them. The 500 tons which would have been purchased from OREMET was dropped from the program.

Each contractor was to supply 3,250 short tons at $1.245 per pound, including brokerage costs in disposing of the payment materials and costs for special packaging to meet government specifications. Delivery was required over a 2-year period. The equal amounts for the two companies did not take into account the differing productive capacities.

5. The Buy-Back Program

The buy-back provisions called for purchase by each of the two participating producers over a 10-year period; i.e., 8 years beyond the period for Government acquisition. The provisions would be subject to future Government actions in declaring the sponge both excess and available for disposal.

Ten percent of the excess authorized for sale would be set aside for other then-participating producers and for direct use by the Government.

In the contracts, the two producers were given the option of buying back at the original acquisition price of $1.245 per pound or at the market price at time of sale. Both companies chose the original acquisition price-a wise move from their standpoint in view of the nearly 100-percent” increase in the current price.

6. Deliveries Under the Program

Of the two companies, only RMI has completed its contractual deliveries. RMI had delivered 3,249 tons by May 24, 1974, and has already entered into the buy-back phase of the contract, having taken about 600 tons of DPA material to date. As of December 31, 1974, TIMET deliveries totaled 2,103,3 short tons against the obligation of 3,250 tons, The completion date for deliveries was extended to March 31, 1975. TIMET has faced production problems due to shortages of chlorine and natural gas as production and energy materials.

The stockpile objective was reduced to zero in April 1973 as part of the overall review of stockpile policy, but it is subject to further review. Although the entire stockpile is therefore now in excess of mobilization needs, acquisition has continued in accordance with the contracts. About 50 percent of the 8,514 tons of nonspecification material has been separately disposed of. Sale of recent authorization covering 975 tons for DOD use is pending.

7. Conclusion

There has been decided market improvement since the stockpile program was begun.

Domestic production of sponge increased in 1973 by more than 40 percent over 1972, and it increased by another 18 percent in 1974. Part of this production was, of course, due to the program. At the same time, sponge metal consumption increased by 54 percent in 1973 and by 33 percent in 1974. Imports accounted for slightly less than 30 percent of total consumption in each of these 3 years. It would appear that the increased demand—resulting from higher domestic and foreign purchases of military aircraft, as well as stronger nonaerospace demand—would have gone far toward sustaining the industry without the need for the stockpile program. Much, if not all, of the material which moved into the stockpile would have found current markets, In any event, the domestic industry is now considering capacity expansion,

8. References

Files of the Office of Preparedness, General Services Administration.

Study of Titanium Usage, Materials Advisory Board, National Academy of Sciences.

C. EXPANSION OF COPPER-PRODUCING CAPACITIES: THE DEFENSE PRODUCTION ACT OF 1950, AS AMENDED

1. Introduction

In view of the international situation existing at the time the Defense Production Act of 1950 (64 Stat 798, 50 U.S.C. Sec. 2061 et seq.) was debated, it was recognized that in order to provide for the national defense and national security it would be necessary to divert certain materials and facilities from civilian use to military and related purposes. In order to reduce the time required to achieve full mobilization in the event of an attack on the United States, it would also be necessary to develop preparedness programs and expand productive capacity and supply beyond the levels needed to meet civilian demand. This case study is a brief account of a successful effort that in the end accounted for more than a million tons of copper production.

2. Defense Production Act of 1950

Neither the Stockpile Act of 1939 (53 Stat. 811) nor the Stockpiling Act of 1946 (60 Stat 596, 50 U.S. C, Sec. 98d) had made any provision for governmental assistance to encourage expansion of copper production. The Defense Production Act of 1950, as amended, was intended to establish a system of priorities and allocations for materials and facilities, to authorize the requisitioning thereof, to provide financial assistance for expansion of productive capacity and supply, to provide for the settlement of labor disputes, to strengthen controls over credit—and by these measures, to facilitate the production of goods and services necessary for national security and other purposes. The act authorized Government action to divert scarce resources into the production of military weapons and other essential programs, including stockpiling; to expand production of needed materials, equipment, and components; and to minimize the economic impact of the defense buildup.

a. Authorization of Contracts and Orders.—Title I of the act authorized the President to require that contracts or orders deemed necessary or appropriate to promote the national defense, be given priority and allocation assistance to the extent necessary or appropriate. These powers were not to be used to control the general distribution of any material in the civilian market, unless it was a scarce and critical material essential to the national defense, and unless the requirements of the national defense for such materials could not otherwise be met without causing a significant dislocation of the normal distribution in the civilian market, thereby creating appreciable hardship. Title I also contained provisions for protection against hoarding and price gouging.

b. Expansion of Productive Capacity, Incentives.—Title III of the act was designed to promote the expansion of productive capacity and supply of materials necessary for the national defense. Under title III, provision was made for loan guarantees and loans for the expansion of capacity, the development of technological processes, or the production of strategic and critical metals and minerals, This financial assistance was to be made available only to the extent that it was not otherwise available on reasonable terms.

Also under title III, provision was made for the purchase or commitments to purchase metals, minerals, and other materials for Government use or resale, and for the encouragement of exploration, development, and mining of critical and strategic minerals and metals. Under title III, a variety of production expansion programs were developed for a number of materials. These included production loans, Government floor-price purchase, contracts, and issuance of certificates of necessity. These certificates permitted accelerated amortization of capital investment for tax purposes and exploration loans up to 50 percent of total costs repayable from eventual production,

c. Tax Provisions and Floor Prices.—As indicated above, the Defense Production Act of 1950 was designed to produce the stimulus needed to expand production in a number of materials. These stimuli included rapid tax amortization, loans, and floor-price purchase contracts to stimulate private companies to increase mine production. Under these contracts the Government agreed to purchase specified amounts of output at the guaranteed floor price if the market should not take up these quantities at that price or a higher price,

In 1951 and 1952 the Defense Production Administration approved 10 projects for Government assistance in the production of copper, In most of these projects a floor price was guaranteed in a long-term purchase contract, Until the middle of 1952 no actual purchases of copper by the Government had occurred on such expansion contracts. Some of the 10 projects also involved accelerated tax amortization, or government loans, or both.

d. Increase in Production.—It was estimated that the annual increase in output from the mines opened by these projects would total about 250,000 tons of copper, It was expected that the full output would come in by 1955 and that about 100,000 tons would be available in 1954.

3. Results of the Program

Table B–2 lists 19 contracts to expand production of copper. In terms of the Government's commitment to purchase copper under these contracts, the total potential commitment of the 19 projects totaled 1,191,240 short tons of copper. However, since copper prices were relatively good during much of the contract delivery period, 949,345 tons were sold to industry and only 253,525 tons were delivered to the government. In addition, obligations to deliver 9,924 tons to the government were canceled.

There was also a small program for the maintenance of production at some mines which could not produce copper at the fixed price prevailing in 1952. Contracts were consummated for 30,434 short tons of copper at an average subsidy of $127.39 per ton. These contracts were terminated on removal of copper from price regulation in March 1953. Under this program, 16,201 tons of copper were delivered.

Table B–2.—Copper: Summary of Defense Production Act borrowing authority transactions

(In short tons)

Contract number	Contractor	contract quantity	Delivered to Government	"Put''rights not used	Canceled
DMP–III-11	Rhodesian Congo Border Power Corp. . .	34,316	15,705	18,611	—
DMP–19	San Manuel	347,500	79,117	268,383	—
DMP-131	National Lead Co.	3,600	1,420	430	1,750
D-12190	White Pine Mining Co.	243,750	30,045	213,705	
DMP-80	International Nickel Co..	50,000	47,504	—	2,496
DMP-83	Banner Mining Co.	6,480	4,833	—	1,647
DMP-89	Copper Range Co.	3,982	8,658		345
D–12129	AS+R.	88,500	—	88,500	
D-12116	Anaconda	128,000		128,000	—
DMP-94	Appalachian Sulphide	2,000	2,000		—
DMP-3	Campbell Chibougamau.	31,600	—	31,600	—
D-12084	Copper Cities	85,000	—	85,000	
DMP-84	Copper Creek Cons. Mining Co..	2,750	101	—	2,649
DMP-60	Falconbridge.	16,000	15,978	—	22
DMP-92	Howe Sound Co.	5,939	5,935	—	4
DMP-57	Miami Copper Co..	25,198	25,198	—	—
D-12087	North Butte Mining.	2,625	—	2,625	—
D-12088	Phelps Dodge....	112,500	—	112,500	—
DMP-90	Riviera Mines Co..	1,500	468	—	1,032
Subtotal		1.191,240	231,959	949,354	9,924
Various	Maintenance of production (1952).	30,434	16,201	—	14,233
Various	Stockpile diversions.	5,365	5,365	—	
Total		1,227,039	253,525	949,354	24,157

Source: Report on Borrowing Authority, June 30, 1974. Office of Preparedness, General Services Administration

4. Conclusion

The program did achieve its objectives; however, it is important to recognize that price incentives were used and that tax amortization certificates were also issued as stimulus under the program. Several properties operating today began producing as a result of this expansion program.

5. References

Defense Production Act of 1950 (64 Stat 798, 50 U.S.C. Sec. 2061 et seq.)

Report on Borrowing Authority, June 30, 1974, General Services Administration,

Files of Office of Preparedness, General Services Administration.

D. RELEASES OF COPPER FROM THE STOCKPILE

1. Introduction

Because of past efforts to stimulate the production of copper for the defense stockpile, the subsequent history of disposals represents a change in stockpiling policy which primarily reflects determinations by the executive departments of the Federal Government, largely through Presidential action. This case study indicates how the copper releases were accomplished and the steps taken in stockpile disposal.

2. **Early Releases of Copper**

a. Coinage Releases.—In November 1959 the Bureau of the Mint purchased copper for coinage from industry at a price which was publicly criticized because of its high level, especially since copper was available in the national stockpile and Defense Production Act inventory. The Mint thereafter sought the copper it needed from the stockpile.

Between May 24, 1960, and October 22, 1964, nine separate releases totaling 107,000 tons were made to the Mint. At the time these releases were made, the total inventory of copper exceeded the copper stockpile objective, and all of these releases were made from the DPA inventory. It was therefore not necessary to secure congressional approval.

b. Requests for Stockpile Releases.—Subsequent to the declassification of stockpile information in 1962, the Office of Defense Mobilization (subsequently the OEP) was besieged with frequent requests that copper be released to industry from the stockpile. The OEP consistently resisted these demands, pointing out that the stockpile was not designed to be an economic weapon or to act as a buffer stock, and that it was to be released only on authority of the President for the common defense in time of war. At that time the maximum stockpile objective for copper was 1 million tons and the inventory totaled about 1,135,000 tons. Since preliminary estimates indicated that the nuclear stockpile objectives, when established, would exceed the inventories then on hand, it was not considered prudent to release even that amount which exceeded the objectives. In June 1963 the copper stockpile objective was reduced from 1 million tons to 775,000 short tons.

In 1963 and 1964 the price of refined copper in the foreign markets was substantially higher than the U.S. producer price, and U.S. dealers tended to follow the foreign market price rather than the U.S. producer price. These differentials gave rise to demands for copper from the U.S. stockpile inventories which, if released, would be at the U.S. producer price level. A frequently submitted rationale was that the copper was required for defense contracts and that the costs of materials would ultimately be borne by the Government.

3. **Copper Releases Accelerated**

In December 1964 the President ordered the release of 20,000 tons of copper from the stockpile. This was released from the DPA inventory and was allocated by the BDSA (Commerce Department) on a defense-related hardship basis. The remaining balance of DPA copper was relatively small--only 6,186 tons.

In April 1965 a second release to industry was authorized by the Congress and the President (Public Law 89-9). This time, 100,000 tons were released from the strategic stockpile. Again allocations were made by BDSA on a defense-related hardship basis.

a. Further Coinage Requirements.—In August 1965 the Mint indicated a new and larger need for copper. Public Law 89-81, approved July 16, 1965, provided for the elimination of silver from dimes and quarters and a reduction in the silver content of half dollars from 90 percent to 40 percent. The new dimes and quarters would consist of about 90 percent copper and 10 percent nickel, while the half dollars would be about 60 percent copper. In view of these estimated coinage needs for copper over the next several years, the Treasury requested that 117,000 tons of copper be earmarked for Mint use, in addition to that already so identified.

The Director of OEP requested the Administrator of GSA to make available to the Mint all of the uncommitted DPA copper in inventory, except 1,800 tons to be reserved for payment in kind for upgrading contracts and approximately 110,000 tons of fire-refined copper from the national stockpile. Since the 110,000 tons needed congressional authorization, the Director of OEP requested the Administrator of GSA to seek such approval as soon as possible, including a waiver of the 6-month waiting period. The authorization was approved by the Congress on October 9, 1965, in Public Law 89–251.

b. Presidential Authority.—On November 15, 1965, the Attorney General sent a memorandum to the Director of OEP, advising him that under section 5a of the Stockpiling Act of 1946, the President may order the release of material from the stockpile at any time when, in his judgment, such release is "required for purposes of the common defense. "

On November 17, 1965, the Secretaries of Commerce, State, Treasury, and Defense, and the Chairman of the Council of Economic Advisers signed letters which recommended the immediate release of 200,000 tons of copper from the national stockpile for purposes of the common defense.

c. Anticipated Supply Disruption.—Defense uses of copper for the Vietnam war were substantial at the time and were expected to double in 1966. The Chilean copper industry, the largest single foreign supplier to the United States, was on strike, and the supply of copper from Zambia was in danger of being cut off. This would have imposed serious disruptions in the supply of copper for the industrial nations of Western Europe, and these disruptions, in turn, would have had repercussions for the total supply of copper available to the United States.

4. Presidential Action

On November 18, 1965, the President, acting in accordance with the provisions of section 5 of the Strategic and Critical Materials Stockpiling Act of 1946, as amended (50 U.S.C. 98d), ordered the release of 200,000 tons of copper from the stockpile for purposes of the common defense. Three corollary actions were taken:

- Exports of both copper and copper scrap from the United States would be controlled for an indefinite period in order to conserve domestic supply;
- Legislation was to be requested of Congress by the administration to permit the suspension of import duties on copper, which at that time amounted to 1.7 cents per pound; and
- Discussions were to be held with the directors of the New York Commodity Exchange urging them to curb excessive speculation in copper trading by raising the margin requirements from the current level of 10 percent to a figure more comparable to that required by the New York Stock Exchange (i.e., 70 percent at that time),

a. Further Request.—Approximately 4 months after the November 1965 release of 200,000 tons of copper from the national stockpile, another request for a similar amount was put forward,

Despite the imposition of U.S. export controls on copper, copper scrap, and copper products, which heiped to prevent any serious disruption of domestic production or further increases of prices in the dealers' market, the demand for copper continued to increase, and many users found difficulties in obtaining adequate supplies, The increase in demand for copper gave credence to the belief that speculative inventories were being accumulated.

According to a memorandum for the Attorney General from the Acting Chairman of the Council of Economic Advisers, the rationale for another stockpile release appeared to be more directly related to economic considerations and only indirectly related to defense needs,

b, Further Presidential Action.—On March 21, 1966, the President, again acting in accordance with the provisions of section 5 of the Strategic and Critical Materials Stockpiling Act (and basing his action on the opinion of the Attorney General and on letters signed by the director of OEP; the Secretaries of State, Treasury, and Commerce; the acting Secretary of Defense; and the Acting Chairman of the

Council of Economic Advisers), determined that a release of 200,000 tons of copper was required for purposes of the common defense. The President directed that disposals should be made through regular producer channels on a periodic basis and in such a way as to facilitate the orderly distribution of copper supplies with priorities to defense and defense-supporting users.

c. Replenishment Option.—The Secretary of Commerce, the Director of OEP, and the Administrator of the GSA were instructed to make provision, in connection with the copper disposals, to give the Government an option to replenish the stockpile at the then-current market price of 36 cents, or at the domestic market price if it were less than 36 cents at the time the Government option was exercised. The option arrangement was to give the Government the right to call for immediate delivery in the event of any emergency,

The Administrators of the GSA and other Government agencies were instructed to use acceptable substitutes for copper where feasible.

d. Domestic Expansion Plan of 1966.—The Secretaries of Commerce and Interior and the Director of OEP were instructed to take all necessary steps to expand domestic production of copper through the use of special incentives on a selected basis.

On March 29, 1966, the President authorized the Director of OEP to take steps to accomplish a copper expansion program. (See Case Study on the second copper expansion.)

The repurchase of copper never took place. Funds were not available for repurchase in 1969, 1970, 1971, or 1972. Finally, in September 1971, the Administrator of GSA was authorized by the Director of OEP to cancel all options to repurchase this copper.

e. Industry Position on a Third Release.—By September 1966 the question of a third release of 200,000 tons of copper from the national stockpile was raised. In a meeting at the Department of Commerce the eight leading copper producers indicated they felt there was no need for any additional releases of copper from the stockpile; in fact, they did not want it and believed they could handle all defense orders without assistance, They felt the inventory was too low and might be needed at some future time. However, if any release was to be made, it should be confined to defense-related orders. Furthermore, the producers did not want to handle the allocation and wanted someone else to do it. It should be noted that these were the opinions of the producers who were ever mindful of their markets and their customer relations.

The consumer inventories of fabricated copper mill products were high at the time, and the order boards at the mills contained many duplications. It was also estimated that a release of copper would probably go into inventories rather than consumption.

However, labor contracts were due to expire between March and June 30, 1967, and the extra inventory could support industrial production during the second and third quarter of 1967 if strikes occurred.

f. Presidential Action.—A review under revised criteria affecting the stockpile objective for copper appeared to support an inventory objective of about 250,000 tons. The inventory at the time was 408,000 tons. On December 1, 1966, the President, in accordance with the provisions of section 5 of the Strategic and Critical Materials Stockpiling Act, as amended (50 U.S.C. 98d), determined that the release of 150,000 tons of copper was required for purposes of the common defense. This left the copper inventory balance at 258,000 short tons.

The President's letter ordering the release of 150,000 tons of copper noted his approval of the recommendations of the Office of Emergency Planning; the Secretaries of Treasury, Defense, and Commerce; the Acting Secretary of State; and the Chairman of the

Council of Economic Advisers. The letter also directed that disposals should be made through regular producer channels solely for defense and defense-supporting uses, as necessary.

On December 2, 1966, the OEP instructed GSA and Commerce to sell the 150,000 short tons of copper released from the stockpile in two logs—90,000 tons in February and 60,000 tons in May.

g. Industry Proposal.—Copper industry-labor contracts were up for renegotiation in mid-1967. Subsequently, the copper producers indicated to BDSA that they might have a difficult time absorbing the full impact of defense orders when the stockpile copper was exhausted. It was proposed that the copper be sold as follows:

- 22,000 S.T. (short tons) each month for the first 3 months of 1967;
- 20,000 S.T. each month for the next 2 months of 1967;
- 12,000 S.T. each month for the next 2 months of 1967; and
- 9,000 S.T. each month for the next 2 months of 1967.

This would permit the copper producers to stretch out the copper over a 9-month period, and it would provide a hedge against the possibility of strikes in their copper mines.

5. Final Disposal of Copper

The balance of copper inventory was subsequently released to the U.S. Treasury for coinage. This terminated the copper stockpile disposal program.

6. Reference

Files of Office of Preparedness, General Services Administration.

E. SECOND EXPANSION PROGRAM, DUVAL SIERRITA MINE

1. Introduction

This case study is an account of the Federal program which resulted in the establishment of the Duval Sierrita mine, an operation which is producing copper today with a favorable return to the Government and a substantial improvement in the availability to U.S. industry of copper and molybdenum.

2. The Title Ill Proposal

The release of 200,000 tons of copper ordered on March 21, 1966, carried with it the suggestion that production capacity for copper be increased. This suggestion was formalized in a letter dated March 29, 1966, from the President to the Director of the Office of Emergency Preparedness (OEP) which authorized him to take steps to encourage additional production through new purchases or commitments to purchase copper under section 303 of the Defense Production Act.

The Director of the OEP thereupon directed the Administrator of the General Services Administration (GSA) to develop, by authority of title 111 of the Defense Production Act, a limited program of expansion of copper production capacity in addition to such increases in capacity as were then contemplated or already underway by domestic producers. Priority attention was to be given to those situations where additional copper production could be brought into being in a relatively short time. The period of performance of proposed contracts covering purchases and commitments to purchase under the program was not to extend beyond June 30, 1971.

An effort was to be made to provide for total commitments of approximately 120,000 tons of copper. However, in view of the limitations on use of the borrowing authority contained in section 304(b) of the Defense Production Act of 1950, as amended, the total of new purchases and commitments, including contingent liabilities, was not to exceed $100,000.

a. Purchase Price Estimates.—The proposed supply of copper could not be effectively increased at lower prices or on terms more favorable to the Government. Therefore, it was recognized that purchases, or commitments to purchase, involving prices higher than the one then current (**36** cents per pound), or involving anticipated loss on resale, would be inevitable.

An OEP telephone survey of the major copper producers revealed that 10 of these producers had their own expansion program underway and did not need or want Government assistance. Estimated 1965 production of these 10 companies totaled 1,193,625 short tons. Capacity to be added was estimated at 95,000 tons in 1966; 114,500 tons in 1967; and a net addition of 21,000 tons in 1968.

Potential additional expansions for which Government assistance would be needed showed an additional potential capacity of 4,750 tons which could be in during 1966, 20,000 more in 1967, and 30,000 in 1968. However, these projections were dependent upon higher prices.

b. Marginal Properties.—Firms seeking to expand production or initiate new production from marginal properties were invited to submit applications for governmental assistance to the GSA, which chaired an interagency working group including representatives of the Departments of Commerce and Interior and the OEP. The group evaluated proposals received under the program and recommended appropriate disposition. Forms of governmental financial assistance which were considered included advances on firm purchase contracts, guaranteed private loans, and incentive price arrangements. In addition, the program attempted to utilize to the extent possible the facilities, funds, and authorities available in such agencies as the Department of Commerce, Interior, and the Small Business Administration.

3. Selection of Duval Corporation

Under this program, approximately 150 applications were received from firms and individuals. From the several proposals received, one contract, involving substantial long-term production of new copper, was executed in November 1967 with the Duval Corp., a subsidiary of the Pennzoil Corp. The Duval Corp. was to develop and operate the Duval Sierrita mine in Pima County, Ariz. Of the $100 million authority available in the Defense Production Act, this project took $83 million, to be repaid with 109,000 tons of copper,

a. The Contract.—As the contract was originally written, the Duval's Sierrita mine in southern Arizona was to produce **60,000** short dry tons of ore per day. Between November 1967 and March 1973, eight amendments were attached to the contract. These concerned increases in minimum capacity from 60,000 to 70,000 short dry tons per day; a stretchout of deliveries completion from 1971 to 1975, then to 1979; an increase of working capital of the company from $10 million up to $25 million; and the shipment of electrolytic cathodes in lieu of electrolytic wirebars. The switch to cathodes was made to accommodate the needs of the Mint for cut cathodes. In January 1971 provision was made to transfer shipments to the Mint instead of to GSA.

The GSA controls capital expenditures and has the authority to restrict the cash flow of the company. The copper is being delivered at 38 cents per pound. This price was 2 cents in excess of the market price of copper at the time the contract was written. Thus far the price has been substantially below the market in all of its deliveries. Deliveries up through March 15, 1975, have totaled 43,831 tons.

b. Expansion Program Terminated.—Because the primary objectives of the Copper Production Expansion Program had been achieved, and since the small balance of remaining funds precluded any significant new production under the program, the OEP concluded on April 15,1968, that the best interests of the Government would be served by closing out the program and so notified GSA.

4. Conclusion

The contract for the Duval Sierrita mine has again demonstrated the value of a copper contract of this nature, The Government has benefited, copper-producing capacity has been increased, and an expanded mine facility has been put into operation.

5. Reference

Files of Office of Preparedness, General Services Administration.

F. THE NICKEL LOAN OF 1970–71

1. Introduction

The free world lost nearly zoo million pounds of primary nickel production from July to November 1970, when the two major free-world producers of primary nickel were shut down by labor strikes. U.S. availability of nickel fell from more than 28 million pounds to 9 million pounds of primary nickel per month. In its efforts to ease the situation, the Government released in November 9 million pounds of nickel from the inventories of the U.S. mint. These were used to fill defense-rated orders in November and December. This case study tells the story briefly of the nickel acquisition contracts, the stockpile, and the eventual disposal of its contents.

2. Nickel Shortage and Stockpile Release

Even with the strikes settled and the Treasury nickel being shipped to defense consumers, the supply picture was far from adequate, Therefore, the Director of OEP in concurrence with the Secretaries of Defense, State, Commerce, and Interior recommended that the President take action to insure added nickel supplies for common defense purposes. Accordingly, on December 15, 1970, the President, acting under section 5 of the Strategic and Critical Materials Stockpiling Act, released 20 million pounds of nickel for purposes of the common defense.

The release of nickel from the stockpile took the form of a loan rather than a sale, with the arrangements calling for the stockpile to loan nickel to any of the three primary nickel producers. The loans were to be subject to the set-aside provisions of the Defense Materials System and to distribution by allocation for defense-rated orders by the Business and Defense Services Administration (BDSA) of the Department of Commerce.

a. Contract Accepted by International Nickel Co., Inc. (Inco).--Three firms were eligible to participate: Hanna Nickel Smelting Co., Kaiser Le Nickel Corp., and the International Nickel Co., Inc. (Inco). However, Hanna and Le Nickel, feeling that they could not comply with the conditions set forth by the Government, dropped out of the program. International Nickel accepted the conditions. These conditions required that—

- The participant would agree to distribute the nickel, in the form received or in an upgraded form, to U.S. consumers of nickel under allocations by BDSA.
- The participant would agree to return all nickel due the U.S. Government before July, 1, 1972, the exact schedule to be negotiated by GSA.

- The quantity a participant must return would be calculated on a value-for-value basis, less processing and handling costs, plus the value of interest earned. The specific handling and processing costs and the rate of interest would also be subject to negotiation by GSA.

- The participant would agree to replace nickel with a higher form than that received from the Government.

The nickel to be loaned was in the form of nickel oxide powder, large cathodes, and briquettes. These forms had been in the stockpile at least 10 years. Produced under older production technology, they were of somewhat lower quality than the nickel used in the industry at the time of the loan. It was planned that when a participant replaced the stockpile nickel, they would replace it with nickel from new production and of higher quality. This would raise the quality of the stockpile and make it more flexible for emergency use.

In accepting the Government's conditions, Inco also agreed to aid the small-business firms injured by the strike by increasing the amount of production made available to plating houses, distributors, and others who distribute to small nickel users.

b. Nickel Shortage Overcome.-Almost 1 year later, representatives of Inco tested the possibility of converting the loan of 20 million pounds of nickel to an outright sale or obtaining a deferral of their repayment deliveries to the stockpile. At the time the company extended this feeler, demand for nickel was high, due to the need for filling pipelines. It was believed that meeting the repayment delivery schedule would place a hardship on the company. Shortly afterward, the nickel shortage turned into an oversupply.

A review of the nickel stockpile objective in December 1970 reduced the stockpile objective to zero. There was therefore no apparent need for the physical return of the loaned nickel.

In anticipation of formal proposal from Inco, several factors were considered. GSA lawyers reviewed the legality of converting the nickel loan to a sale, and decided that if the President desired to convert the loan to a sale, he could do so without any further public announcement, However, it was noted that at the time of the loan there was much publicity about the fact that nickel was being released in one form but would be returned to the Government in upgraded form, thus increasing the national security value of the stockpile. Furthermore, the Director of the OEP, testifying before the Armed Services Committees, had provided specific details on the proposed loan, including the fact that the stockpile would be upgraded by the return of newer nickel. Nevertheless it was expected that an announcement of the zero objective established in December 1970 would remove any serious objections to the conversion of the loan to a cash sale.

c. Nickel Disposal Program.—The disposal program faced a substantial shortfall in its targets for fiscal year 1971, and the estimated $26 million sale was considered to be an attractive bonus. Furthermore, it would be a positive dollar receipt compared with the uncertain outcome of any later request for necessary disposal legislation from Congress.

Another consideration was the relative importance of maximizing receipts in fiscal year 1971 versus maximizing them in fiscal year 1972, when the final receipt picture could have some impact on the 1972 election campaign. It appeared that the fiscal year 1971 budget was already in a substantial deficit position; as the sale of the nickel would not appreciably alter that position, it was suggested that a White House decision be sought on whether the conversion to sale should be delayed to fiscal year 1972, when the receipts could be used to maximum political advantage.

It was pointed out that a delay in the repayment schedule would present no problem to the Government. Inco would have to continue paying interest on the loan.

d. Deferral of Nickel Deliveries. -On December 15, 1970, representatives of Inco met with the director of OEP and members of his staff to review the status of the nickel loan under section 5 of the Stockpiling Act. The company requested approval of a deferral of their deliveries for the period of January to June 1971. In return, Inco would agree to an amendment of the contract which would insure that the Government would not suffer any loss, in either total value or number pounds of nickel. In view of the status of the nickel market at the time and the outlook for the following 3 or 4 years, it was agreed that it would be in the best national interest to permit Inco to defer their deliveries to an added-on time period.

A review of stockpile policy and guidance was underway at the time of the meeting. Because of that and the most recent review of the nickel stockpile objective, it was decided to amend the contract later in the year to permit the government to receive, as it desired, either nickel or cash in repayment of the loan. To calculate the interest costs involved in deferring deliveries from the first one-third time period to an added-on time period, it was agreed that the middle date in each time period would be used.

In general, the company appeared agreeable to doing whatever the Government desired, but indicated a need for planning time if the Government decided on cash payment.

e. Revision of Payment Terms.—The GSA and Inco accordingly began negotiating a revision of the repayment terms of the loan contract. On January 14, 1971, Inco representatives stated that the company was willing to convert the first third of the contract to a cash payment. They recognized that the Government wanted to convert the entire contract to cash, but they would not make a commitment on the remaining two-thirds at that time. However, they were sure that Inco and GSA could reach a satisfactory agreement before June 1, 1972. The GSA representatives felt they could reach agreement prior to that date if they received authority from OEP. The conversion of the contract to cash required three actions: (1) Announcement of the new nickel stockpile objective; (2) Presidential approval of cash repayment; and (3) OEP authorization for GSA to seek cash conversion.

On February 9, 1971, the Director of OEP formally established a zero stockpile objective for nickel, Ten days later he requested the President to amend his instruction of December 15, 1969, to permit a cash repayment rather than replacement of the nickel. The President was advised that if the Government were compelled to take nickel in repayment of the loan, the metal would be excess to the zero stockpile objective. The OEP and GSA would then have to seek congressional authority to dispose of it. On March 5, 1971, the President accepted the Director's recommendations and authorized the acceptance of cash as repayment for all or part of the nickel loaned after December 15, 1969.

The subsequent negotiations between Inco and GSA were successful. The GSA expected to receive over $28 million in principal and interest prior to July 1, 1973.

f. Disposal of Excess Nickel.—I)uring the January 1971 negotiations, Inco sought assurances that reduction of the stockpile objective would not mean Government entry into the commercial nickel market. It was suggested that the OEP could minimize this concern by indicating that any excess nickel would be made available to the U.S. Mint for coinage and that OEP plans at the time precluded any commercial offers excess stockpile nickel.

On February 24, 1971, at the request of OEP, the GSA submitted a plan for selling the balance of the nickel stockpile to the Mint. The OEP accepted and approved the plan and authorized the sale to the Mint of the entire Defense production Act inventory— 2,439,518 pounds of nickel.

On April 5, 1971, the GSA submitted its request for congressional approval of the plan.

77-119 0-76-18

On July 26, 1972, the Congress enacted Public Law 92–355, authorizing the GSA to sell the balance of their strategic stockpile of nickel. The sale covered 77,712,878 pounds of nickel from the strategic stockpile. The sales value of the disposal to the Mint amounted to $119,617,293 for the strategic stockpile nickel, plus $3,244,559 for the Defense Production Act nickel, for a total of $122,861,852. The acquisition cost had totaled $44,711,340,

3. Conclusion

As of this date, the nickel in the defense stockpile has been sold and disposed of. As indicated in the preceding paragraph, the Federal Government showed a profit of approximately $78 million without taking into account inflationary trends.

4. **Reference**

Files of Office Preparedness, General Services Administration

G. INTERNATIONAL TIN COUNCIL

1. Introduction

Most of the world's major tin producers and consumers are signatories of the International Tin Agreement, the only formal international commodity agreement for a metal. (The United States has recently signed and submitted to the U.S. Senate for advice and consent to ratification its agreement to the Fifth International Tin Agreement.) Under this agreement, the International Tin Council (ITC) sets floor and ceiling price operating ranges for the ITC buffer stock manager, who buys and sells tin on world markets with the intention of preventing wide swings in world tin prices. The producers make obligatory contributions to the tin buffer stock and are required to impose export control if the ITC deems such action necessary. The combined actions of the buffer stock manager and export controls have prevented prices from going below ITC - established floor prices, but the ITC has been less successful in preventing the price from going above the established ceiling price.

The ITC Agreement was signed or ratified by 20 tin producing and consuming countries and became effective on July 1, 1956, for a 5-year term. The second ITC Agreement came into force on July 1, 1961, Three of the larger consuming nations, the United States, U. S. S. R., and West Germany did not sign or ratify either agreement. The Third Agreement became effective July 1, 1966, and the Fourth Agreement on July 1, 1971. Because the First ITC Agreement became the model upon which subsequent agreements were reached, some review of its program becomes important.

2. The First International Tin Council Agreement

The stated objectives of the original agreement were (1) to insure adequate supplies of tin at reasonable prices, and (2) to prevent excessive fluctuations in the price of tin, The governing body of the ITC is composed of a representative from each producing and consuming member government. The producing countries have 1,000 votes (5 initial votes for each country) and an additional number proportionate to their consumption. The voting power could be changed to meet changing conditions.

The First Agreement established a floor price of £640 per long ton (80 cents per pound) and a ceiling price of £880 per long ton ($1.10 per pound). The floor and ceiling prices were raised several times. On December 5, 1963, for example, the floor price was raised to £850 per long ton ($1.0635 per pound) and the ceiling price was raised to £1000 per long ton ($1.25 per pound). This agreement further provided for establishing a buffer stock of 25,000 long tons of tin or the equivalent in cash, Contributions (not to exceed 75 percent in metal) of metal or cash were compulsory for producing countries. Additional voluntary contributions could be made by producing or consuming countries.

a. Pricing Under the First ITC Agreement.—Under the agreement, when the price of tin was at or above the ceiling price, the Buffer Stock Manager was required to offer tin for sale if he had tin available. When the price was at or below the floor price, the manager was required to buy tin if he had funds. The range between the floor and the ceiling was divided into three sections, as follows:

	Upper range	Lower range	Middle range
£ per long ton	850-900	900-950	950-1,000
Cents per pound	106.25-112.50	112.50-188.75	118.75-125
Manager may.	Buy	No action*	Sell

● Unless the Council directs otherwise.

The Buffer Stock Manager bought tin in 1958 in an attempt to support the floor price of $750 per ton (91.25 cents per pound) until funds (both regular and special voluntary contributions) were depleted in September.

In 1959, the manager liquidated tin acquired by the special fund. The remaining tin was sold in 1961 in an attempt to maintain the ceiling price of £880 per long ton (110 cents per pound).

The manager entered the market briefly in the fall of 1962 to support the floor price of £790 (98.75 cents) and again in 1963 in an attempt to maintain the ceiling price of £965 (120.625 cents).

b. Export Control Authority.—It should be noted that the ITC had an ally in its efforts to contain the price of tin, This was its authority to require its producer members to impose export controls when the situation recommended such action, Thus, export controls by producer member countries were in effect from December 15, 1957, to September 30, 1960. The Buffer Stock Manager was permitted to operate in the middle price range to prevent a sharp rise in the price of tin when the export controls first became effective,

3. The Fourth International Tin Agreement

This agreement became effective July 1, 1971, and will expire June 30, 1976, There are 7 producer members and 20 consumer members, The members and their voting strengths are listed as follows:

Producer countries:	Votes
Malaysia	426
Bolivia	179
Thailand	126
Indonesia	138
Nigeria	45
Zaire (Congo-Kinshasa)	39
Australia	47
	1.000

Consumer countries:	
Japan	204
United Kingdom	147
Germany, Fed. Rep. of	111
France	90
U.S.S.R.	65
Italy	58
Netherlands	45
India	42
Canada	40
Poland	34
Czechoslovakia	34
Belgium	29
Spain	24
Yugoslavia	16
Hungary	15
Denmark	11
Bulgaria	10
Austria	10
Taiwan	8
Korea, Republic of (South)	7
	1,000

a. Buffer Stocks Under Fourth Agreement.—The buffer stock of the Fourth Agreement comprised compulsory contributions equivalent in cash or tin metal to **20,000** tons payable by the producing members of the Council on an installment basis. An initial contribution—the cash equivalent of 7,500 tons or £10,125,000 was paid at the inception of the agreement-and from these funds 2,672 tons of tin were acquired from the liquidation of the Third Agreement buffer stock.

Further installments could be called up by the Council from time to time as considered necessary, and the Council could extend to the Executive Chairman the authority to call up funds at short notice. At its second session under the Fourth Agreement, the ITC made use of the new provision and gave authority to the Executive Chairman to call up installments should he consider it necessary for the efficient operation of the buffer stock.

In order to avoid unnecessary retention of funds in the buffer stock, another new provision permitted the Council to make refunds to the producers if the total cash assets of the buffer stock at any time exceeded the total of initial contributions payable and of any voluntary contributions. The revolving nature of the fund, together with the new power both to buy and sell in the upper and lower section, made it possible for the manager to operate with smaller financial resources committed over the period of the agreement.

Two consumer nations, France and the Netherlands, have made voluntary contributions to the buffer stock.

The International Monetary Fund has accepted the Fourth Agreement as consistent with the principles applicable to its buffer stock financing facilities under which the Fund will meet, subject to provisions including the establishment of a balance of payment needs, requests by IMF members for foreign exchange required for financial compulsory contributions to the buffer stock.

b. Pricing on London Metal Exchange.—The tin price on the LME governs the participants of the agreement as follows:

- If the market price of tin on the LME is equal to or greater than the ceiling price and the manager has tin at his disposal, the manager is to offer tin for sale on the LME at the market price, until the market price of tin falls below the ceiling price or the tin at his disposal is exhausted.
- If the LME market price of tin is in the upper sector of the range below the floor and ceiling price, the manager may operate on the LME at the market price if he considers it necessary to prevent the market price from rising too steeply provided he is a net seller of tin.
- If the LME market price is in the middle sector of the range between floor and ceiling prices, the manager may buy and/or sell tin only on special authorization by the Council.
- If the LME market price is in the lower sector of the range ‘between the floor and ceiling prices, the manager may operate on the LME at the market price if he considers it necessary to prevent the market price from falling too steeply, provided he is a net buyer of tin.
- If the LME market price is equal to or less than the floor price, the manager shall, unless otherwise instructed by the Council, offer to buy tin on the LME at the floor price until the market price of tin is above the floor price or the funds at his disposal are exhausted.

4. The Fifth Tin Agreement

The ITC convened on May 20, 1975, to negotiate a Fifth Agreement to become effective July 1, 1976. The agreement, finalized in June 1975, is set to run 5 years to June 30, 1981.

The major question facing the conference was the method of financing a bigger buffer stock. Producer nations have proposed that the buffer stock be doubled to 40,000 tons and that it be financed by compulsory contributions by consumer and producer nations.

The new agreement, however, provides for compulsory buffer stock contributions by producer nations totaling 20,000 tons to be supplemented by voluntary contributions from consumers of up to an additional 20,000 tons. So far, only France and the Netherlands have indicated their willingness to contribute. Canada, Britain, Switzerland, and Italy have indicated they will consider the proposal. Consideration is also being given to membership by the United States. However, this may create a number of problems for the United States. This will be discussed further below.

The Fifth Agreement also contains a new clause under which the ITC may modify the amount of buffer stock contributions required of members if it obtains outside financial assistance from any international group, such as the International Monetary Fund (IMF).

The IMF presently loans money for use by the ITC to countries with balance-of-payments deficits, but is considering extending credit directly to the Council's buffer stock.

The new agreement also empowers the ITC to recommend that producers give preference to consumer countries which were ITC members during past times of tin shortage. This would act as a deterrent to any of the consumer countries who may consider leaving the ITC because of the requirement to contribute to the buffer stock. It may also be considered as an effort to compel the United States to join the agreement.

5. Position of the United States

The United States has recently signed the Tin Agreement and submitted it to the Senate for advice and consent to ratification. Under the ITA a buffer stock made up of compulsory contributions from producer member-countries and voluntary contributions from a few consumer member-countries is used by a Buffer Stock manager to intervene in the free tin market to try to maintain tin prices within a prescribed range.

The United States, as a condition of its membership in the ITA has insisted that contributions to a buffer stock be the responsibility of producing, not consuming countries, since it is producer-countries that benefit most directly from the stockpile operations. As a further condition of membership, the United States has insisted that disposals from our General Services Administration (GSA) administered strategic stockpile will not be affected by membership in ITA. We have, however, consulted with the Tin Council on our surplus disposals of tin and will continue to do so. The objective of the ITA is to reduce fluctuations of tin prices in international markets; our objective in surplus disposal operations is to assure that they are carried out in a way that will minimize impact upon the commercial markets.

6. References

American Metal Market, May 12, June 11, June 27. July 8, July 11, 1975.

Minerals Facts and Problems, by U.S. Bureau of Mines, 1965 and 1970, GPO.

Minerals Yearbook 1969, Department of the Interior.

Minerals Yearbook 1971, Department of the Interior.

H. INTERNATIONAL CARTELS

1. Introduction

This review is limited to a discussion of international materials cartels, both existing and potential, as opposed to national cartels operating in individual countries. International cartels are defined as combinations among governments or companies in two or more countries which intend to control the production, pricing, and distribution of a commodity. International commodity agreements, such as the International Tin Agreement, are not considered cartels. Examined in this paper are existing cartels in petroleum, copper, bauxite, and mercury, as well as potential cartels in other mineral raw materials. The International Tin Agreement is covered in a separate case study.

2. Materials Subject to Cartel Action

Listed below are those materials subject to potential cartel action where combinations or unilateral action in restraint of trade could have an adverse effect upon the U.S. economy. Any discussion of potential cartels would cover those materials listed below in which international cartels either exist or could be formed, under conditions favorable to their effectiveness, as well as materials in which cartels are unlikely for the reasons indicated.

Petroleum	Iron ore	Titanium
Copper	Lead	Tungsten
Bauxite	Manganese	Vanadium
Mercury	Nickel	Zinc
Chromite	Phosphate	Tin
Cobalt	Platinum	Natural Rubber

3. Petroleum and the Organization Of Petroleum Exporting Countries (OPEC)

a. Formation of Petroleum Cartel.—The Organization of Petroleum Exporting Countries (OPEC) was created in 1960. It comprises 12 countries or areas controlling more than two-thirds of total world reserves of crude petroleum, with the top six members having well over 50 percent of the total. Further, the OPEC members account for more than 85 percent of world trade in oil. The members, their reserves, and daily average production in 1973 are shown in table B–3.

Table B–3.—OPEC members, petroleum reserves, and production

Members	Reserves (Billion bbls)	1973 Production (Million bbls/day)
Saudi Arabia. . . .	140.8	7.7
Kuwait.	72.7	3.1
Iran, ., , , , , ...	60.2	5.9
Iraq. , ...	31.2	2.0
Libya.	25.5	2.2
United Arab Emirates.	25.5	1.5
Nigeria.	19,9	2.0
Venezuela , , ., .,	14.2	3.5
Indonesia.	10.8	1.3
Algeria.	7.4	1.0
Qatar.	6.5	.5
Ecuador , ...	5.7	.2

Source: Business Week, Jan. 13, 1975

As a combination of governments, OPEC was an outgrowth of combinations of international oil companies, including U.S. firms, which had been in operation for some 30 years prior to 1960. These international oil companies had exercised various degrees of control over Middle Eastern production, partly through price cuts which kept competition out. Nevertheless, these firms had found their market power diminishing in the 1950's and 1960's as smaller independent companies and various state oil units opened up new drilling concessions and gave governments better deals than they were receiving from the established producers. A contributing factor to the weakening of power by the international oil companies was a growing trend towards the nationalization of the petroleum industry in some countries.

b. **Organization** of OPEC.—The creation of OPEC was triggered by price reductions by major producers, which brought angry reactions from oil-producing countries and which were for the most part rescinded immediately after the cartel was formally established. OPEC's bargaining power was limited in the early 1960's by excessive world supply. Nevertheless, despite its slow beginning, various coordinated actions by the group and by individual members gradually strengthened the cartel's hand.

c. Purpose of OPEC.—The original purposes of OPEC were economic—to increase member government revenues by raising taxes and royalties earned from crude oil production and to take over from the major international oil companies control over production and exploration through government ownership. Revenue from taxes and royalties collected from producers were tied to so-called "posted prices, " which were set solely for the purpose of determining the amount of revenue and did not necessarily reflect selling prices or market values.

d. Pricing of Petroleum.—Changes in posted prices have nevertheless served as indications of variations in costs of purchasing crude oil from OPEC members. This has been dramatically true with the sharp increases which were initiated on October 16, 1973, immediately after the start of the Arab-Israeli war and followed up subsequently, Actually the cost of crude oil is based on a combination of both the posted price and tax and royalty rates, and it may vary from area to area, depending on individual OPEC member action. From a posted price at the Persian Gulf of $3.01 per barrel in August 1973, the level rose to $5.12 on October 16 and to $11.65 on January 1, 1974: Prior to October 1973 the posted price had been set by the oil companies, presumably after consultation with OPEC. Subsequently, however, the price increases were unilaterally announced by OPEC. The royalty had traditionally been set at 121/~ percent of the posted price. In June 1974 that rate was raised to 12½ percent by all the Middle Eastern and African countries except Saudi Arabia, For the fourth quarter of 1974 the royalty was generally set at 16 2/3 percent, but on November 1, Saudi Arabia, Qatar, and Abu Dhabi (One of the United Arab Emirates) raised that rate to 20 percent. This action was accompanied by a cut in the posted price by those countries and an increase in the tax rate, with the net result of an increase in actual price of about 50 cents per barrel. Taxes had been set by OPEC at 55 percent of the posted price, less the royalty and production cost, but have been increased and are now about 85 percent in the Persian Gulf countries, but lower in South America,

Further price increases may occur on October 1, following a current freeze. Apparently, increases ranging up to $4 per barrel are being considered, in order to offset purchasing power presumably lost as a result of inflation. A small increase (about 30 cents per barrel) will also stem from a switch on October 1 from dollar value quotations to Special Drawing Rights (SDR) of the International Monetary Fund, which are based on a weighted group of 16 currencies. The dollar makes up one-third of SDR value.

In a recent (July 1975) action, Ecuador—the smallest OPEC member in terms of reserves and output—reduced its export price through a cut in the income tax rate charged oil producers operating in that country. Although the resulting price decrease is probably less than 50 cents per barrel and Ecuador's participation in OPEC is small, its action may be a straw in the wind, in view of a generally declining trend in petroleum demand and production,

e. Political Warfare.—The Arab-Israeli conflict of late 1973 introduced the new element of political warfare through the instruments of export embargoes which were in effect from October 1973 until the spring of 1974 and the sharp price increases which have been put into effect. OPEC has partly achieved its political goals by forcing a hard look at Arab-Israeli relations, Although its economic goals, which concern both Arab and non-Arab members of the cartel, have also been furthered, the cartel's drastic actions in supply restrictions and price increases have brought reactions which should tend to reduce its long-term effectiveness. The extent of conservation, substitution, and the development of other energy sources not only by the United States but by other import-dependent countries as well will be significant determinants of OPEC's future. The inflationary effect of the price increases was an important factor in the recent recession here and abroad.

f. Future Policy Decisions.—As offsetting actions occur, OPEC will be faced with policy decisions which will affect its future. It could cut prices far enough below their present levels to retard production in Alaska and the North Sea, or it can reduce its production by enough to balance the entry of new supplies of oil from those areas. For countries like Venezuela, Ecuador, Iran, Nigeria, Iraq, and Algeria, decreased revenues resulting principally from production cuts would tend to defeat plans for industrial growth or lower their standards of living-both unpalatable political results. For some countries, reduced revenues could affect plans for the growth of military establishments,

Such internal differences and varying political ambitions would have a dampening effect on the solidarity of OPEC. If a mutually acceptable plan cannot be designed, each country may make its own decision about production and price and thus undermine OPEC's effectiveness. On the other hand, those OPEC members like Saudi Arabia and Kuwait, who have the largest reserves but no ambitions for economic growth, would be more concerned about maintaining the long-term strength of the cartel's export market. OPEC's future ability to achieve its goals will depend in part on whether or not its conflicting elements can be reconciled, and in part on the extent to which dependence on OPEC's oil is reduced.

4. **Background**

a. The U.S. Position.—Although the United States is a major world producer of petroleum, it is dependent upon imports for a substantial proportion of its supply-about 30 percent for crude and 2o percent for petroleum products. Despite the Arab embargo, U.S. imports increased in 1973 and 1974 under pressures of growing demand. The major foreign sources of crude petroleum in 1973-74 were Canada (27 percent of total), Nigeria (15 percent), Venezuela (13 percent), Saudi Arabia (12 percent) and Iran (9 percent). Imports from the 12 members of OPEC accounted for two-thirds of the total. A major breakthrough in output will come, of course, with the completion of the Alaska pipeline, and in Western Europe with North Sea developments. Production from shale is a longer-range prospect.

Petroleum is the source of 46 percent of energy consumed in the United States (1974). Other sources are natural gas, 30 percent; coal, 18 percent; hydropower, 4 percent; and nuclear power, 2 percent. Shifts to these alternative materials raise problems of availability, particularly in the short run. While natural gas has environmental advantages of cleanliness, its supply has been limited due in part to a low-price deterrent to development of resources. A larger supply of coal may be inhibited by environmental considerations, although coal liquefaction and gasification hold some promise. Increased production of nuclear power is part of the longer range program toward greater independence from imported oil. Conservation measures by Government and industry have brought some decline in demand as another phase of the independence drive.

b. Reserve Oil Supply.—There is no Government stockpile of petroleum, but recent voting in the Congress indicates that stockpiles will be established. On July 8, 1975, the Senate, without a dissension, voted to create a 90-day national reserve supply of oil as insurance against another Arab embargo. This reserve, to be owned by the Government and stored in underground salt domes, tanks, abandoned mines or surplus tankers, could amount to from 360 million to 785 million barrels, depending on the annual level of imports. The Government would also be authorized to acquire reserves of petroleum products.

The Senate bill, which will be considered in the House, authorized the Government to get its oil from three potential sources: 1) purchases directly on the market; 2) as royalties from wells on Federal offshore oil leases; and 3) from existing naval oil reserves at Elk Hills, Calif.

5. **Copper and CIPEC**

CIPEC is an abbreviation of Concil Intergouvernemental des Payes Exportateurs de Cuivre—translated as Inter-Governmental Council of Copper Exporting Countries. CIPEC was established in 1967 following a meeting of representatives of Chile, the Congo (Kinshasa)-since renamed Zaire, Peru, and Zambia who met in Lusaka, Zambia, on June 1, 1967, to discuss common problems concerning copper.

Up to the present the membership has consisted of Chile, Peru, Zaire, and Zambia. The Council provides for a ministerial conference which meets every 2 years and an Administrative Council which meets twice yearly in May and November in Paris, and a permanent Information Bureau of Copper in Paris. On occasions special nonscheduled meetings of the Administrative Council have been held. The stated purpose of CIPEC is to act in a consultative manner in helping member countries, individually or collectively, to avoid extreme fluctuations in the price of copper.

a. Effect of Copper Price,—Price fluctuations have only a marginal effect on the quantities of copper exported by the producing countries, but do have a substantial effect on the foreign currency earnings and on the tax receipts of the producer countries. This has a serious effect on the planning for development of these countries. It also gives rise to grave internal political problems, When copper prices-and tax receipts-are high, so are governmental expenditures. When prices retreat, exporting countries must face a reduction of resources and retrench on expenditures, imports, and investments.

b. Problem of Developing Nations.—Developing countries are seeking national independence. They desire to control the activities of mining enterprises. They want to process minerals as far as possible down the line to manufacturing, in lieu of exporting concentrates and blister for further processing in the consuming centers, Thus, governments in many countries have felt they were under obligation to intervene in health and security matters. Their intervention now extends to such matters as labor conflicts and wages, conservation, currency remittances and utilization, marketing, and pricing policy, In some countries, this indirect control has been supplemented by a direct participation of the state in the capital, and therefore in the management, of the mining companies. Finally, the developing countries, realizing that they cannot become developed nations on the basis of a single commodity, are interested in diversifying their economies.

c. Common Problems.—There are problems common to developing nations including the CIPEC members, CIPEC is not a supranational authority, but rather a consultative body providing the member governments with basic information and opportunities to exchange views and possibly harmonize their own individual and fully independent policies. The principal function of the international staff located in Paris is to gather statistics, provide information on markets, production programs, substitutions, trade barriers, and labor problems and their effects on the copper industry. Toward this end the Information Bureau conducts marketing studies and disseminates reports on world copper developments.

The importance of mine production of CIPEC countries is shown as follows (in thousands of short tons):

	1969	1970	1971	1972	197$
World total	6,281	6,567	6,669	7,329	7,857
Chile	771	756	791	800	819
Peru	219	234	229	248	241
Zaire	393	425	447	472	538
Zambia	825	754	718	791	779
CIPEC total	2,208	2,169	2,185	2,311	2,377
Percent of world total	36	33	33	31	30
U.S. production	1,545	1,720	1,522	1,665	1,718
Percent of world total	25	26	23	23	22

Source: Minerals Yearbook, Bureau of Mines.

There is an approximate similarity in the economic characteristics of the member countries of CIPEC. All four countries may be called "underdeveloped" or "developing" countries. The population growth rate is substantially higher than that of the United States and other developed countries.

Copper is produced in 60 countries throughout the-world. World production and estimated reserves (in thousands of short tons) are presented as follows:

World copper production

	Mine production		
	1973	1974[a]	Reserves
United States	1,718	1,588	90,000
Canada	899	900	40,000
CIPEC countries:			
Chile	819	910	70,000
Peru	241	240	30,000
Zaire	538	560	20,000
Zambia	779	760	30,000
CIPEC total	2.377	2,470	150,000
Others:			
Free world	1,683	1,742	95,000
Communist countries[1]	1,160	1,240	55,000
World total	7,857	7,940	430,000

'Estimated.
EXCept Yugoslavia.
Source: Commodity Data Summaries, 1975; Bureau of Mines.

The United States is almost self-sufficient in respect to its needs for copper. Salient statistics on copper in the United States for the years 1972–74 are as follows:

	(In thousands of short tons of copper)		
	1972	1973	1974
Production:			
Mine	1,665	1,718	1,588
Refined copper:			
Primary	1,873	1,868	1,620
Secondary	423	465	500
Total	2,296	2,333	2,120
General imports:			
Blister	157	154	200
Other primary forms	248	244	379
Secondary	11	19	33
Total general imports	416	417	612
Exports:			
Refined	183	189	110
Other primary forms	26	31	23
Secondary, old	45	88	49
Total exports	254	308	182
Shipments from Government stockpiles			252
Consumption: Refined	2,239	2,437	2,300
Price: Average (cents per pound)	51.2	59.5	77.1

Source: Commodity Data Summaries, 1975: Bureau of Mines

d. National Dependence on Copper.—A second characteristic, in somewhat varying degree, is the extreme dependence of each of these countries on copper. This dependence affects the balance of payments, the gross national product, and the Government's budgets. For CIPEC member countries as a whole, copper exports represent a total of 64 percent of their foreign currency entries. The individual percentages vary from 25 percent for Peru, which has a relatively varied economy in which other metals, fishery products, and different agricultural products contribute to a better balance of trade, to over 55 percent for Zaire, over 65 percent for Chile, and 95 percent for Zambia (1967 data). The effect of copper on the member countries' balance of payments may be recognized from the fact that their copper exports pay the total of their imports up to more than 70 percent.

e. Manpower.—The copper industry requires a large investment per employee and therefore contributes only marginally to the use of manpower. Even so, this contribution amounts to 15 percent in Zambia. The copper industry contributes importantly to the gross national product of Zaire (33 percent) and Zambia (45 percent). In Chile and Peru, where the economies are relatively more diversified, the contribution of copper is significant but not as great as in the African countries,

f. Taxes.—Taxes on copper, including company profits tax, export duties, and royalties, approximate 55 percent of the total tax receipts of Zambia, 45 percent for Zaire, 14 percent for Chile, and 12 percent for Peru (in 1965).

g. Secondary Impacts of the Copper Industry.—The effect of the industry within these countries includes the consumption of goods and services, parts of which are produced in the country itself Without the copper industry most of these goods and services would have no market and would therefore not exist. In the case of Zambia, for example, it has been estimated that if these indirect consequences were taken into account, the copper contribution to the GNP would be 50 percent instead of 40 percent, the contribution to Government revenues would be 75 percent instead of 60 percent, and the contribution to employment would be 32 percent instead of 15 percent. Furthermore, income generated in the mining industry in the form of salary, wages, etc., is again spent on goods and services. When this is taken into account, the Zambian figures become 69 percent for the contribution to the gross national product, 84 percent to Government revenue, and 57 percent to total employment.

h. Recent Developments.—Due to a lagging world economy in 1971 and 1972, most minerals and metals were in surplus supply. Prices for these commodities, including copper, were soft and there was little incentive to expand capacity. In 1973, demand for copper suddenly rose and producer's inventories were quickly exhausted.

Domestic and world demand for copper continued strong in the first quarter of 1974. During the months of February through May the balance of the copper stockpile inventory amounting to 252,000 tons of refined copper was released for use by the U.S. Mint. The drawdown of inventories continued and prices were forced up until a record high monthly average of $1.38 per pound was reached on the London Metal Exchange (LME) during the month of April 1974. However, before mid-1974 there was a weakening of the copper market which continued for the balance of the year. (LME copper prices averaged 57 cents per pound in December 1974.)

Strikes at most producing units in July and August 1974 and reduced demand in the second half of 1974 combined to create a negative effect on the U.S. copper industry. For the year as a whole, the U.S. mine, smelter, and refinery production—and refined copper consumption—were all substantially smaller than in 1973. Consequently, imports of unmanufactured copper increased significantly, while exports declined.

i. 1974 CIPEC Communique.—This situation was bound to affect CIPEC. Following a 2-day meeting in Paris, CIPEC issued a communique on November 19, 1973, stating that beginning December 1, 1974, its four members would reduce shipments by 10 percent below the levels established in the previous 6 months. (Production was not affected.) The communique also stated that the quota system would be reviewed and adjusted if the 10 percent reduction did not achieve the desired effect on prices. This was the first positive collective action by CIPEC countries to attempt improvement in the price of copper. Early in April 1975 the CIPEC Ministerial Council met in Paris and decided to increase the cut in shipments an additional 5 percent to a total of 15 percent and to cut production as well by 15 percent, These measures became effective April 15, 1975. CIPEC is reported to be seeking support for a producer/consumer buffer stock and to have appealed to the International Monetary Fund for financial help.

CIPEC has also been trying to increase its membership but to little avail. One possibility is Iran which expects to become a substantial producer of copper when the Sar Cheshmeh porphyry copper mine begins production. Although 1977 is the target date, 1978 is more realistic. At full production, future annual output is estimated at 145,000 tons of refined copper per year. Iran has indicated an interest in joining CIPEC.

6. International Bauxite Association

a. Cartel Potential.—Ten countries, including most of the world's major bauxite exporting countries, have formed the International Bauxite Association (IBA) to coordinate information on bauxite production and increase revenues from bauxite operations in member countries, These countries—Australia, Dominican Republic, Ghana, Guinea, Guyana, Haiti, Jamaica, Sierra Leone, Surinam, and Yugoslavia—produce over 65 percent of the world's bauxite, and account for about 80 percent of the bauxite/alumina trade. The potential for a bauxite cartel thus exists in the structure of the IBA.

b. The Case of Jamaica.—Jamaica has taken steps to increase its revenue from the sale of bauxite through increased taxes and most producers appear to be willing to follow its pricing lead. Although Jamaica may press other members of IBA to attempt joint restrictions of supply, no firm pricing and taxation policies have yet been established. A sevenfold increase in Jamaica's revenue from bauxite has resulted in a doubling of its cost to buyers. Most of the other members of IBA are anxious to expand production and gain a bigger share of the export market, and may thus no-t go along with Jamaica's aims for supply restrictions. Brazil is a nonmember with vast resources of its own, and its plans to increase exports would be counter to any move by IBA to limit output.

c. Price of Bauxite.—Even a further doubling of the price of bauxite would add less than 10 percent to the price of aluminum metal. A price increase of this size may lead to only limited substitutions. Although this further doubling would probably have little effect on U.S. bauxite production, the other aluminum-bearing ores might become competitive at that price level.

d. Stockpile Requirements.—A recent study by the Office of Minerals Policy Development, U.S. Department of the Interior (March 1975), has estimated optimal government and industry stockpiles of aluminum metal equivalent, in excess of strategic requirements, needed to offset the economic impacts of embargoes and cartel-sponsored monopoly pricing. In terms of aluminum content, the total combined private and Government inventory declared excess of strategic requirements is around 6 million tons. The study finds that this inventory is only about one-fourth to one-fifth the indicated optimum for a cartel action with a probability close to 1. In order to minimize the costs of certain levels of monopoly pricing policy, the optimal inventory release policy would be impossible. The most that could be hoped for is a credible threat to prevent the cartel from charging full monopoly prices. "Staged sales, perhaps in the amounts in proportion to those which would be sold under an optimal policy, may be required to make the stockpile a more potent weapon. "

In another set of calculations the study estimates annual real costs to the U.S. economy of embargoes and cartel price actions, as shown in table B-4.

Table B-4.-Annual real costs to the U.S. economy of a foreign initiated commodity action in aluminum

Million dollars		
Year after beginning of commodity action[1]	Embargo	Cartel price actions
1	[2]24,500/918	[2]20,000/360
2	10,500	6,300
3	8,100	5,400
4	5,600	4,700
5	4,800	3,800
6	4,500	3,200
7	4,100	2,600
8	3,800	1,800
9	3,100	1,100
10[3]	170	160

[1]10-year short-run to long-run adjustment period.

[2]The larger number assumes no release from privately held inventories during the first year of the commodity action. The smaller number assumes private inventories are released at the equilibrium price of (1.1) times the price in the year prior to the commodity action. With an interest rate of 10 percent, this release price will cover the holding cost of a stockpile for one year.

[3]The 10th year costs would continue for each year after year 10.

e. Background, Substitutes, and Imports.—The United States produces about 10 percent of its bauxite requirements. ***Imports*** come principally from Jamaica (54 percent of the total in 1970–73), Surinam (20 percent), Dominican Republic (8 percent), and Guyana (7 percent). Bauxite is by far the most important aluminum raw material produced commercially. About 90 percent of all bauxite is used to make aluminum. There are large domestic deposits of alumina-bearing clays, as well as other aluminous materials, but their production is not yet competitive. Alumina, the intermediate product made from bauxite and processed into aluminum, is also imported to the extent of about one-third of U.S. needs. These imports are chiefly from Australia (49 percent in 1970–73), Jamaica (27 percent), and Surinam (16 percent).

Aside from the substitution of other aluminum-bearing material for bauxite, discussed above, there are possibilities of substitution for aluminum by other materials. Copper, magnesium, stainless steel, and plastic can be substituted to a limited extent, but without identical results and in some cases at higher costs.

The U.S. Government strategic stockpile of metal-grade bauxite totaled 14,158,881 long dry tons on December 31, 1974. The stockpile objective is 4,638,000 tons, leaving an excess of 9,520,881 tons. The total stockpile is equivalent to about 10 months' consumption. The refractory-grade bauxite stockpile is 173,000 tons, all of which is excess. As a result of the completed long-range disposal program for aluminum metal, the stockpile of that material is now zero.

7. The Mercury Cartel

The United States is dependent on foreign sources for a substantial part of its needs for mercury. Net imports have risen from 32 percent of U.S. consumption of primary mercury in 1970 to virtually 100 percent in 1974. Salient U.S. supply/demand statistics for the 1970-74 period are presented as follows:

Salient statistics—United States

	1970	1971	1972	1973	1974[e]
Production:					
Mine	27,296	17,883	7,333	2,171	1,700
Secondary	8,051	16,666	12,651	10,329	9,000
General imports	21,672	29,750	29,179	46,076	51,400
Exports and reexports	4,703	7,232	963	342	500
Consumption	61,503	52,257	52,907	54,283	59,600
Price per flask:					
Average N.Y. (duty paid)	$407.77	$292.41	$218.28	$286.23	$290.00
London	$411.45	$282.46	$203.01	$273.54	$275.00
Stocks: Consumer and dealer	12,693	11,489	11,537	14,019	16,000
Employment: Mine and mill	600	350	150	80	80

Import Sources (1970-73): Canada, 53 percent; Algeria, 12 percent; Mexico, 11 percent; Spain, 11 percent; other, 13 percent. Imports in 1974 were 62 percent greater than the 1970-73 average because of the sharp reduction in domestic production. Mexico and Algeria each supplied about one-fifth of the imports, and Canada supplied about one-third.

[e]Estimate,

[1]Includes releases by the General Administration of surplus mercury obtained from the Atomic Energy Commission.

World resources of the major mercury deposits of the world are unknown, and only estimates based on production records and geologic knowledge can be made. Reserve and resource estimates for the United States and Algeria were increased significantly during 1974 with the discovery and development of new deposits.

World Mine Production and Estimated Reserves are presented by the Bureau of Mines, as follows:

World mine production and reserves

	Mine production		Reserves
	1973	1974[e]	
United States	2,171	1,700	450,000
Canada	12,500	12,000	120,000
Italy	32,315	30,000	400,000
Mexico	‘28,000	25,000	250,000
Spain	60,076	60,000	2,000,000
Yugoslavia	15,606	15,000	500,000
Other free world	40,535	36,300	565,000
Communist countries (except Yugoslavia)	‘85,000	82,000	1,015,000
World total	276,203	262,000	5,300,000

‘Estimated.

a. The Spanish-Italian Cartel.—In 1928, Spanish and Italian producers of mercury controlled over 80 percent of world production. Mercurio Europeo, a cartel of Spanish and Italian producers, was formed October l, 1928, when world stocks were excessive. Headquarters was at Lucerne, Switzerland. The cartel was formed for the purpose of controlling production, allocating sales, and stabilizing prices. Sales were to deallocated 55 percent to Spain and 45 percent to Italy. Meetings were held annually to allocate world quotas and markets.

Although one of the stated aims of the cartel was to stabilize prices, the actual policy of the cartel was to sustain prices. Less rigid control was exercised over production. Consequently producer stocks increased and by the end of 1930 were estimated to be approximately 150,000 flasks, most of which had been produced but not sold by members of the cartel As might have been expected, the maintenance of high prices stimulated production in other countries which tended to replace markets formerly supplied by Spanish and Italian producers.

b. U.S. Production.—The largest gain in mercury production occurred in the U.S. mines, In 1931 the U.S, mines were able to supply U.S. requirements for the first time in 14 years and, in addition, had an exportable surplus. In mid-1931 the cartel reduced its price but failed to stimulate buying. However, in 1932 U.S. production was cut in half. Efforts on the part of the cartel to stimulate consumption were unsuccessful.

c. Cartel Interruptions.—The cartel was suspended in 1936 when it was denounced by Spain who alleged that Italy was selling arms to the insurgents. The cartel operations were resumed in May 1939 following the end of the Spanish Civil War. Operation of the cartel was virtually impossible in World War II, but was revived in 1945.

Spain withdrew from Mercurio Europeo and the cartel was dissolved January 1, 1950, following a large purchase of Italian mercury by the U.S. Government with counterpart funds.

d. Other Competition and Decline in Price.—A group of mercury producers including Algeria, Italy, Mexico, Spain, Turkey, and Yugoslavia, with Canada as an observer, had been meeting informally during the early 1970’s to exchange views on market developments and try to formulate a price policy. Efforts by individual members such as Spain and Italy to raise prices by stockpiling had been unsuccessful in the past. In May 1974 the group met in Algiers and decided to form a producers organization, The provisional secretariat announced a mininum sales price of $350 per flask, EOB., effective May 17, 1974, Although the price briefly reached the announced minimum price, it has steadily fallen since then.

It is felt that higher prices would likely bring more rapid substitution, especially in battery applications and in the chemicals industry. If prices returned to the levels obtained in 1969, U.S. mine production would probably be resumed, and production would increase in other countries.

8. Chromite

a. Cartel Potential.—The major concern about possible cartel price and supply actions applies to metallurgical-grade chromite. A formal combination of the major sources of this material—the U. S. S. R., Rhodesia, South Africa, and Turkey—for the purpose of controlling markets appears to be a remote possibility because of the political differences among them. However, supply restrictions by a Rhodesian-South African cartel might find tacit cooperation of the U.S.S.R. On the other hand, technological developments in the use of chromite, which permit the use of South African chemical-grade ores in metallurgical applications, have reduced U.S. dependence on the U.S.S.R. and Rhodesia for metallurgical-grade chromite.

b. Recent data.—A recent study of the Office of Minerals Policy Development, U.S. Department of the Interior (March 1975), has made estimates on optimal industry and Government stockpiles under varying degrees of probability of an embargo by exporting countries or of cartel-sponsored monopoly pricing. Estimates have also been made of real costs of embargoes and monopoly pricing. Tables B–5, B-6, B–7, and B-8 present these findings of the study,

c. The U.S. Deficiency.—The United States had produced no chromite (chromium ore) since 1961. While large amounts of chromium-bearing materials are found in this country, they are low-grade and uneconomical to develop under current and foreseeable costs and technology. The major use of chromite is in the manufacture of stainless steel (66 percent of the total in 1971). The other uses are

Table B-5.-Estimated real cost of a chromium embargo

Years of embargo (t)	Annual cost (millions of dollars)	Present value of cost (millions of dollars)
1	273	248
2	963	796
3	799	601
4	789	540
5	632	393
6	533	301
7	495	254
8	461	215
9	412	175
10	374	144
Subtotal years 1–10	5,731	3,667
	Plus $374 million in each additional year up to and including the 24th year, thereafter, alternative unit costs exceed long-run price.	
Subtotal years 11–24	5,236	1,061
Total years 1–24	10,967	4,728

Table B–6.—Optimal chromium stockpile in an embargo situation

[Thousands of short tons]

Year of embargo	Probability of occurrence				
	1	0.2	0.1	0.05	0.01
1	247	240	231	215	81
2	521	501	479	435	69
3	516	313			
4	512	225			
5	508				
6	502				
7	498				
8	489				
9	477				
10	460				
11	444				
12	426				
13	407				
14	385				
15	362				
16	336				
17	308				
18	277				
19	243				
20	205				
21	163				
22	118				
23	68				
24	12				
Total.	8,484	1,279	710	650	150

Table B–7.—Estimated real cost of a chromium cartel action

Years of cartel (t)	Annual cost (millions of dollars)	Present value of cost (millions of dollars)
1	203	185
2	625	517
3	556	418
4	523	358
5	456	283
6	408	231
7	365	187
8	326	152
9	288	122
10	250	97
Subtotal years 1-10	4,000	2,550
Plus an annual cost of $250 million in each additional year up to and including year 17. Thereafter, alternative unit costs exceed the monopolistic price,		
Subtotal years 11–17	1,750	470
Total years 1–17	5,750	3,020

77-119 0-76.19

Table B–8.—Optimal stockpile in a chromium cartel situation

[Thousands of short tons]

Year of cartel	Probability of occurrence				
	1	0.2	0.1	0.05	0.01
1	247	240	231	215	
2	484	464	443	403	
3	480	445	403	320	
4	476	428	369	248	
5	471	393	293		
6	466	352	205		
7	462	296			
8	453	291			
9	441				
10	425				
11	410				
12	393				
13	374				
14	354				
15	331				
16	307				
17	279				
Total	6,853	2,909	1,944	1,186	

refractories (19 percent) and chemicals (15 percent).

Imports of all grades in 1974 came from South Africa (30 percent of the total), U.S.S.R. (29 percent), the Philippines (17 percent), Turkey (11 percent), Rhodesia (7 percent), and Albania (6 percent). One of these countries, Rhodesia, was out of the picture during 1967–71, when imports were halted by the United States in support of U.N. sanctions against that country. The resultant heavy dependence on Russian chromite was eased beginning in late 1971, when imports from Rhodesia were resumed.

d. Processing and Use.—For metallurgical purposes, in the production of stainless steel, chromite is processed into ferrochrome. While much of this processing had been performed in the United States, increasing quantities are being produced overseas, largely in ore-producing areas. This shift is reflected in significant increases in U.S. imports of high-carbon ferrochromium over the last 5 to 6 years. Consumption has also risen as a result of shifts toward use of this grade, though not to the same extent as the rise in imports. In 1973 and 1974 imports of this commodity were 13 times as large as in 1968, and now account for 70 percent of all ferrochromium imports. Imports of the low carbon grade have fluctuated and were actually lower in 1974 than in 1967. Of total imports of both grades, South Africa was the principal source (37 percent of total), followed by Rhodesia (23 percent) and Yugoslavia (13 percent).

e. Use in Stainless Steels.—Chromium is an indispensable ingredient of stainless steel. Possible substitutes for stainless steel in some applications include aluminum, nickel, and titanium or alloys of these metals with other elements. Chromium used as an alloy in the production of steels other than stainless and in high-temperature metals may be substituted fully or in part by cobalt, nickel, molybdenum, or vanadium, but usually with lower performance standards or higher costs. Chromium used in plating can be replaced by nickel, zinc, and various other metals. Substitutes are also available for chromium used in pigments.

f. Stockpile Composition.—Chromium is stockpiled by the Government in various forms: three grades of chromite, three grades of ferrochromium and chromium metal. As of December 31, 1974, stockpile surpluses were as follows, in relation to U.S. consumption in 1973: metallurgical-grade chromite, 26 months' supply; refractory-grade chromite, 15 months; chemical grade, 14 months; low carbon ferrochromium,[1] 25 months; high carbon ferrochromium, 18 months; ferrochromium silicon,[1] 8 months; and chromium metal[1], 8 months.

9. **Cobalt**[2]

With approximately two-thirds of the world cobalt production, Zaire clearly is in a position to increase world cobalt prices by artificially manipulating the supply. Such action, however, is unlikely because cobalt is a byproduct of other mineral production. Nickel can be substituted for cobalt in a number of important uses, and the large U.S. stockpile is a standing threat to cobalt producers.

10. Iron Ore

There have been no concerted moves by producers to use or control international iron ore trade. Furthermore, a sustained iron ore producers' cartel for the purpose of increasing prices appears unlikely because of the abundance and wide distribution of iron ore reserves, World iron ore production is expected to remain 20-25 percent below capacity for at least several years. And with 85-90 percent of the world's iron ore produced from open pits, large increases in ore production can be achieved within 1–2 years.

a. The Caracas Group.—The less-developed countries (LDC) iron ore producers (Liberia, Brazil, Venezuela, and others) stated their view at UNCTAD that iron ore prices should be linked to those of steel, but nothing has yet come of this idea. An informal LDC group, known as the "Caracas Group," has held a series of meetings to discuss iron ore prices. Its last meeting was in Geneva in March, with Australia, Canada, and Sweden attending as observers. The meeting dealt mainly with technical aspects of production, transport, and trade and did not consider possible action to improve prices or to restrict supplies, nor did it act on proposals for establishing a more formal structure,

In May 1974 Venezuela announced its intention to nationalize the iron ore operations there. Under Government ownership and control, Venezuela may well attempt to obtain higher prices for its iron ore exports, within the limitations of the existing competitive situation, whether or not there is a subsequent move to secure joint producer action. The Government may also limit exports and channel supplies to its growing domestic steel industry and to other members of the Latin American group, called the Andean Pact.

A "worst case" scenario might be the simultaneous closing down of the Great Lakes iron ore facility, a limiting of Venezuelan exports, and a prolonged labor strike in Canada, a series of events which would affect 33 percent of U.S. iron ore consumption.

b. Possible First U.S. Action.—The first reaction of the United States could be to attempt short-run supplementation of ore supplies from presently operating surplus capacity. Other reactions would include: attempts to secure new domestic sources and to open up new mines abroad (2.7 years' lead-time); relaxation of environmental constraints; conservation of steel and substitution to the extent practicable; and an embargo on exports of scrap iron.

c. Use of Low-Grade Ores.—It should be noted, however, that bringing new domestic sources of iron ore on stream entails significant costs. We would be mining lower grade ore, thereby necessitating more energy in the furnaces, more pollution control, and probably

[1] Zero objective.
[2] *Reference*. The following statements, dealing with the potential for cartellike action to restrict supplies or raise prices for a number of other materials, are taken verbatim from the Special Report-Critical Imported Materials, published by the Council on International Economic Policy, December 1974.

additional transportation facilities to reach remote supply sources.

Aside from the possibility of a sudden disruption resulting from the unilateral nationalization of U.S.-owned iron ore production facilities abroad, there are no impending supply problems for the United States. There is a nebulous group which conceivably could be encouraged by an appearance of success in other commodities to coalesce into operating as a price-hiking cartel. To be effective, the cartel would have to include Australia, Brazil, and Canada. Although these three countries are currently more favorably disposed toward international producer organizations, their wider interests compel policies of moderation in questions of pricing of and access to their mineral resources, The sheer volume of imported iron ore, and the lack of substitutes or reserve stocks, make this commodity a critical one to watch.

11. Lead

Price gouging would have to involve both Canada and Australia and this is unlikely, given the current policies of these countries. Several factors, however, suggest that a significant price increase in lead is a possibility: (1) due to environmental standards the future earnings potential of lead may be dim; the temptation to reap immediate profits, great; (2) there are few economic substitutes. On the other hand, because the dependence of foreign producers on lead for foreign exchange is small, there is little interest of individual producer countries in joint market action to obtain higher prices. Moreover, producers may feel that higher prices wilI discourage new uses of lead.

In the short run there might be some temptation to gain higher profits from lead due to its relatively dim future. If a cartel were formed, it would have to involve developed countries. The United States currently produces 75 percent of its lead requirements and could become self-sufficient within 54 years.

The likelihood of a joint price-gouging effort is low. And without a cooperative effort to control production, the attempt to sustain high prices would be difficult if not impossible.

12. Manganese

An effective manganese cartel would, at the minimum, require the cooperation of Gabon, Brazil, South Africa, and Australia. Such action could take the form of a price leadership group of Brazil, Gabon, India, and Australia, with South Africa and the U.S.S.R, following the “lead. For political reasons, South Africa might be unwilling to join an LDC producer group, Before joining with others to restrict exports to raise prices, Australia would have to consider carefully the effect of such actions on its other exports to Japan, particularly iron ore, for which Japan is by far Australia’s most important market. Iron ore is in plentiful supply worldwide, and an Australian move to restrict manganese exports could possibly result in a gradual Japanese shift in iron ore sourcing to “more stable” suppliers, The same constraint is true for India, which exports both manganese and iron ore to Japan. Finally, Brazil is a substantial iron ore supplier to Western Europe, where continued available markets for iron ore might be threatened by a cutback in manganese exports. Supply restrictions or price-manipulating efforts would likely be frustrated within a 2-to-3 year period by production and capacity expansion by others —to the long-term detriment of the restricting producers, Price increases would also add impetus to seabed recovery of manganese nodules.

13. Nickel

The potential for cartel-like action to raise prices or restrict supplies is quite limited. It appears that prices have already reached cartel profit-maximizing levels. A formal cartel of producing governments acting jointly probably would not revise the present pricing strategy to any considerable extent. Moreover, the possibility of new producers (including seabed producers) in the next few years would make any market-sharing agreement by a cartel both difficult and unstable. Over the long run, these developments make the probability of price declines substantial.

14. Phosphate

The conditions for a cartel action are present: supply and demand are not responsible to price in the short run, there is a lack of substitutes for the crucial agricultural applications, there is no excess capacity, and there are only a few producing countries. The price of phosphate rock will rise, cartel or not.

15. Platinum

With only five significant producers of primary platinum operating in three countries, the potential of collusive pricing behavior is fairly high. But because of the following factors, one might conclude that platinum is already priced at or near optimum levels:

- Despite marginal costs of production (believed to be only half or less of recent market prices), major producers appear to withhold stocks from the market to maintain what resembles a long-run profit maximizing price.
- Despite tremendous gyrations in the dealer price of platinum, major producers have for many years supported a stable producer price.
- Producers have admitted to holding down prices to prevent more intensive efforts to develop platinum substitutes.

It thus appears that the platinum producers already cooperate to regulate both supply and price. The potential for further action therefore seems to be present.

a. Substitutes for Platinum.—The basic force opposing action detrimental to the United States or other consumers appears to be apprehensiveness on the part of producer companies concerning the development of substitute materials or processes which do not require platinum. There are also indications that there are substantial inventories in the hands of the major users.

Other materials or processes could be substituted for the use of platinum catalysts in the petroleum refining and chemicals, but this would be a lengthy and expensive endeavor, Short-term reactions could include the release of stockpile materials and the allocation of available supplies, including excess industrial inventories to the more essential uses.

b. Few Platinum Suppliers.—The possibility of supply withholding or drastic price increases is present because of the small number of suppliers, demand which is relatively insensitive to price, and the lack of ready substitutes. Concerted intergovernmental action would not be necessary; price leadership by one platinum producer and the tacit cooperation of others would be sufficient, However, the history of the industry, including the recent undertaking by the major producer to increase production to fill contracts with U.S. auto manufacturers, indicates a sensitivity by the producers to market needs and a willingness to fill them.

16. Titanium

With the considerable world ilmenite production and the numerous present producers, a concerted producer country action to increase ilmenite prices artificially would appear difficult. Although higher prices for Australian minerals and raw materials is a major goal of its Labor Government, Australia, which has 97 percent of the non-Communist world’s rutile production, would have to “go it alone” in any market action on rutile production, rather than taking the politically easier step of “giving in” (willingly or unwillingly) to LDC requests for Australian cooperation in a market action. Given Australia’s strong political and economic ties to the West, it is doubtful she would be willing to take such action alone. Nevertheless, the Australian rutile producers seem to have jointly been making price and output decisions to extract as much long-run profit as they could; however, if these producers feel they have not fully exploited their situation, further price increases may be forthcoming, The chances of significant artificial price increases in titanium involve developed countries and the possibility of such action is negligible. In any case, the economic impact on the United States would not be significant. In the longer run, the development of substitutes for rutile seems promising.

17. Tungsten

Because of what appears to be a dwindling reserve situation, and given the lack of available substitutes, tungsten is a possible candidate for short-term price manipulation, although Canada and Australia would have to be involved to make a cartel effective.

While we are dependent at present on imports, the dependence is more a matter of current price situation than necessity, Given the possibilities for substitution, the existing stockpile levels, and the domestic reserves, it does not appear that the United States can be threatened by either embargo or price actions on the part of foreign tungsten producers for many years.

18. Vanadium

The only possibility would be a unilateral price increase by South Africa. A significant increase could be frustrated by substitutes: columbium has, in fact, been replacing vanadium in steel-alloying applications over the past 2-4 years, and other alloying elements, such as molybdenum, are also replacements at higher prices. Nevertheless, the United States imports all its columbium.

19. Zinc

A "Producers Group," including virtually all West European, Canadian, and Australian privately owned producers, is apparently trying to establish prices and operating rates to maintain price stability at a level satisfactory to the members. In view of current production magnitudes and potential, a group attempting to establish firm control of the world zinc market would probably have to include Australia, Canada, Mexico, the European Community, Zaire, and Zambia. A zinc cartel would therefore require the close cooperation of highly disparate private-sector entities. It might also run afoul of the European Community's antitrust regulations,

Most foreign producers realize the value of the U.S. market and thus are likely to avoid moves which could lead to greater U.S. production. Given this fact, the diffusion of sources, the countries involved, and the eventual availability of certain substitutes, it is unlikely that price gouging or cartel-like action will occur. What we can expect is that the major zinc producers will try to tailor their output and expansion plans to try to avoid creation of all oversupply and falling prices, such as was experienced during the 1960s and early 1970's.

20. Tin

Most of the world's major tin producers and consumers are signatories of the International Tin Agreement (ITA), the only formal international commodity agreement for a metal, (The United States has recently signed and submitted to the U.S. Senate for advice and consent to ratification its agreement to the Fifth International Tin Agreement.) For a detailed discussion of the ITA see Case Study, The International Tin Council. Under this agreement, the International Tin Council (ITC) sets floor and ceiling prices and its buffer stock manager buys and sells tin on world markets with the intention of preventing wide swings in world tin prices. The producers make obligatory contributions to the tin buffer stock and are required to impose export controls if the ITC deems such action necessary.

a. Tin Agreements.—Four sequential Tin Agreements have been in operation since 1956. Over their life, the combined actions of the buffer stock manager and export controls have prevented prices from going below ITC-established floor prices. The ITC has been less successful in preventing the price from going above the established ceiling price. Since November 1973 the world tin price has exceeded the ceiling price, despite the fact that the buffer stock manager has disposed of about 40,000 tons from the U.S. stockpile,

Price gouging on the part of tin producers is deemed unlikely, Under the terms of the ITA, to which all of the major producers belong, one of the objectives is to increase production in case of a tin shortage and make a fair distribution to tin metal consumers in order to mitigate serious difficulties which consuming countries might encounter, To restrict supplies would run counter to the agreement and jeopardize the upcoming negotiations for the Fifth Agreement, Moreover, the producers are quite concerned about the potential sales from the U.S. stockpile. Substitutes and the potential for conservation of tin in solder make long-run prospects for cartel-like action poor.

b. Cartel Activity not Expected.—The present price of tin is higher than even many of the tin producers believe can be sustained. A more likely possibility is that producers, acting through the International Tin Agreement, will move to ensure that prices do not drop to previous low levels, They will attempt to accomplish this by significantly raising the present floor price in the tin agreement,

21. Natural Rubber

There is an international organization, the International Rubber Study Group (IRSG), comprising producers and consumers of both natural and synthetic rubber, including the United States. This organization has not acted to control supply or price, but it has served mainly as a forum for discussion of the problems of the rubber producers. Because of dissatisfaction with the IRSG ability to solve the low-price problems, the Southeast Asian producing countries, led by Malaysia, formed the Association of Natural Rubber Producing Countries (ANRPC) in 1971. Thus far, the association has concentrated on technical matters, although the members have discussed the possibilities of joint action in regard to natural rubber marketing, freight rates, and stockpiling natural rubber.

The natural producers have never tried to curtail production to advance higher prices, but the Malaysian Government attempted to influence the market by buying rubber in 1971 and 1972 and by suggesting in July 1974 that producers temporarily hold larger stocks until the price decline had been reversed. The natural-rubber producers have been sensitive to the political and economic problems that curtailed production would entail; e.g., widespread rural unemployment and hardship for small family-operated plantations. Nevertheless, since natural-rubber production capacity cannot be expanded rapidly, exporting countries could sustain price increases for a few years.

It is unlikely that the natural-rubber producers will withhold supplies from the market for long, but led by Malaysia they may attempt to obtain greater control over world marketing of natural rubber. However, even if this is achieved, they are not likely to be able to sustain any price gouging effort because of the availability of synthetics,

22. References

Cartels and International Patents Agrecments, Washington, D. C., Legislative Reference Series, Library of Congress, June 1944.

"Cartels: The Menace of Worldwide Monopoly," *The* New Republic, Mar. 27, 1944.

Control *of* Cartels and Monopolies, by Corwin G. Edwards, New York: Oceana, 1967.

Con trolling World Trade: Cartels and Commodity Agreements, by Edward J. Margon. Committee for Economic Development and the Research Study. New York: McGraw-Hill, 1946.

The Law *of* International Cartels, by Heinrich Dronstein. New York: Cornell University, 1973.

"OPEC: The Economics of the Oil Cartel, " Business *Week*, Jan. 13, 1975. pp. 77—81.

"The U.S. Now Must Deal With Other Cartels, " New **York** Times, June 1, 1975, Sec. 4, pp. E4.

Appendix C

ECONOMIC STOCKPILING IN FOREIGN COUNTRIES

Appendix C discusses economic stockpiling in the nine-nation European Economic Community (EEC) in general, and then specifically examines the stockpiling policies of three foreign countries: Japan, France, and Sweden.

A. THE EUROPEAN ECONOMIC COMMUNITY STOCKPILING PROGRAM

This information was derived from an interview which was not part of the planned series undertaken as part of this assessment. It represented a valuable opportunity to exchange ideas with a representative of the European Economic Community (EEC) who is engaged in a study closely paralleling the stockpile assessment, The informant is a Coordinator for Industrial Raw Materials Supply Policy for the EEC. He was referred to us by the Visitor Program Service, a nonprofit organization making arrangements for foreign dignitaries to consult with experts in this country.

The informant was in the United States to discuss economic stockpiles with Government officials, experts in stockpiling or resource management, corporation heads, private research companies, and so on. He said that the nine-nation EEC had asked him in 1974 to prepare a policy paper on the subject of economic stockpiling, The request was prompted by the OPEC oil embargo, the subsequent price increase, and the possibility of similar actions being taken by other nations for other materials, The following information briefly outlines the EEC plan and the informant's reactions to this assessment,

1. Conclusions

This policy paper prepared by the informant was reviewed by the EEC, The conclusion reached was that an economic stockpile might contribute to the achievement of one or more of the EEC's objectives and that the informant should undertake extensive travel and discussion with persons in other countries of the world, including other importing and exporting countries. It was felt that the United States might be able to offer some useful counsel based on previous stockpile experience.

2. EEC Management

Of particular interest was the informant's description of a combined policy/management system being analyzed by the EEC. The policy objectives are the growth and stabilization of the economies of less developed nations which are heavily dependent on the income from exports of a particular material. To support these objectives, the EEC nations would enter long-term agreements for purchase of such materials at agreed-upon prices. If market prices fell below the agreed-upon price, the nations would make their required purchases and pay for them at the agreed-upon price rather than the market price. He was less certain of the arrangement it the contrary occurred. This apparently is one of the subjects under negotiation.

The EEC arrangement is, of course, an alternative to stockpiling. It was the informant's view that its application should be limited to those materials for which the nations are not heavily import dependent. The reason for this is that the drain on their financial ***resources*** (and possible competitiveness in export markets) would be too great if market prices fell substantially below the agreed-upon prices for a large import volume material, The informant said that considerable progress in this effort had already been made and that discussions were about to commence regarding the budget contribution to be made by member nations.

3. The Attitude of West Germany

Of particular interest was his anticipation that West Germany would present the greatest difficulty in funding any economic stockpile program and his reason for thinking so. He said that West Germany could be expected to offer opposition to any EEC program which interfered with the operation of the free enterprise system. This is not to say that West Germany does not participate, or is inexorably opposed to such programs, but rather that it places very much more stress on the cost of such interference than do the other member nations.

4. Review ot OTA Stockpile Assessment

The informant reviewed the list of economic stockpile policies and found them generally consistent with the EECs thinking. He was in total agreement with those cases in which U.S. interests and EEC interests were parallel, such as protection against cartels and increased foreign country production of materials.

a. Concentration on Aluminum, Steel, and Base Metals.-Several phases of this assessment were outlined to obtain the informant’s reaction. He was astonished at the number of materials under consideration. He said the Raw Materials Supply Policy section of the EEC, which he heads, is one of six such units into which the EEC staff is divided. He stated that lack of sufficient expertise alone demanded that study efforts be limited to top-priority materials only. All efforts are presently being concentrated on lead, zinc, copper, bauxite, and iron ore.

He was moving toward the conclusion that iron ore was too bulky to make it feasible to stockpile. For much the same reason, he was weighing the costs and benefits of stockpiling bauxite ore against the costs and benefits of stockpiling it in a more highly fabricated form such as alumina, or even aluminum.

Notes.—The informant made the following observations:

- He would have been quite surprised if such an assessment had not been underway.
- He seemed to proceed on the basic assumption that major changes will take place in the next few years in the buyer/seller relationships between less developed nations exporting industrial materials and highly developed importing nations.
- His view was that the major element in such a new relationship would be the development of a stabilization device to permit the industrialized importing nations to aid (economically) the less developed exporting nations. (Presumably the national interest of the developed nations would be served by improving the stability and economic prospects of the less developed nations, thus reducing the likelihood of cartels, embargoes, violent price increases, etc.)
- An economic stockpile program represents one potential tool for use in accomplishing the above-stated objectives. It should be evaluated in terms of an alternative means of dealing with the future rather than in terms of the institutional arrangements that were created to deal with the past.
- The prospect of the European Economic Community’s engaging in the management of an economic stockpile program, or taking alternative actions with the same objectives, raises the possibility of a large new institution with which a U.S. stockpile program will interact. Considering especially the relatively thin margin

which frequently exists between a shortage and upward pressure on prices and a surplus and falling prices, that interaction could be of critical importance to the success of both the U.S. and EEC programs.

B. STOCKPILING IN JAPAN

Japan, of all the major powers, has the worst imbalance between requirements for mineral resources to support a modern industrial complex and the ability to produce these resources domestically. Japan depends on imports for almost 100 percent of its requirements for bauxite and alumina, chromium ore, nickel, phosphate rock, and tungsten; for more than 90 percent of its copper, iron ore and concentrate, manganese ore, and tin; and for more than 75 percent of its lead ore and concentrate, and zinc, The following account presents Japan's program as currently planned.

1. Import Dependence and Stockpiling

Japan's resource shortage is complicated by its high degree of independence on relatively few sources of imports, In 1973, for example, more than 50 percent of its copper imports came from Canada, Zambia, and the Philippines; 64 percent of its lead from Canada and the United States; 58 percent of its zinc from Canada and Peru; 65 percent of its nickel from New Caledonia and Canada; and 54 percent of its bauxite from Australia, Japanese industry was forced to cope with reduced production attributed to conditions beyond its control, such as labor walkouts and strikes, natural disasters, and political changes in the producing countries. Domestically, Japanese industry in recent years has also experienced great difficulty in obtaining plant sites because of aroused public interest in environmental protection and preservation.

a. Stockpile Consideration.—The use of stockpiles as one means of solving Japan's resource problems has been under active consideration for much of the last decade. At least as early as 1967, the Japanese Ministry of International Trade and Industry (MITI) drew up plans for a semigovernmental agency to acquire and maintain stockpiles of materials like nickel, molybdenum, cobalt, tungsten, and vanadium which are needed by the specialty steel industry, The plan contemplated an agency, supported on a 50–50 basis by the Government and the specialty steel industry, which would guard against increases in metal prices by developing mines in Japan and abroad and by purchasing ores when market prices were low.

b. Copper.—Late in 1971, officials of Japan's copper smelting industry urged the Government copper and copper concentrates, which at that time were estimated to be about 50,000 tons above Japan's normal stock position of 30,000 tons. The officials stated that copper smelters were having difficulty in arranging cuts in copper concentrate shipments from overseas sources, particularly in the developing countries. And because of the low market prices overseas, Japan's surplus of refined copper could not be exported except in very small lots,

c. Other Metals.—Early in 1972, MITI proposed that the Government support a $500-$700 million stockpile of materials consisting of iron ore, zinc, nickel, bauxite, copper, and other ores and concentrates, The proposed stockpile would serve three major purposes: (1) protection of Japanese industries from price fluctuations and delivery interruptions; (2) use of the country's growing foreign reserves, then approaching $16 billion; and (3) elimination of pressure on Japanese industries, faced with business slowdowns, to cancel or amend existing contracts for imports of overseas ore.

d. Guidelines for Stockpile. -Stockpiling again received high-level attention a few months later when the subject was included in a document published in May **1972** by the Natural Resources Committee of the Prime

Minister's Economic Council. This document contained the first important statement of Japan's minerals policy issued after devaluation of the U.S. dollar. It proposed the following guidelines for Japan's future minerals policy:

- Increase efforts to stabilize world supply and demand, emphasizing international cooperation to achieve harmony with scarce resources;
- Establish a buffer stockpiling program to help stabilize prices, thereby enabling the orderly development of minerals in countries with mineral resources;
- Expand the world minerals supply by using Japan's technical and financial resources in all fields of minerals activity—from exploration, development, and production to transport, processing and construction;
- Stress technology and planning to achieve maximum utilization of resources, investigate substitutes for and regeneration of materials, develop new energy sources, adopt more efficient processes, control pollution hazards, cooperate with other countries in large projects, and aid developing countries; and
- Develop integrated approaches to resource development and utilization in contrast to pursuing a project-based approach.

In addition to acquiring minerals for its own needs, Japan's basic goal would be to help developing countries improve their efficiency and maximize economic growth. Japan's involvement would be from the initial phase and would be broad in scope--encompassing mapping, initial surveying, business consultations, infrastructure building, financial and technical assistance, joint ventures, and improvement of the investment climate.

e. Rare Metals.—In June 1972, MITI began studies on a program to stabilize demand, supply, and prices of the so-called "new metals" (such as tantalum, beryllium, columbium, zirconium, and rare earths), and to create adequate emergency stockpiles of these materials equivalent to 6—12 months' supply. Stockpiling would be handled by the Japan Rare Metals Co. This company had been established in 1967 by the steel, ferroalloy, and nickel producers to buy up nickel, tungsten, cobalt, and molybdenum. By mid-1972, 1,300 tons of ferronickel and 120 tons of tungsten ore had been stockpiled.

f. Nonferrous Metals.—The $500–$700 million stockpiling program for nonferrous metals which MITI had proposed early in 1972 was temporarily shelved late that year. Instead of going ahead with it, the Japanese Government used its large holdings of foreign-currency reserves to finance loans to refiners of nonferrous metals who were committed to take delivery of foreign ores beyond their immediate requirements. The rationale for this course of action was that many developing nations, as well as suppliers in Australia and Canada, would otherwise encounter serious financial difficulties and might well seek outlets other than Japan.

2. The Japanese Ministry of International Trade and Industry (MITI) Metals Program

In September 1974, a nonferrous metals study group of the Mining Industry Council (an advisory group to MITI) recommended that the Japanese Government immediately subsidize the stockpiling of certain nonferrous metals. In making its recommendations, the study group sought to identify metals that are economically important to Japan; not amenable to substitution; unavailable domestically; maldistributed in terms of known reserves and the sources of import into Japan; monopolized by large international mining companies subject to supply interruptions through strikes, natural disasters, and political instability; and frequent targets of speculative purchasing. The group selected nine metals as follows:

- Recommended for immediate stockpiling: copper, nickel, chromium, and tungsten;
- Immediate stockpile held to be desirable, but market conditions judged to be currently inappropriate: zinc, cobalt, and molybdenum;
- Supplies considered stable at present, but supply structure requiring observation: antimony and tin.

a. Four Critical Metals in the First Category.—The study group recommended stockpiling of copper, nickel, chromite, and tungsten in the first category as follows:

- The report of the study group noted that Japan's consumption of copper over the past decade has increased at an average annual rate of 11.4 percent and that Japan's dependence on imports has reached 89 percent. It was estimated that 100,000 MT of primary copper would meet Japan's requirements for 1 month on a minimum basis. Stockpiling was justified on the ground that difficulties in finding refining sites and managing pollution problems will force Japan to become increasingly dependent on imports of refined copper and reduce the country's ability to adapt to supply interruptions.
- The amount of nickel was set at 8,000 MT, estimated to provide a 3 months' supply. Japan has no domestic nickel resources, and depends on only four countries (New Caledonia, Canada, Australia, and Indonesia) for 90 percent of its total supply. The report expressed particular concern over labor problems and tropical storms in New Caledonia, which supplies 47.1 percent of Japan's nickel,
- One million MT of chromite was estimated to provide a 3 months' minimum supply. According to the study group, Japan's consumption of chrome has increased by an average of 12 percent annually over the past decade. The concentration of world chromium resources in Rhodesia and South Africa presents Japan with a major problem in view of its efforts to improve relations with Black Africa. Japan has recently been increasing the percentage of its imports from India, Iran, the U. S. S. R., and Malagasy.
- With tungsten, 330 MT was determined to provide a 3 months' minimum supply. Japan's consumption of tungsten has increased at an annual rate of 4.6 percent over the past decade, The study group noted with concern that Communist China has over 75 percent of the world's reserves of tungsten ore, that Japan obtains tungsten from a large number of small mines in developing countries which are frequently in financial difficulty, and that the U.S. tungsten stockpile cannot be expected to lend stability to the market for many more years.

b. Other Critical Metals **in a** Second Category.—In recommending the second category of metals for stockpiling when market conditions are appropriate, the study group made the following observations regarding zinc, cobalt, and molybdenum:

- While Japan produces 40 percent of its zinc requirements domestically, during the past decade consumption of zinc has increased at an average annual rate of 8.7 percent, and Japan is dependent for 74 percent of its imports on three countries (Canada, Peru, and Australia). The large-scale scrapping of Canadian zinc refineries unable to meet new environmental standards is a matter of concern to Japan, which gets 34.5 percent of its zinc imports from Canada.

- Japan's consumption of cobalt has been increasing at an average annual rate of 11.5 percent over the past decade. Japan's only production of cobalt at present is a byproduct of nickel mining, and amounts to about 10 MT annually. Plants are being built that are expected to produce a total of about 2,800 MT annually. Imports from Zaire account for over 80 percent of Japan's cobalt supply. At present cobalt stocks on hand amount to about 3 months' supply, the level recommended for stockpiling.

- Japan's consumption of molybdenum has been increasing at an average annual rate of 12.6 percent over the past decade. Japan is almost totally dependent on imports for molybdenum, with the United States supplying 53 percent of Japan's ore imports and 37 percent of its metal imports. Strikes by miners and longshoremen in the United States are of concern to Japan. Although the stockpiling of 3 months' supply was considered desirable, the current tight world supply situation as regards this metal precluded such action.

c. Two Metals in a Third Category.—The study group recommended observation of two metals, antimony and tin:

- Domestic demand for antimony has been increasing at an average annual rate of 1.8 percent. Japan is almost totally dependent on imports for this metal, with Bolivia and Communist China supplying about 50 percent and 30 percent, respectively, Stocks on hand exceed the recommended 3 months' stockpile supply,

- Domestic tin demand has increased at an average annual rate of 8.6 percent, Japan produces only a small amount of tin, and depends on two countries for most of its imports (Malaysia, 85 percent; Indonesia, 12 percent), The research group concluded that buffer stocks held under the International Tin Agreement are adequate to insure a stable supply, but thought that market developments should be watched.

The research group also studied Japan's supply situation regarding aluminum, iron ore, coking coal, and timber products, but made no recommendations for stockpiling these materials.

d. Stockpile Supervision and Quantities.—The study group's report recommended that the stockpiling of the four metals in the first category (copper, nickel, chromium, and tungsten) be carried out through a private corporation financed by Government-guaranteed funds and also partially subsidized by the Japanese Government. The Japan Mining Public Corp., which is controlled by MITI, would supervise stockpiling arrangements and the issuance of bonds.

MITI considered the recommended stockpile quantities to be adequate for major supply interruptions, but it halved the amounts of copper and chrome to be stockpiled. It did not consider the acquisition of buffer stocks to stabilize prices. MITI requested the Finance Ministry to budget 44,100 million yen ($147 million) for this project, and also asked the Japan Export-Import Bank to make available 70,000 million yen ($233 million) at 7.5 percent interest to private companies to finance up to 70 percent of the cost of imported ore for the stockpiling product.

e. Financing.—The Japanese Ministry of Finance turned down MITI's request for funds in the fiscal year 1975 budget to finance the proposed national stockpile of nonferrous metals. It also reduced from 70,000 million yen to 10,000 million yen MITI's request for funds to support a special financing issue by Japan's Export-Import Bank to facilitate the obligatory receipt of copper ore.

Of the nonferrous metals, copper is giving Japan the most problems at present. Large stocks are accumulating in the current depressed market despite production cutbacks by smelters. Stock levels in April 1975 were expected to reach 200,000 MT of refined copper, as compared with 136,000 at the end of l974, Copper stocks held by fabricators and consumers were estimated to bring the total to 300,000 MT, Japan has sought relief by urging exporters to reduce or delay shipments to Japan, but has been only partly successful in this campaign. Government loans to support the growing inventory increase totaled 50,000 million yen as of March 1975, and the Japanese Mining Association as of March 25 was requesting another 90,000 yen,

f. **Scrap.—Japan appears to have recently decided to create a stockpile of scrap steel from domestic sources,** Late in April 1975, MITI announced that an organization for this purpose would start functioning by the middle of May. Initially funded at 4,110 million yen (about $13.7 million), the organization (a nonprofit foundation composed of steel manufacturers, scrap wholesalers, and scrap collectors) would stockpile up to 100,000 MT of high-grade domestic scrap steel to stabilize prices and encourage recycling.

g. Recycling.—A separate organization, known as the Cycling Association, will be created to promote utilization of recovered iron resources. The association will guarantee loans advanced to scrap processors for purchasing new equipment to modernize the recycling of scrap. The association will also develop new technology for more efficient utilization of scrap, and will promote the wider use of the new technology and equipment.

3. References

Airgram A-750, from American Embassy, Tokyo, to U.S. Department of State, Dec. 24, 1974.

American Metal Market, Apr. 24, 1975.

Council on International Economic Policy, Special Report: Critical Imported Materials.

"Japan Makes Plans for Stockpiling Agency," Metals Week, Aug. 21, 1967.

"Japanese Smelters Urge Central Stockpile," American Metal Market, Dec. 14, 1971.

Journal of Commerce, Mar. 7, 1972,

Metal Bulletin, Mar, 25, 1974.

"Metal Stock Build-Up Plan Facing Complex Problems, " Japan Chemical Week, vol. 15, No, 755, Oct. 17.1974.

Metals Week, Jan. 20, 1975.

"The Mineral Industry of Japan, " reprint from Minerals Yearbook, U.S. Bureau of Mines, 1972.

C. STOCKPILING IN FRANCE

The French Government in 1972 announced its decision in principle to establish a national stockpile of critical material to meet economic rather than strategic supply crises. The stockpile was to have four purposes:

1. Reduce the excessive vulnerability of certain processing industries, and protect small- and medium-sized companies from excessive shortages and price fluctuations;
2. Allow France to participate more actively in international agreements to stabilize prices of raw materials;
3. Provide possibilities for regulating prices of materials; and
4. Serve political and economic defense needs,

The French Government's decision involved participation with French industry in a combined or cooperative program as follows.

1. Stockpile Management

The stockpiling management program would be given to Groupment d'Importation et de Repartition des Meteaux (GIRM), This semigovernmental organization, whose activities had formerly been limited to copper, would serve a much broader area of responsibility. GIRM would assist French mining companies in mining activities beyond their traditional efforts in French Africa and the oversea territories. GIRM would also be expected to help French companies extend their endeavors into developed countries with minimal resources, such as Australia and Canada, and also ore-rich developing countries such as Brazil, Iran, Indonesia, Zaire, and Yugoslavia. GIRM would examine mining possibilities in mineral-rich countries, intervene more actively as a service company in the developing countries, and generally promote new possibilities for French private mining industries over the long run.

a. Selection of a Commodity.—For stockpile purposes, selection would be made on the following conditions:

1. France is a substantial consumer but not a major producer of the commodity.
2. Suppliers of the commodity are relatively few and are concentrated in politically unstable areas.

b. Copper Priority.—Because France was totally dependent on non-French companies for its copper supplies, copper was given priority over other materials. The Government's goal was to have French-owned companies provide from one-quarter to one-third of France's imports of this metal. To this end, GIRM planned a program of copper development which would eventually embrace activities ranging from extraction to refining. The program anticipated expenditures of some 300 million francs over a period of 4 years, with the French Government subsidizing 35 to 40 percent of the outlays. At the end of 1972, GIRM was maintaining a copper stockpile of about 60,000 tons for the benefit of French industry.

c. Nickel.—The 1972 program also gave special attention to nickel. France's Societe Le Nickel (SLN) signed a nickel stockpiling agreement estimated to add $20 million to the company's coffers, and permitting SLN to continue mining New Caledonia ore at the 1972 rate, while expanding facilities in northern New Caledonia to meet anticipated future demands. Under this agreement, GIRM was to purchase 10,000 tons of SLN nickel ore in 1973 at a negotiated price, with SLN to repurchase the nickel at the same price over the next 5 years, depending on market conditions.

2. Specific Actions Taken

Although discussions of the pros and cons of stockpiling continued within Government circles, the 1972 stockpiling program appears not to have been implemented to any substantial degree, mainly because of opposition from the Ministry of Finance.

Early in 1975, however, following a year's study of France's vulnerability to deficiencies in supplies of hard minerals, the Government of France apparently made some major policy decisions for corrective action. These decisions were inspired by interministerial studies showing that the supply of over half of France's mineral imports (which account for 55 percent of total consumption) could become critical under certain eventualities. The Government's policy decisions, which were taken at a special session of the Council of Ministers, chaired by President Giscard, contemplated action in four areas:

- Mineral geological research and exploration;
- Increased recycling;
- Negotiation with producers; and
- Stockpiling.

a. Mineral Geological Research and Exploration.—**A multiyear approximation of 125 million francs (10 million in 1975 and approximately 25 million annually thereafter) has been made for increased hard mineral prospecting in France, and revision of the mining code is being studied to improve the economic conditions of mineral production. The goal is to double France's own mineral production or, at a minimum to achieve a more complete inventory of the country's available resources. Development or subsidy of noneconomic mines is not presently being considered. French geological research activities overseas are also to receive priority attention.**

b. Increased Recycling.—A new office will be created in the Ministry of Industry to provide increased recycling of metals, as well as other materials. Legislation on recycling will soon be presented to Parliament.

c. Negotiation With Producers.—Maintenance of good relations with mineral exporting countries will continue to be emphasized as the most important factor in securing mineral imports, 65 percent of which come from less-developed countries. To this end, the Government will continue to seek arrangements for cooperating with traditional and potential suppliers of minerals in such fields as geological research, minerals exploration, and manpower training. Relationships that promise to stimulate new export sales for French manufacturers will be emphasized.

d. Stockpiling.—A national minerals stockpile will be created to contain stocks equivalent to 2 months' average imports for each category of raw or processed materials normally imported. An appropriation of 100 million francs (approximately $23 million) has been provided in 1975 for this purpose. The appropriations are expected to double in 1976 and remain at that level during the expected buildup period of 3 to 4 years. (U.S. Embassy officials believe that given gross French mineral imports of approximately 12 billion francs in 1974, the buildup may take longer,) Stockpiles will be maintained at Government expense and will be available only under Government authorization, which could include drawdowns in time of extreme market shortages or price rises.

According to the Ministry of Industry officials, France would not try to use the stock to intervene in the marketplace, The relative unimportance of potential French stocks in proportion to world supply would make such an effort fruitless in any event. Officials hoped, however, that creation of a national stockpile would enable France to negotiate with minerals producers from a stronger position.

3. References

Buttner, F. H. Draft Report on Stockpiling Effects. on Economic and Supply Stability, National Commission on Materials Policy, Apr. 9, 1973.

Minerals Yearbook, Area Reports: International, U.S. Bureau of Mines, 1972.

Airgram A-95, from American Embassy, Paris, to U.S. Department of State, Feb. 25, 1975.

Metals Bulletin, Apr. 14, 1972.

D. STOCKPILING INCENTIVES IN SWEDEN

In view of the immense investment in the U.S. strategic stockpile, a search for a method of financing stockpiling less costly to the Government should not be surprising. Sweden has decided to eliminate the expense of stockpiling through a system of tax incentives to support production and encourage industry to maintain its own inventories. The explanation of this plan is as follows.

1. Taxation of Corporate Income

The Government of Sweden maintains Government-owned stockpiles of raw material for strategic or economic purposes. At the *same time,* it provides incentives to industry to do so too. It does this through its unusual system of taxation of corporate income. The rules governing the taxation of corporate income in Sweden apply to three special areas:

- Inventory valuation;
- Depreciation; and
- Reserves for future investment.

The Swedish tax rules in these areas have contributed to the ability of Swedish industry to compete in world markets. By providing substantial incentives to industry and commerce. The rules have encouraged the use of private capital to deal with economic fluctuations and the business cycle.

a. Use of Tax Incentives.—An essential feature of these devices is the degree of control they give business taxpayers over the amount of profit to be reported. The corporation has the option of taking larger or smaller deductions in any particular year. To that extent, corporate and other taxpayers are permitted a substantial degree of latitude in leveling out

77-119 0-76-20

their annual results and in building up reserves.

b. Inventory Valuation.—Sweden's tax provisions governing the valuation of inventories are designed to eliminate taxation of merely inflationary profits and permit the strengthening of corporate resources against the possibility of inventory price declines. Although provisions exist in other countries for similar purposes, none takes the same form as Sweden's, where the basic rule is that the valuation of the inventory entered by the taxpayer in his account books shall govern for tax purposes. However, the right to value inventories in the taxpayer's business discretion is subject to certain limitations established by the tax laws.

The main rule governing inventory valuation is complemented by two supplementary rules. The first of these is the rule of "comparable value." If the value of the inventory at the end of a corporation's fiscal year-at cost or market and after deducting obsolete or unsalable items—is less than the average of the value of the inventory at the close of the 2 prior years (this average value is called the "comparable value"), the corporation may write its inventory down by 60 percent of that comparable value, rather than by 60 percent of the value at the end of the income year in question.

The second supplementary rule relates to the valuation of raw materials or staple commodities in the inventory. The corporation has an option to value these inventory assets at the lowest market price in effect during the income year or in any of the 9 previous years, and then to reduce that figure by 30 percent to give an inventory valuation equal to 70 percent of the lo-year low. If the corporation chooses to value raw materials or staple commodities in this way, it may not also take advantage of the rule of "comparable value" outlined above,

In any event, a corporation may always write its inventory down to its actual value despite the foregoing rules and take appropriate deductions from taxable income.

So far as the company's books are concerned, it is immaterial whether the amount of an authorized writeoff is deducted directly from the cost or market value of the inventory on the asset side, or is set up instead as a reserve for inventory price decline on the liability side. The latter method is customarily used, however, when the use of the "comparable value" rule results in a negative inventory value.

c. Depreciation.—The main rule provides that a taxpayer, after first writing off all obsolete or unsalable items in full, may write down the balance of the inventory by 60 percent to a floor of 40 percent of cost or market value, whichever is lower. Cost is determined on a first-in, first-out basis. The amount of this inventory writeoff is deductible from taxable income,

d. Reserves for Future Investment.—A special provision, enacted in 1964, permits a Swedish parent company selling inventory assets to a foreign subsidiary for further resale on the foreign market to defer tax on profits attributable to goods which remain unsold in the hands of the subsidiary at the end of the parent's fixed year. The parent may take a deduction from taxable income, by an amount not exceeding the difference between (1) the price at which the parent sold these goods to the subsidiary (minus any amount of inventory writeoff deducted by the subsidiary), and (2) the parent's cost of these goods. The allocation must be restored to taxable income during the following fiscal year; at the end of that year, the question of a deduction for a renewed allocation is considered in view of current circumstances,

2. Incentives Preferred to Stockpiling

While the tax system of Sweden was not designed to create a national stockpile, but rather to support a health industrial economy in good rapport with Government, it has tended to obviate the need for a national stockpile by encouraging industry to maintain inventories large enough to meet emergency situations.

True, the inventories thus supported include many items not necessarily of a strategic and critical nature, as well as those that are. On the other hand, the coverage becomes much greater than would be possible if the Government were to purchase and store only those items it could afford and which were deemed vulnerable enough to warrant the Government effort.

In brief, the Swedish tax rules as they apply to inventories, along with other tax measures, are designed to increase the efficiency of Swedish industry as a competitor in world markets. The creation of a "Swedish stockpile" is more or less a byproduct, Whether or not it might be desirable to extract at least the principle from the Swedish tax system for application to the United States would seem to warrant further examination.

3. Reference

The Tax System in Sweden, Skandinaviska Enskilda Banken, February 1972.

Appendix D

RELEVANCE TREES AND WEIGHTING MATRICES

A. INTRODUCTION

At the beginning of this assessment there was a general requirement for a detailed analysis of the purposes, policies, and issues of stockpiling. These maybe put in the four categories of stockpiling policies, stockpiling procedures, stockpiling alternatives, and stockpiling impacts. The methodology chosen for analysis is the construction of relevance trees. These are described in more detail later in this discussion. Basically, the relevance trees serve as a detailed method for organizing the assessment. The relevance trees categorize policy, criteria, exogenous factors triggering stockpiling actions and issues and impacts pertaining thereto.

The relevance trees are particularly useful in the construction of the scenarios and technology forecast. By breaking the entire stockpiling subjects down into their constituent building blocks, the important areas may be recognized and then incorporated in the scenarios and technology forecasts. The effort of actually constructing the stockpiling relevance trees is a very educational one, requiring a forced education of the authors which directly leads to a better understanding and more constructive assessment in all of the later tasks.

The relevance trees are particularly useful in showing the construction of the stockpiling systems basic blocks which consist of: criteria for stockpiling, price of materials, policies, procedures, and materials. All of these areas are treated in great detail in the relevance trees.

In chapter V the impacts on the economic, social and political areas due to stockpiling critical material are examined and tested. The impacts and interest groups who are affected and their various relationships are shown in the relevance trees here. The interest groups are shown as Level 5 of the first three relevance trees. From the detailed relevance trees structure, the important interest groups may be selected for examination in the impact areas.

Finally, the relevance trees focus in great detail on stockpiling policies, procedures, issues, and activities, and serve as a guide for coordinating the candidate stockpiling policies and the impacts in order to determine the overall policy implementation for stockpiling key materials.

Hence, it is seen that the construction of the relevance trees in great detail facilitates doing the other tasks, outlining the entire project in detail, and shows the general relationship of the policies, issues, and impact areas in the overall stockpiling policies project. The following is a more detailed discussion of the stockpiling relevance trees themselves and details the method of construction and organization of them. The top levels of the relevance tree for all of the key materials are presented here. However, only the lower levels for the specific key material of iron/iron ore is presented in this assessment. The relevance trees for the other metals and nonmetallic minerals will be essentially the same. For fibers and fuels, some of the lower levels in the relevance trees will be necessarily different.

The relevance trees show a hierarchical structure for stockpiling policies. Each of these relevance trees has several levels. Each level contains a disaggregation of the information contained in the next higher level. The logic linking the levels is revealed by a set of statements (displayed on the tree at the left) defining the content of each level.

For each material, four relevance trees are developed: (1) a stockpiling policy for dealing with reasons for stockpiling; (2) a stockpiling procedure tree concerned with methods of stockpiling; (3) a stockpiling activities tree identifying ancillary programs which may be associated with stockpiling; and (4) a stockpiling impacts tree which shows where and how the impacts of stockpiling will be felt. The lowest level of each tree identifies those interest groups which are most closely affected or which impact on stockpiling policies. The same groups may appear at several positions on level 5 of a given tree as well as on level 5 of the other trees. Where this occurs, it indicates the interplay of policies of the three trees.

B. RELEVANCE TREES

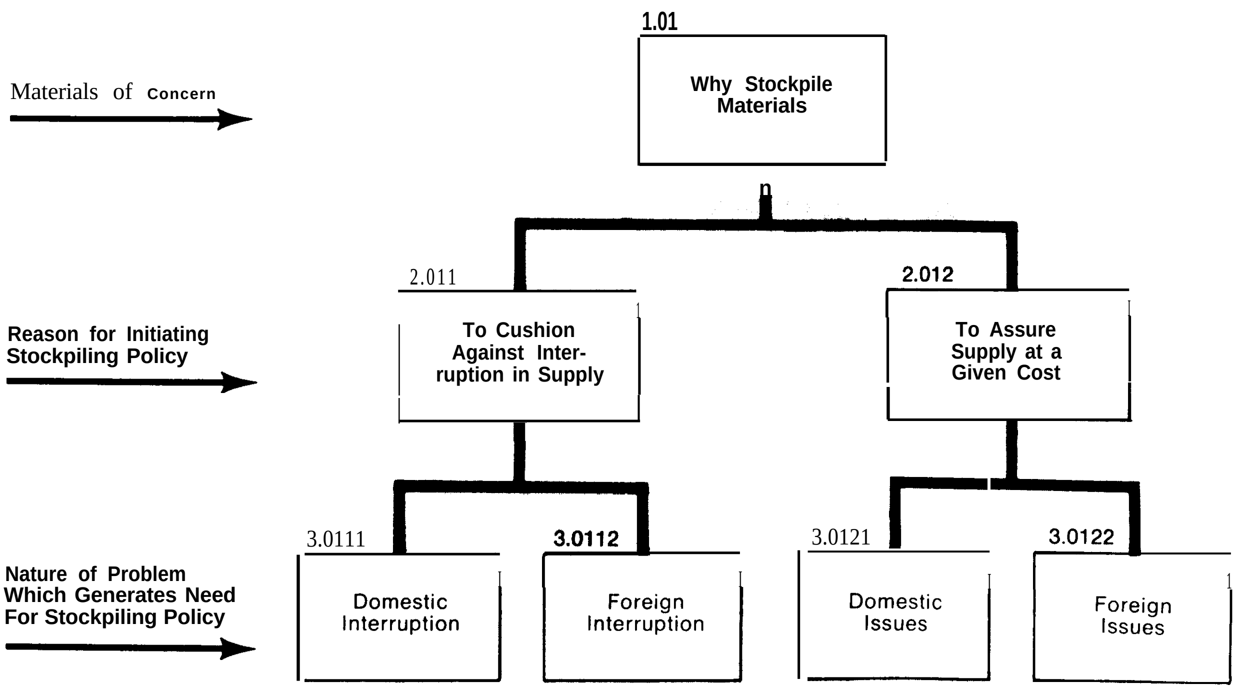
The logic of the individual relevance trees is outlined below:

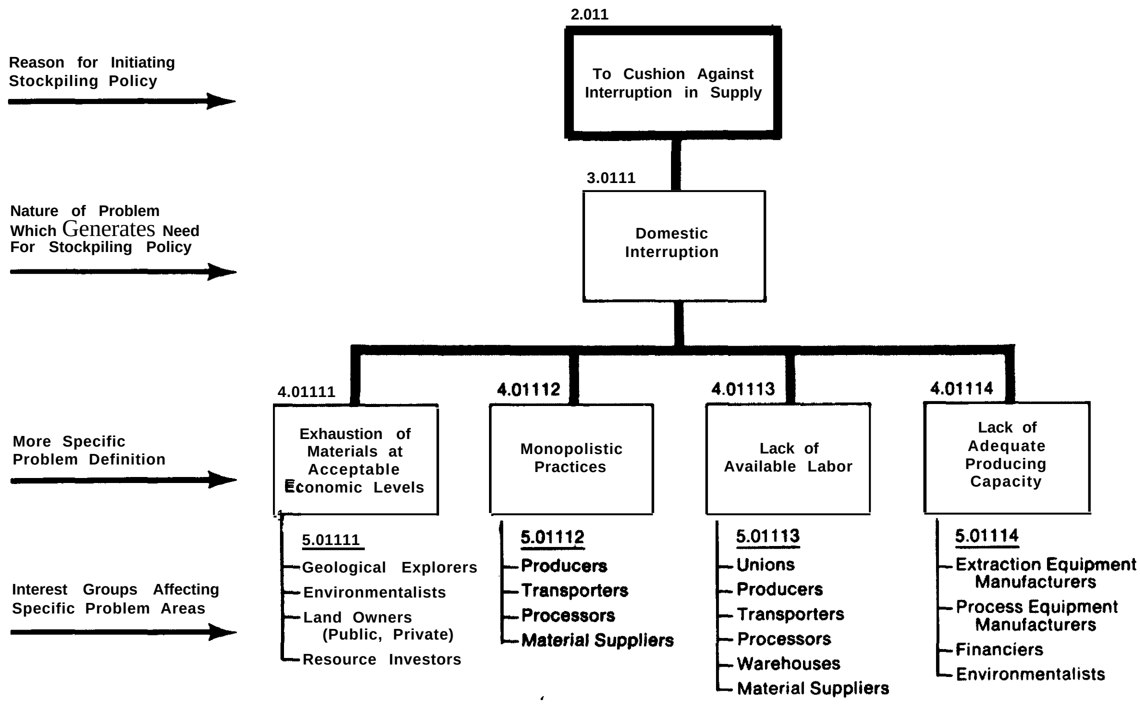
- The Stockpiling Policy Tree begins with the question, Why stockpile a particular material? (Level 1). Level 2 shows two general reasons for initiating stockpiling: to maintain a supply in case of cutoffs from primary sources, and to provide protection against economic pressures, Level 3 identifies the material resource problem areas as being domestic and foreign, The problems which may be alleviated by stockpiling are detailed on Level 4. The lowest level (Level 5) shows those interest groups which can be expected to impact on the specific problems.
- The Stockpiling Procedure Tree deals with the question, How can a particular material be stockpiled? (Level 1). Level 2 shows the two areas of concern: domestic and foreign. On Level 3, general methods of stockpiling are identified. Specific storage procedures are shown on Level 4. Level 5 (the lowest level) identifies the interest groups that may be affected by the stockpiling procedures.
- The Alternates to Stockpiling Tree derives from the question, What activities may stockpiling a particular material stimulate (Level 1)? The general policies which may be initiated as a result of stockpiling are given on

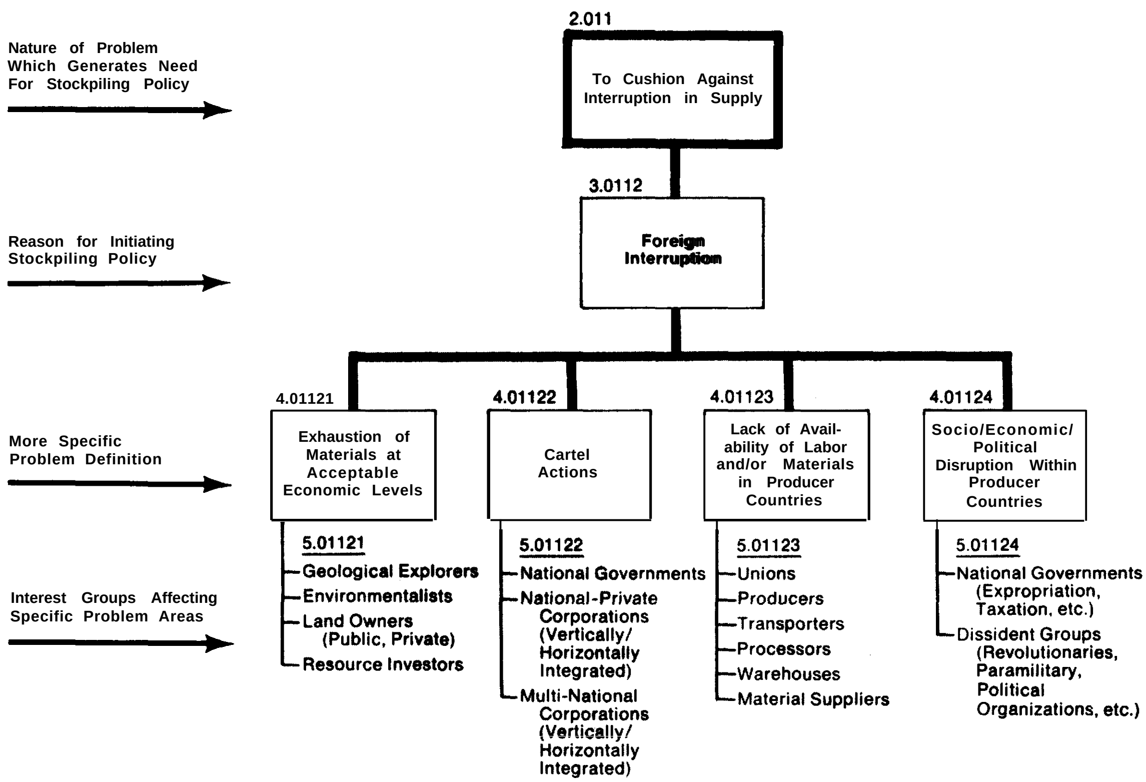
Level 2. Level 3 specifies the policies sufficiently so that programs derived from these policies can be identified on Level 4. The lowest level (Level 5) shows those interest groups which would be directly affected by these programs,

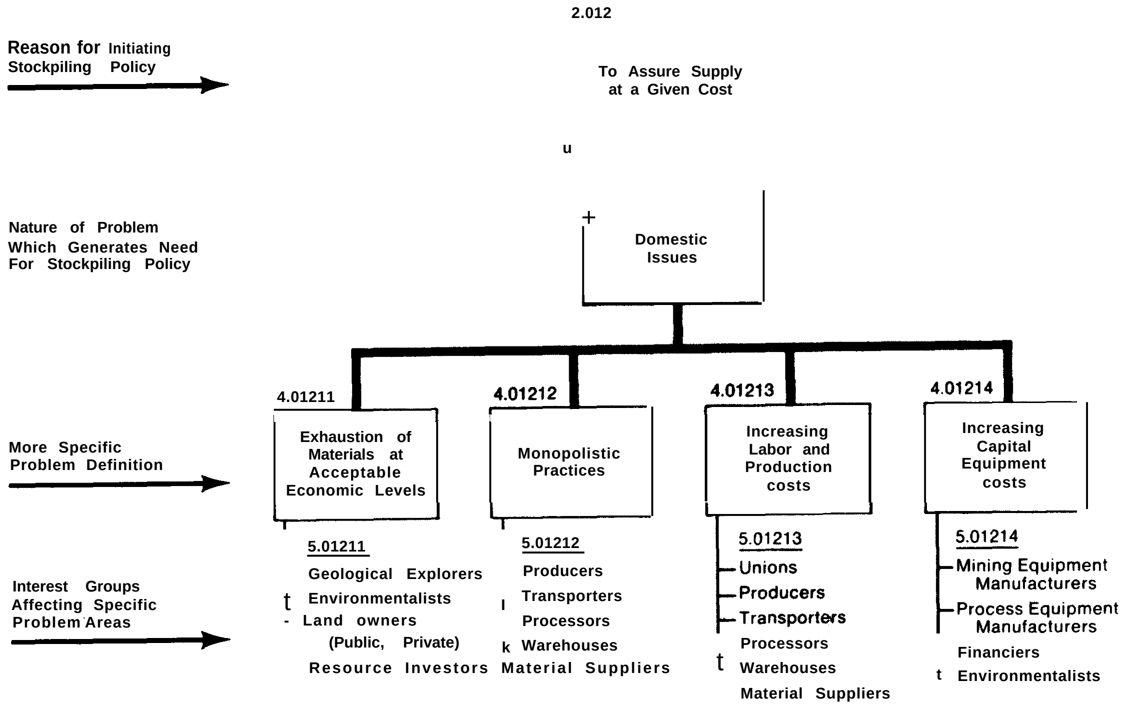
. The stockpiling impact tree begins, at Level 1, asking where, throughout the world, the impact might be felt. The major divisions recognized are: the United States, other countries which import the material, countries which export the material, countries which could export the material or substitutes, and countries which have secondary dependence on the material (e.g., countries which import products manufactured from the material). At Level 2, the relevance tree centers on the question, "How might the impact be felt?" Here, the divisions are social, economic, political, legal, and other, The domain of the impact is next addressed at Level 3. The impacts can be felt totally internally to the country, or in relations between the country and others. Level 4 consists of a further subdivision of the domain, and Level 5 addresses the areas of the impacts themselves (e.g., institutional viability, political stability between nations, and trade alliances). In all, this relevance tree of impacts produced approximately 355 impact areas,

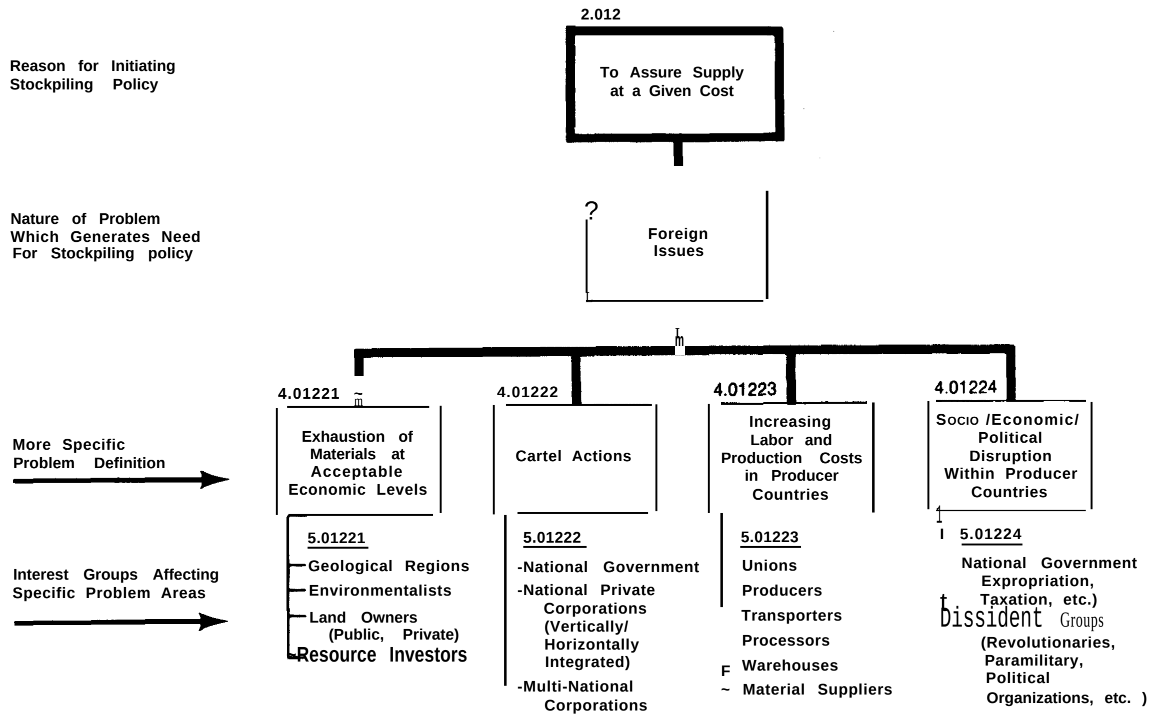
Stockpiling Policy Tree




Reason for Initiating Stockpiling Policy
Nature of Problem Which Generates Need For Stockpiling Policy
More Specific Problem Definition
Interest Groups Affecting Specific Problem Areas
2.011
To Cushion Against Interruption in Supply
3.0111
Domestic Interruption
4.01111
Exhaustion of Materials at Acceptable Economic Levels
4.01112
Monopolistic Practices
4.01113
Lack of Available Labor
4.01114
Lack of Adequate Producing Capacity
5.01111
Geological Explorers
Environmentalists
Land Owners (Public, Private)
Resource Investors
5.01112
Producers
Transporters
Processors
Material Suppliers
5.01113
Unions
Producers
Transporters
Processors
Warehouses
Material Suppliers
5.01114
Extraction Equipment Manufacturers
Process Equipment Manufacturers
Financiers
Environmentalists

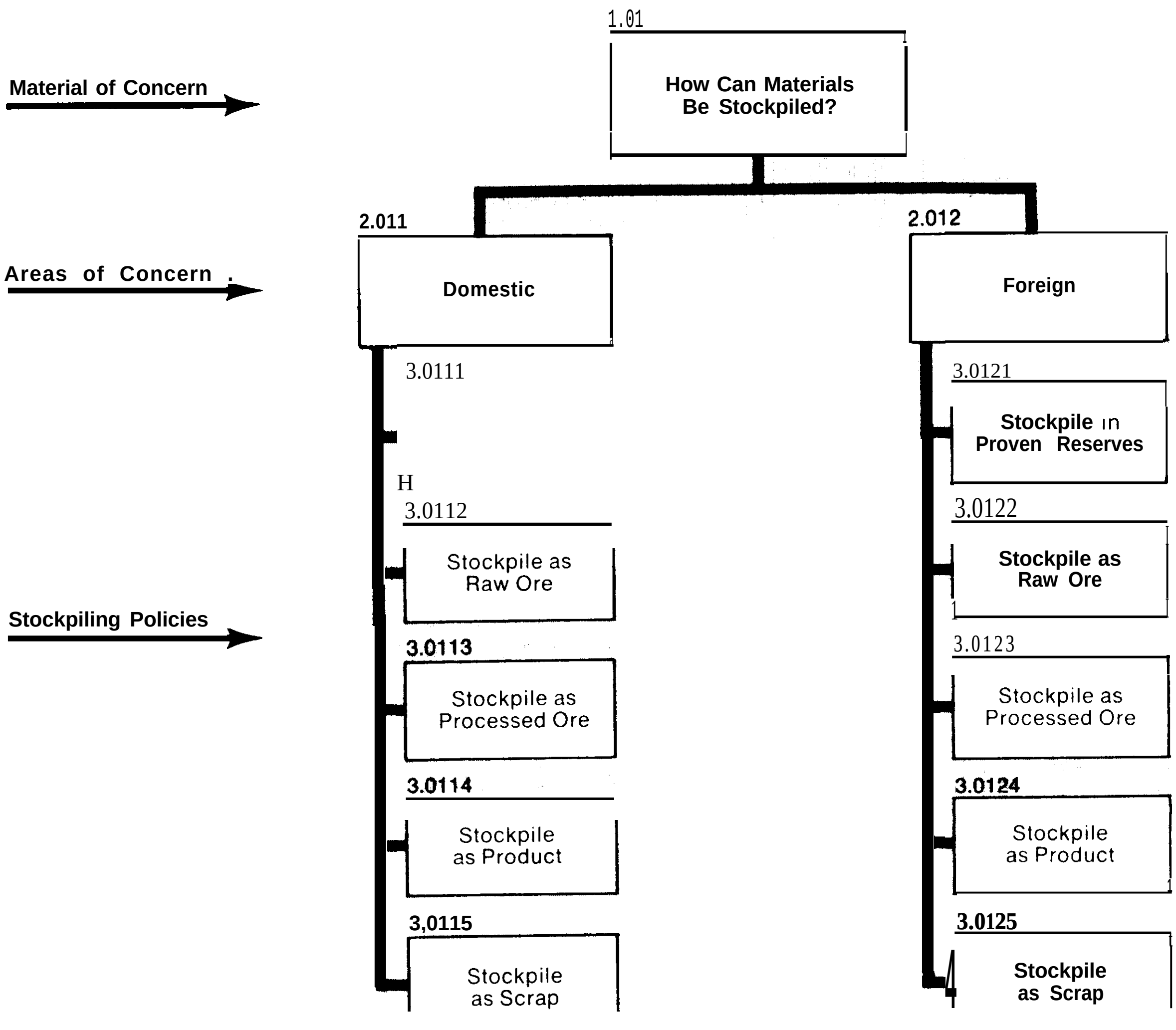

Nature of Problem Which Generates Need For Stockpiling Policy
Reason for Initiating Stockpiling Policy
More Specific Problem Definition
Interest Groups Affecting Specific Problem Areas
2.011
To Cushion Against Interruption in Supply
3.0112
Foreign Interruption
4.01121
Exhaustion of Materials at Acceptable Economic Levels
4.01122
Cartel Actions
4.01123
Lack of Availability of Labor and/or Materials in Producer Countries
4.01124
Socio/Economic/ Political Disruption Within Producer Countries
5.01121
Geological Explorers
Environmentalists
Land Owners (Public, Private)
Resource Investors
5.01122
National Governments
National-Private Corporations (Vertically/ Horizontally Integrated)
Multi-National Corporations (Vertically/ Horizontally Integrated)
5.01123
Unions
Producers
Transporters
Processors
Warehouses
Material Suppliers
5.01124
National Governments (Expropriation, Taxation, etc.)
Dissident Groups (Revolutionaries, Paramilitary, Political Organizations, etc.)

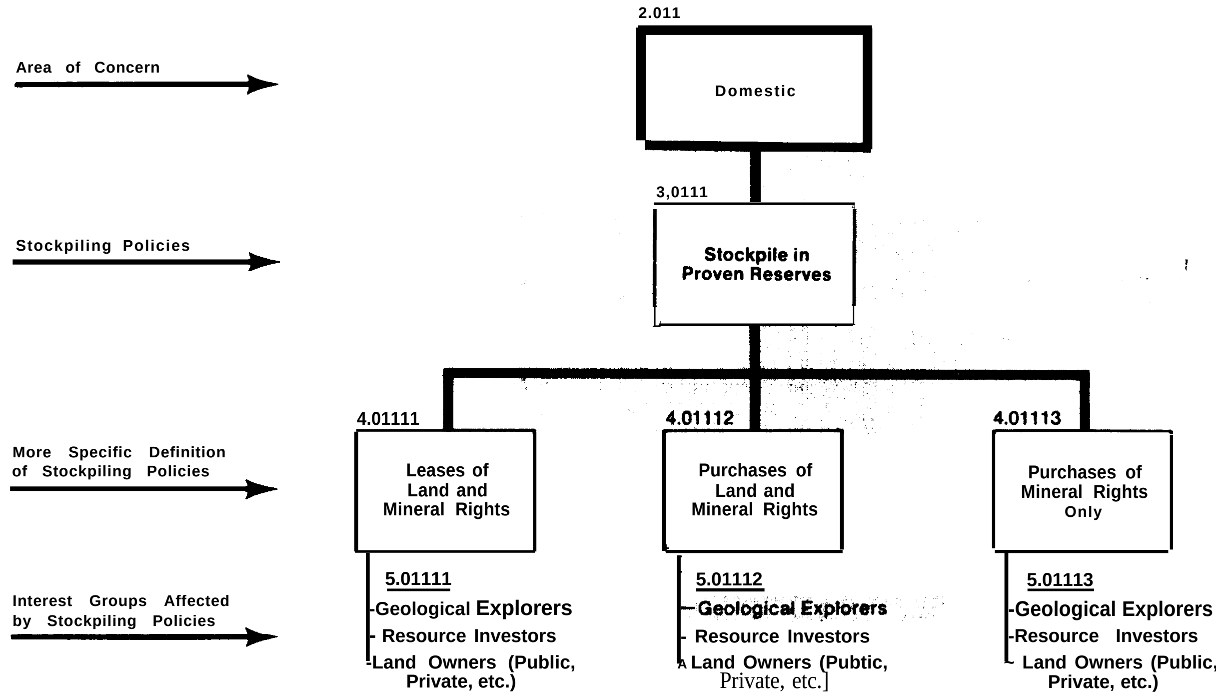

Reason for Initiating Stockpiling Policy
2.012
To Assure Supply at a Given Cost
Nature of Problem Which Generates Need For Stockpiling Policy
Domestic Issues
More Specific Problem Definition
4.01211
Exhaustion of Materials at Acceptable Economic Levels
4.01212
Monopolistic Practices
4.01213
Increasing Labor and Production costs
4.01214
Increasing Capital Equipment costs
Interest Groups Affecting Specific Problem Areas
5.01211
Geological Explorers
Environmentalists
Land owners (Public, Private)
Resource Investors
5.01212
Producers
Transporters
Processors
Warehouses
Material Suppliers
5.01213
Unions
Producers
Transporters
Processors
Warehouses
Material Suppliers
5.01214
Mining Equipment Manufacturers
Process Equipment Manufacturers
Financiers
Environmentalists

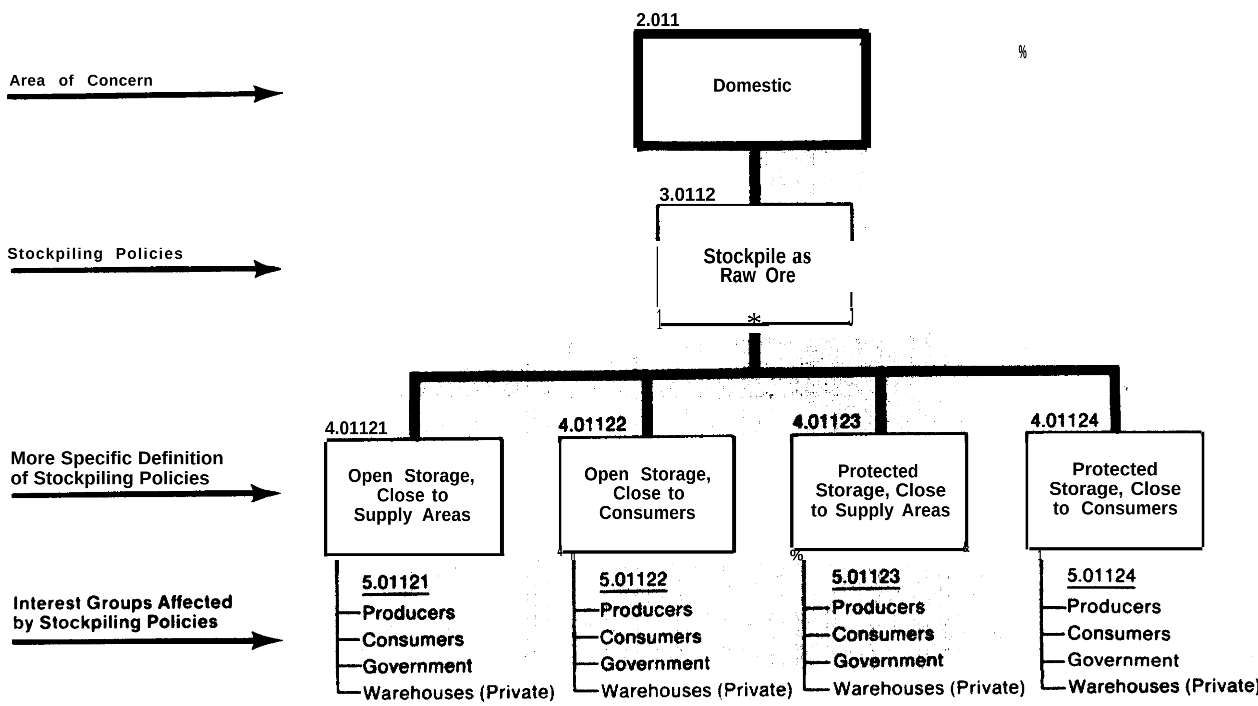

Reason for Initiating Stockpiling Policy
2.012
To Assure Supply at a Given Cost
Nature of Problem Which Generates Need For Stockpiling policy
Foreign Issues
More Specific Problem Definition
4.01221
Exhaustion of Materials at Acceptable Economic Levels
4.01222
Cartel Actions
4.01223
Increasing Labor and Production Costs in Producer Countries
4.01224
Socio /Economic/ Political Disruption Within Producer Countries
Interest Groups Affecting Specific Problem Areas
5.01221
Geological Regions
Environmentalists
Land Owners (Public, Private)
Resource Investors
5.01222
-National Government
-National Private Corporations (Vertically/ Horizontally Integrated)
-Multi-National Corporations
5.01223
Unions
Producers
Transporters
Processors
Warehouses
Material Suppliers
5.01224
National Government Expropriation, Taxation, etc.)
Dissident Groups (Revolutionaries, Paramilitary, Political Organizations, etc.)

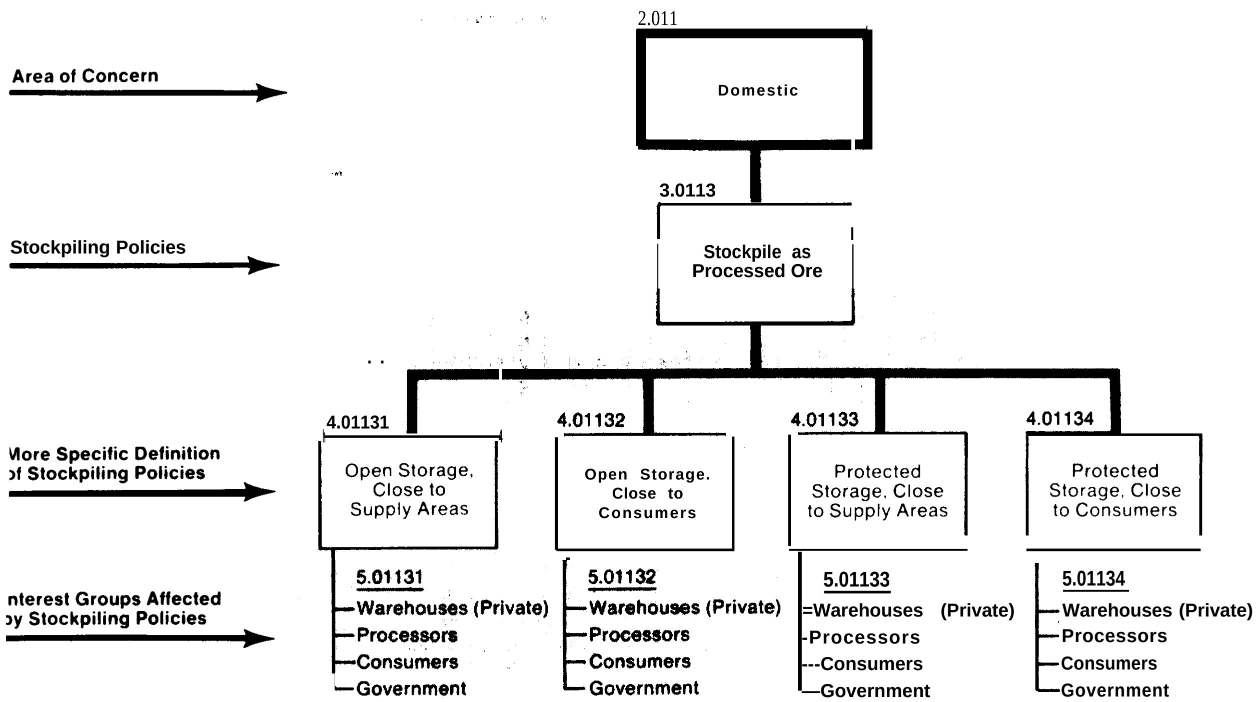
77-119 0-76-21

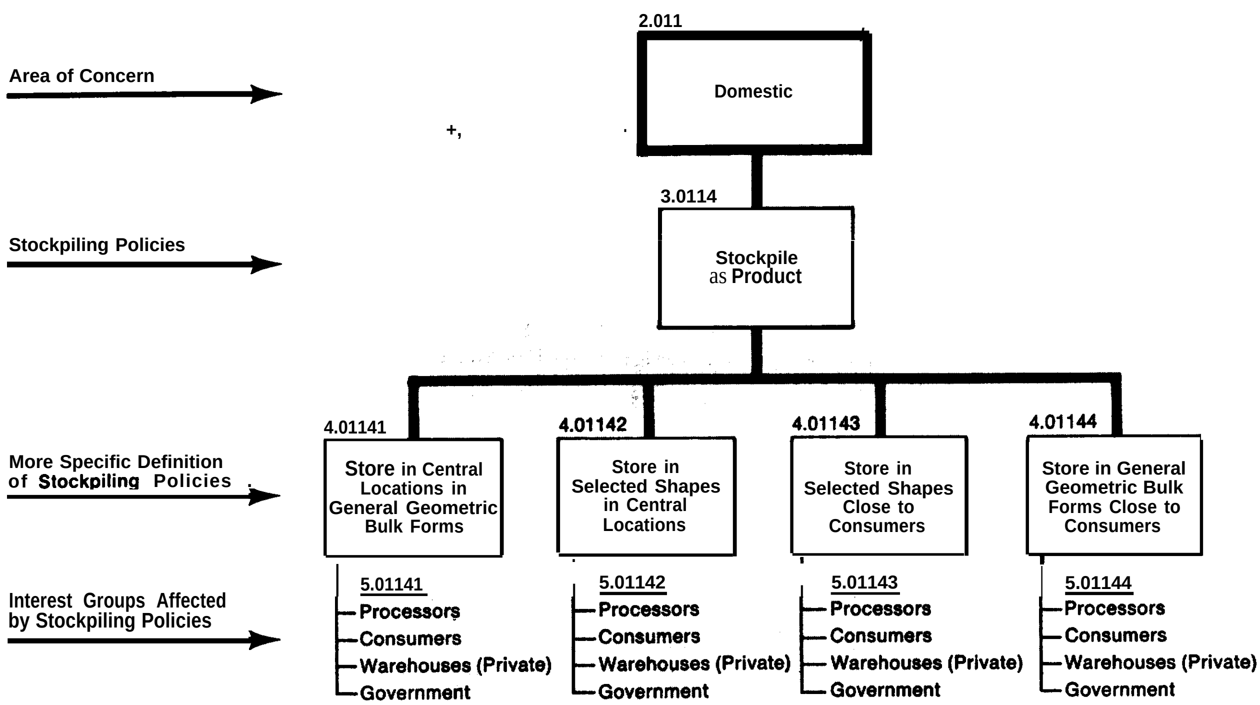
Stockpiling Procedure Tree

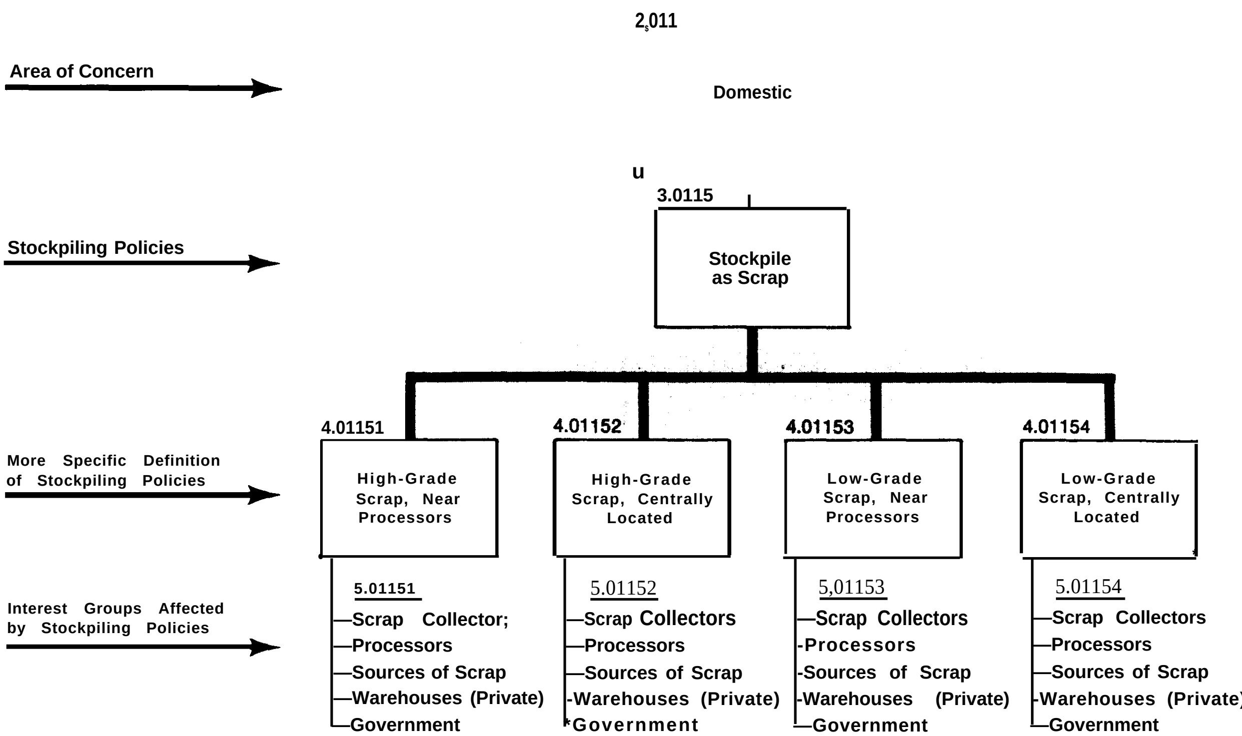


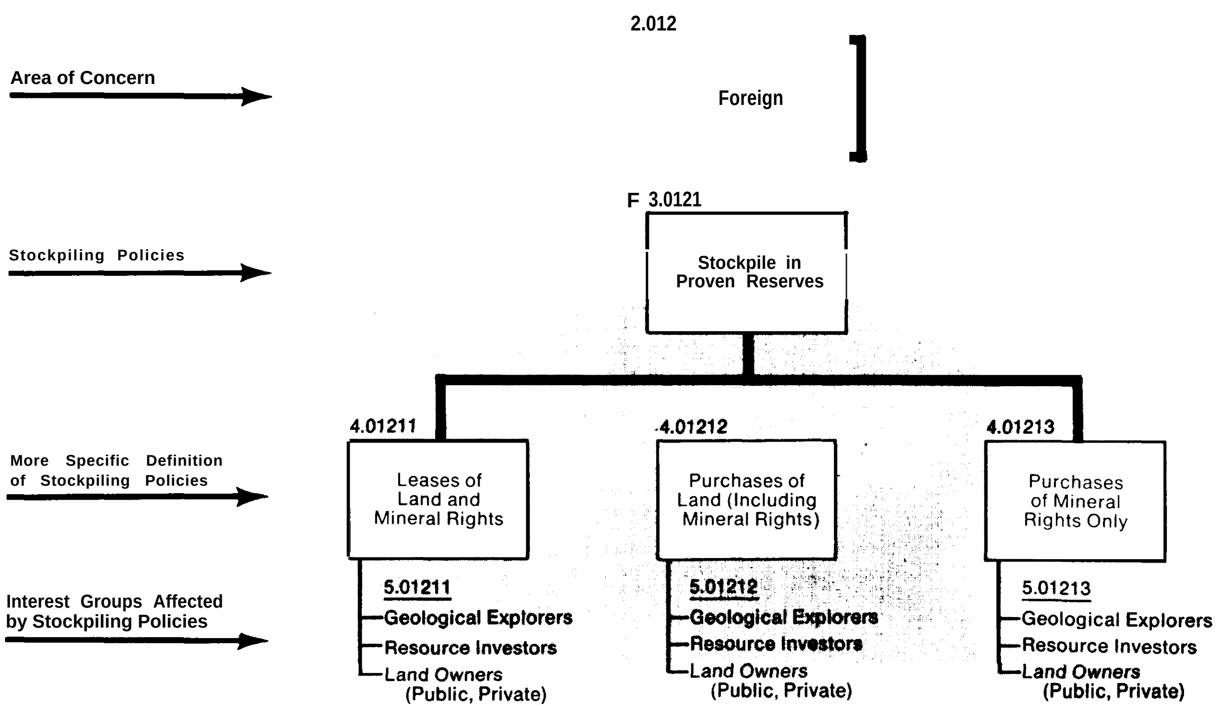

Area of Concern
Stockpiling Policies
More Specific Definition of Stockpiling Policies
Interest Groups Affected by Stockpiling Policies
2.011
Domestic
3,0111
Stockpile in Proven Reserves
4.01111
Leases of Land and Mineral Rights
4.01112
Purchases of Land and Mineral Rights
4.01113
Purchases of Mineral Rights Only
5.01111
Geological Explorers
Resource Investors
Land Owners (Public, Private, etc.)
5.01112
Geological Explorers
Resource Investors
Land Owners (Pubtic, Private, etc.]
5.01113
Geological Explorers
Resource Investors
Land Owners (Public, Private, etc.)

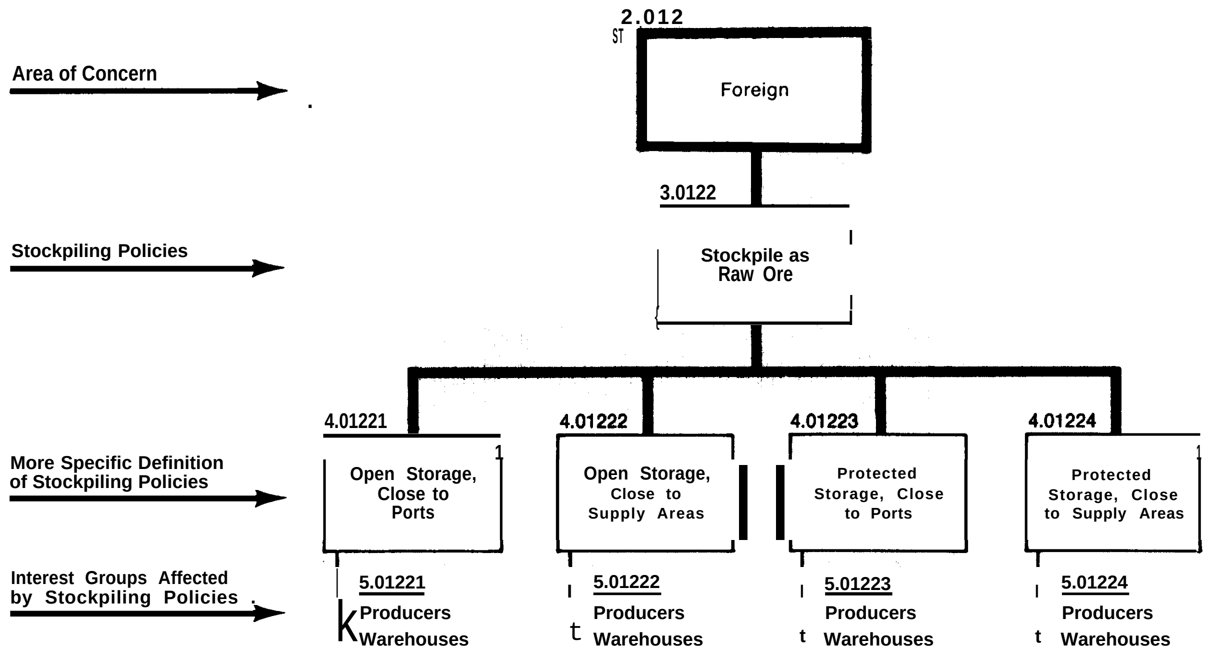

Area of Concern
Stockpiling Policies
More Specific Definition of Stockpiling Policies
Interest Groups Affected by Stockpiling Policies
2.011
Domestic
3.0112
Stockpile as Raw Ore
4.01121
Open Storage, Close to Supply Areas
4.01122
Open Storage, Close to Consumers
4.01123
Protected Storage, Close to Supply Areas
4.01124
Protected Storage, Close to Consumers
5.01121
Producers
Consumers
Government
Warehouses (Private)
5.01122
Producers
Consumers
Government
Warehouses (Private)
5.01123
Producers
Consumers
Government
Warehouses (Private)
5.01124
Producers
Consumers
Government
Warehouses (Private)

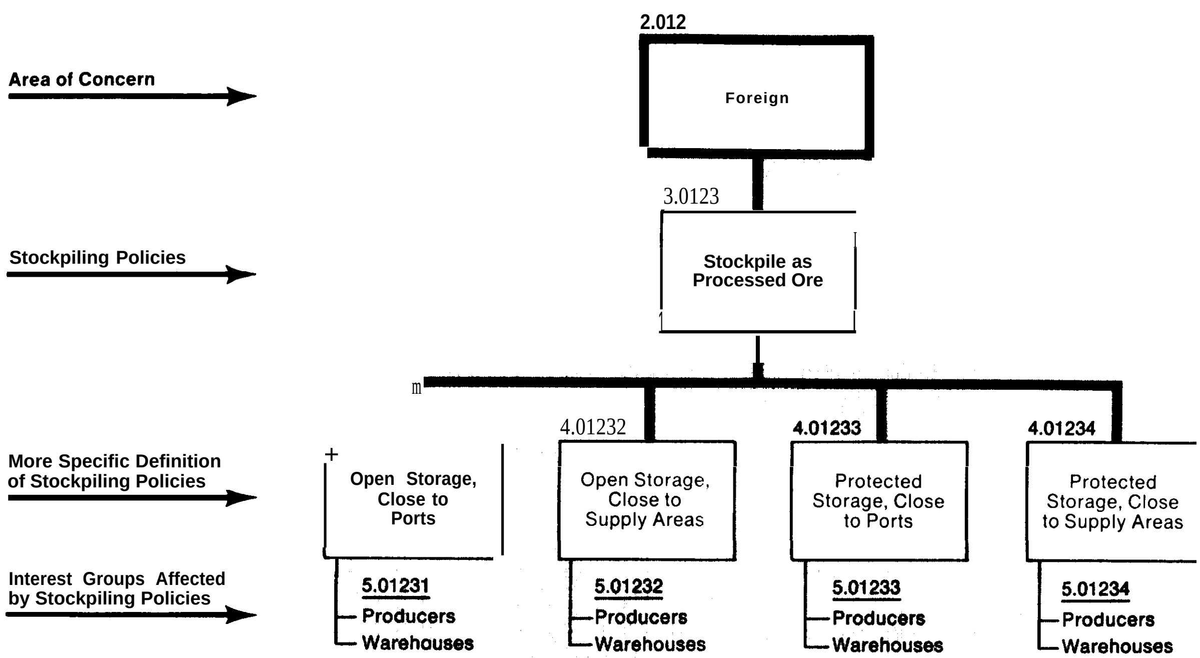

Area of Concern
Stockpiling Policies
More Specific Definition of Stockpiling Policies
Interest Groups Affected by Stockpiling Policies
2.011
Domestic
3.0113
Stockpile as Processed Ore
4.01131
Open Storage, Close to Supply Areas
4.01132
Open Storage. Close to Consumers
4.01133
Protected Storage. Close to Supply Areas
4.01134
Protected Storage. Close to Consumers
5.01131
Warehouses (Private)
Processors
Consumers
Government
5.01132
Warehouses (Private)
Processors
Consumers
Government
5.01133
Warehouses (Private)
Processors
Consumers
Government
5.01134
Warehouses (Private)
Processors
Consumers
Government

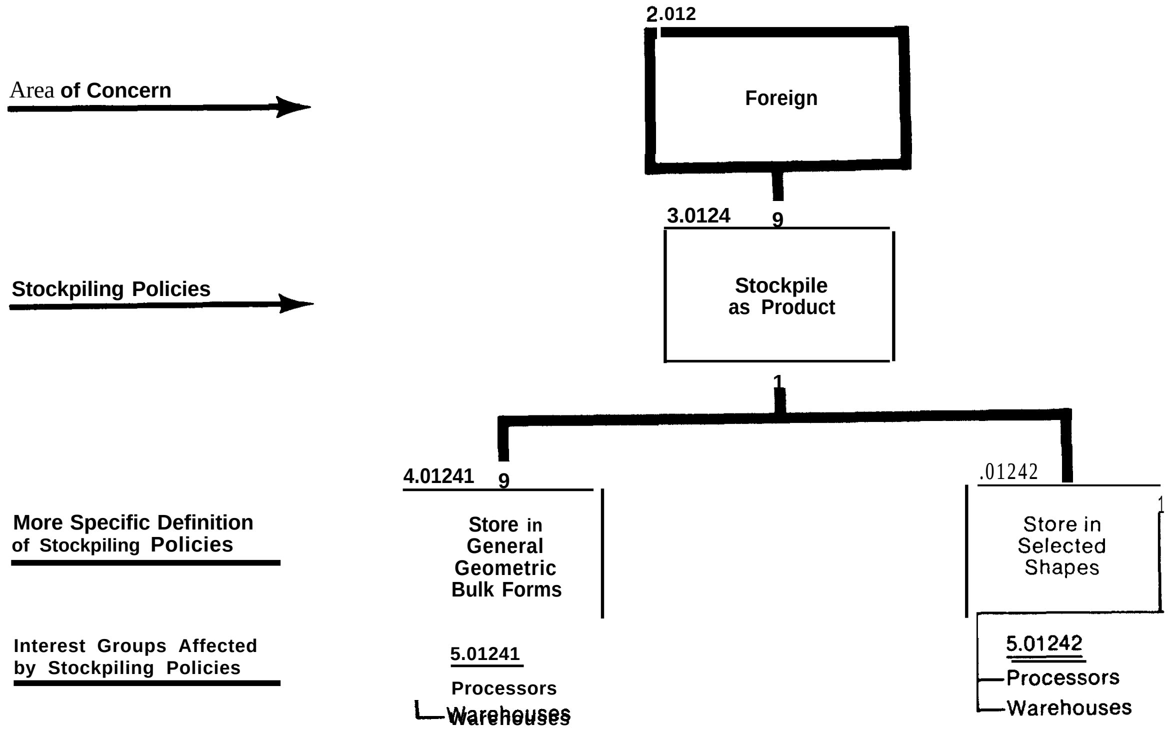

Area of Concern
Stockpiling Policies
More Specific Definition of Stockpiling Policies
Interest Groups Affected by Stockpiling Policies
2.011
Domestic
3.0114
Stockpile as Product
4.01141
Store in Central Locations in General Geometric Bulk Forms
4.01142
Store in Selected Shapes in Central Locations
4.01143
Store in Selected Shapes Close to Consumers
4.01144
Store in General Geometric Bulk Forms Close to Consumers
5.01141
Processors
Consumers
Warehouses (Private)
Government
5.01142
Processors
Consumers
Warehouses (Private)
Government
5.01143
Processors
Consumers
Warehouses (Private)
Government
5.01144
Processors
Consumers
Warehouses (Private)
Government

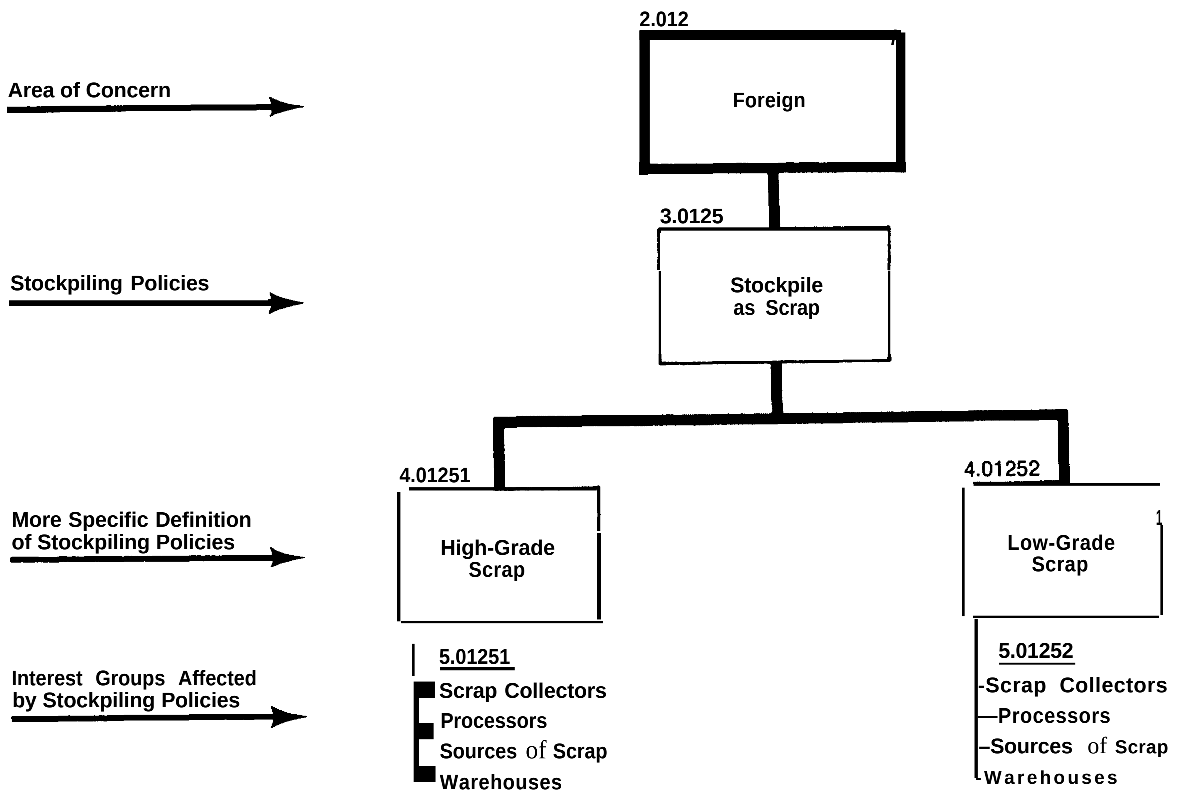

2.011
Area of Concern
Domestic
3.0115
Stockpiling Policies
Stockpile as Scrap
More Specific Definition of Stockpiling Policies
4.01151
High-Grade Scrap, Near Processors
4.01152
High-Grade Scrap, Centrally Located
4.01153
Low-Grade Scrap, Near Processors
4.01154
Low-Grade Scrap, Centrally Located
Interest Groups Affected by Stockpiling Policies
5.01151
Scrap Collector;
Processors
Sources of Scrap
Warehouses (Private)
Government
5.01152
Scrap Collectors
Processors
Sources of Scrap
Warehouses (Private)
Government
5,01153
Scrap Collectors
Processors
Sources of Scrap
Warehouses (Private)
Government
5.01154
Scrap Collectors
Processors
Sources of Scrap
Warehouses (Private)
Government


2.012
Area of Concern
Foreign
3.0121
Stockpiling Policies
Stockpile in Proven Reserves
More Specific Definition of Stockpiling Policies
4.01211
Leases of Land and Mineral Rights
4.01212
Purchases of Land (Including Mineral Rights)
4.01213
Purchases of Mineral Rights Only
Interest Groups Affected by Stockpiling Policies
5.01211
Geological Explorers
Resource Investors
Land Owners (Public, Private)
5.01212
Geological Explorers
Resource Investors
Land Owners (Public, Private)
5.01213
Geological Explorers
Resource Investors
Land Owners (Public, Private)

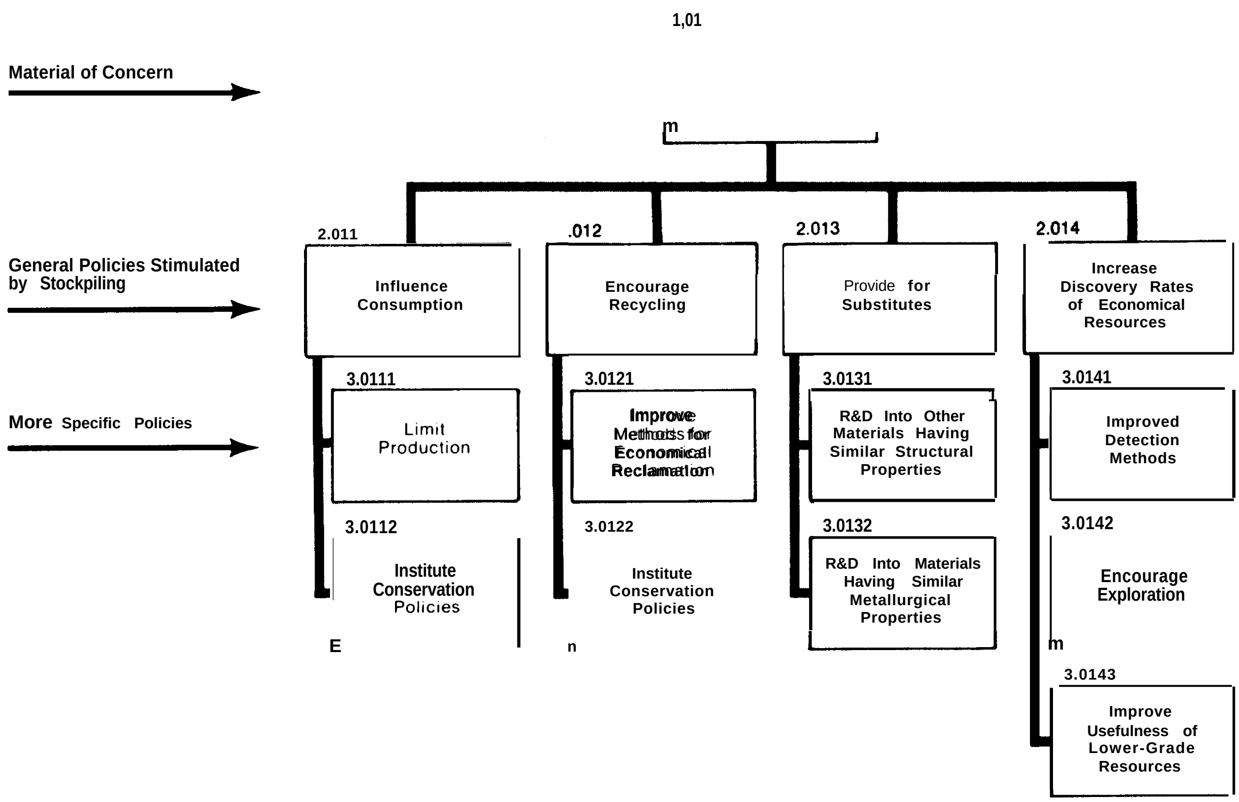

Area of Concern
Stockpiling Policies
More Specific Definition of Stockpiling Policies
Interest Groups Affected by Stockpiling Policies
2.012
Foreign
3.0122
Stockpile as Raw Ore
4.01221
Open Storage, Close to Ports
4.01222
Open Storage, Close to Supply Areas
4.01223
Protected Storage, Close to Ports
4.01224
Protected Storage, Close to Supply Areas
5.01221
Producers
Warehouses
5.01222
Producers
Warehouses
5.01223
Producers
Warehouses
5.01224
Producers
Warehouses

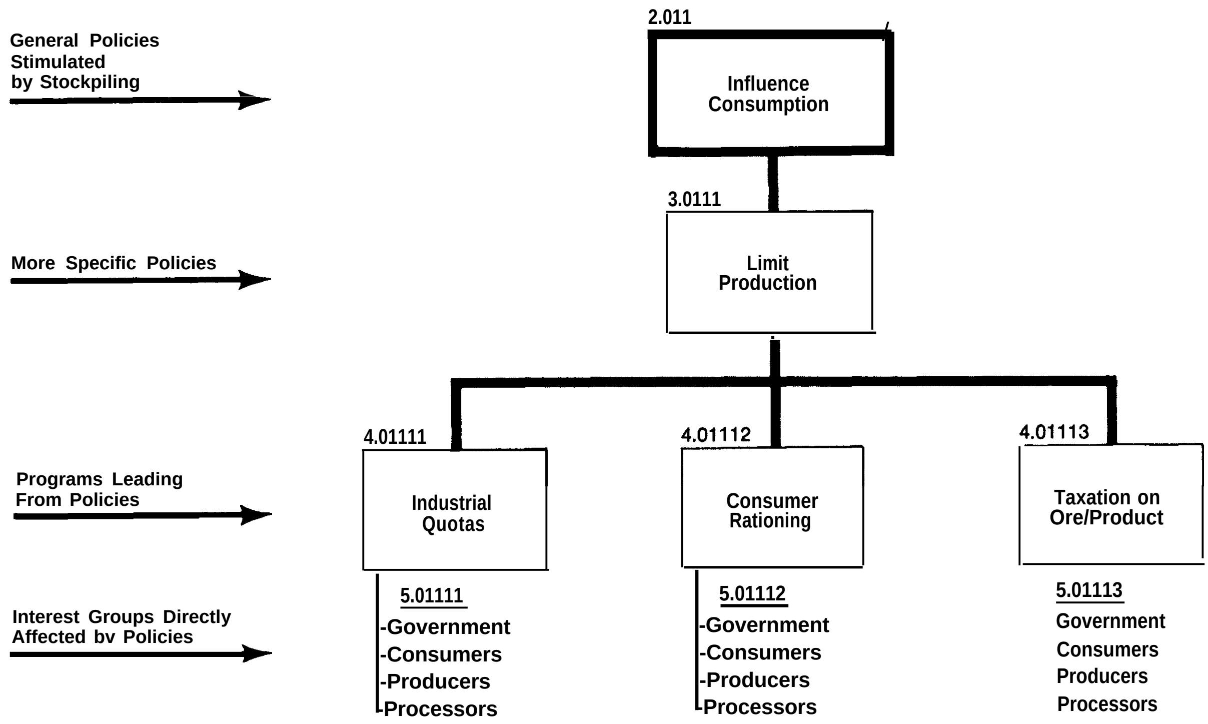

Area of Concern
Stockpiling Policies
More Specific Definition of Stockpiling Policies
Interest Groups Affected by Stockpiling Policies
2.012
Foreign
3.0123
Stockpile as Processed Ore
Open Storage, Close to Ports
4.01232
Open Storage, Close to Supply Areas
4.01233
Protected Storage, Close to Ports
4.01234
Protected Storage, Close to Supply Areas
5.01231
Producers
Warehouses
5.01232
Producers
Warehouses
5.01233
Producers
Warehouses
5.01234
Producers
Warehouses

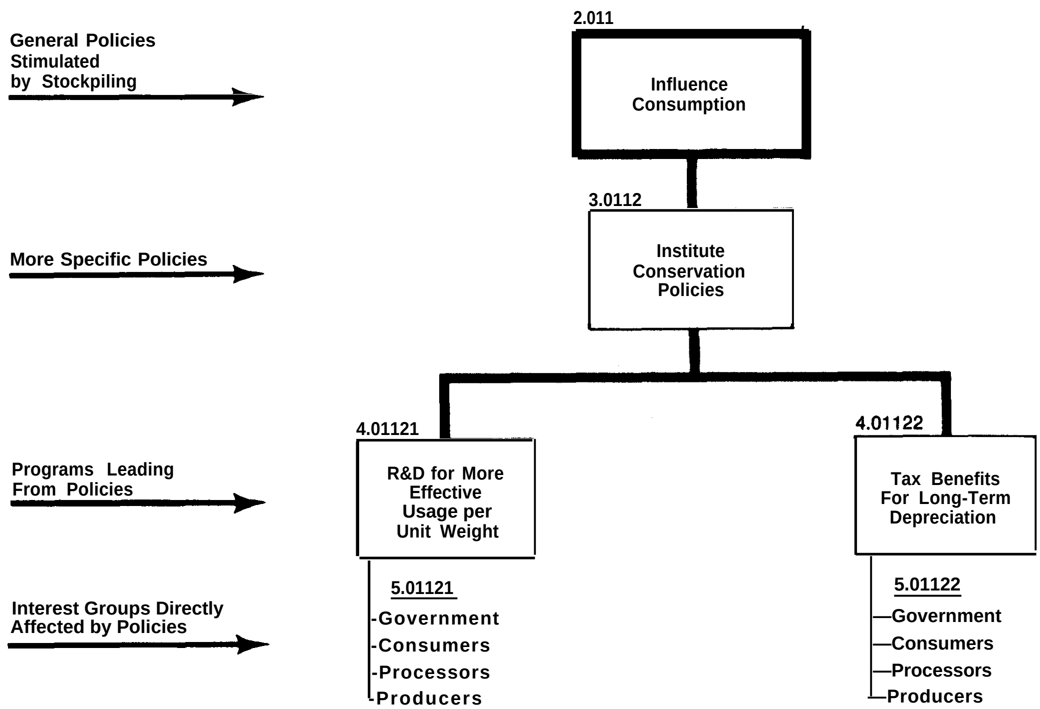

2.012
Foreign
Area of Concern
3.0124
Stockpile as Product
Stockpiling Policies
4.01241
Store in General Geometric Bulk Forms
.01242
Store in Selected Shapes
More Specific Definition of Stockpiling Policies
Interest Groups Affected by Stockpiling Policies
5.01241
Processors
Warehouses
5.01242
Processors
Warehouses

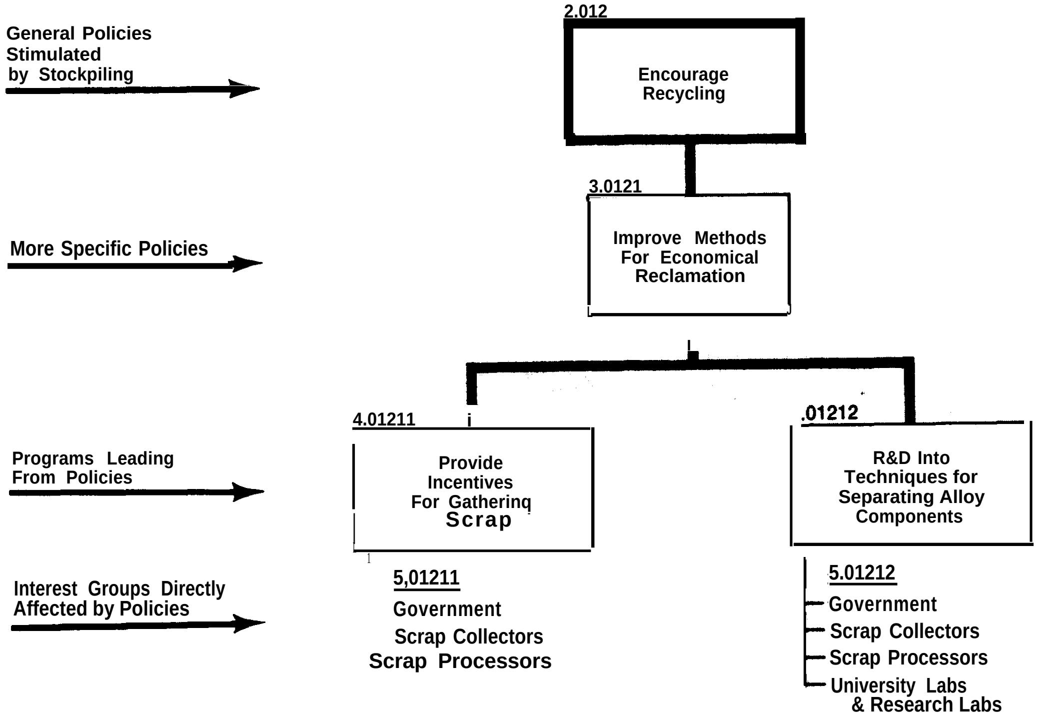

2.012
Foreign
Area of Concern
3.0125
Stockpile as Scrap
Stockpiling Policies
4.01251
High-Grade Scrap
4.01252
Low-Grade Scrap
More Specific Definition of Stockpiling Policies
Interest Groups Affected by Stockpiling Policies
5.01251
Scrap Collectors
Processors
Sources of Scrap
Warehouses
5.01252
Scrap Collectors
Processors
Sources of Scrap
Warehouses

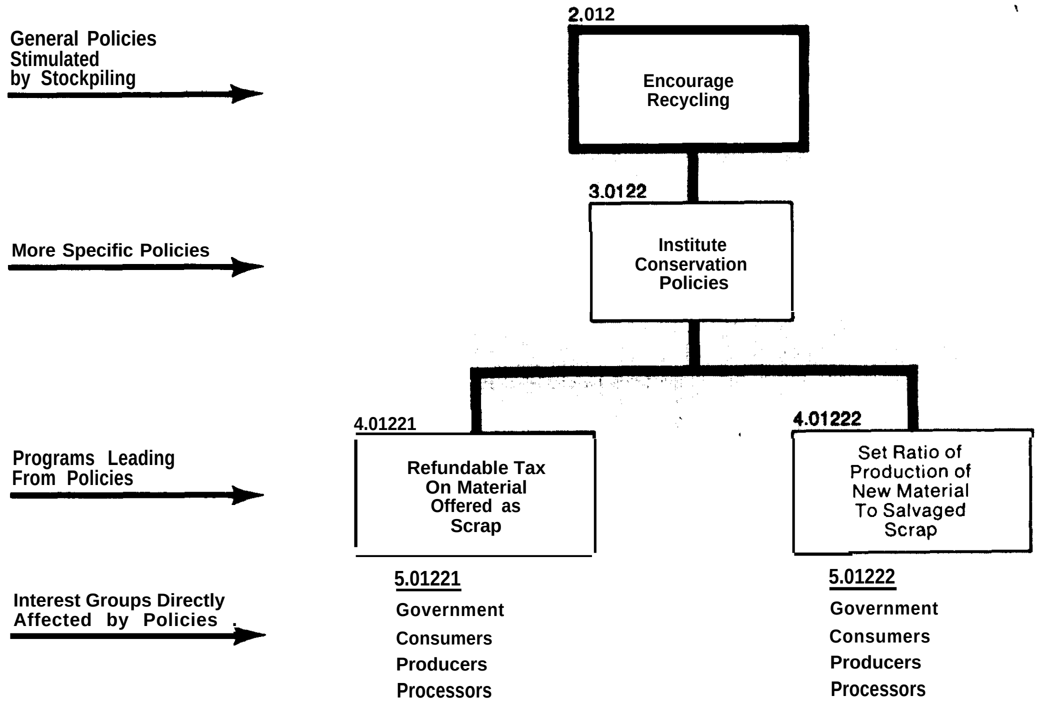
Alternatives to Stockpiling Tree

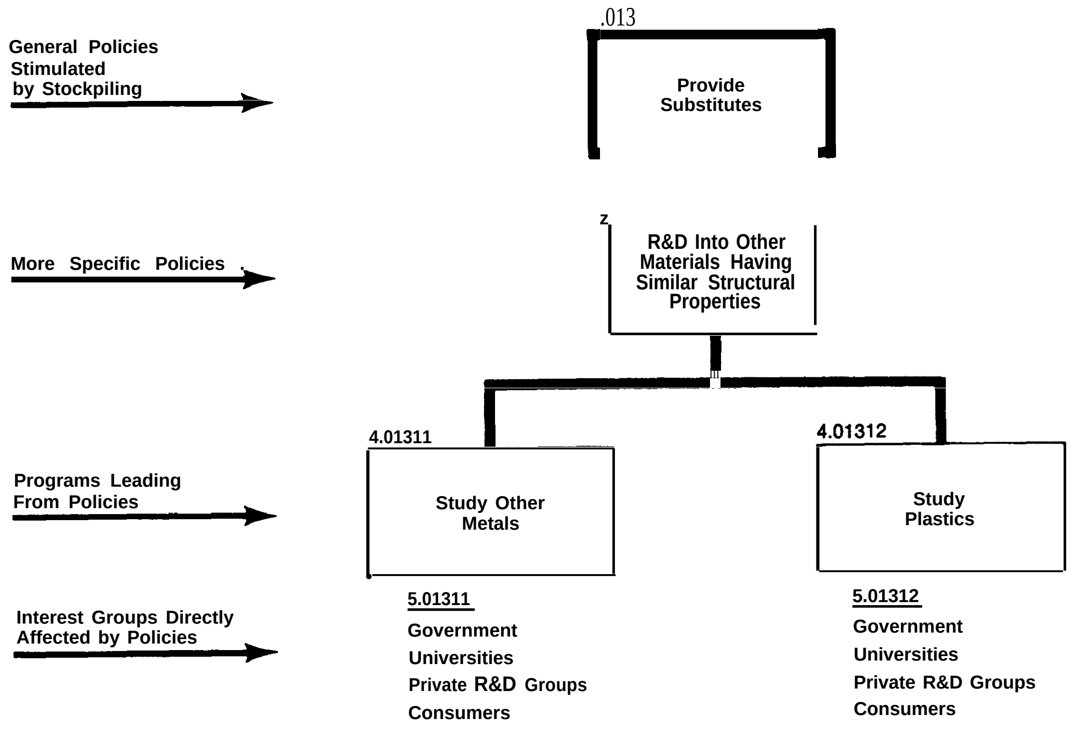



General Policies Stimulated by Stockpiling
More Specific Policies
Programs Leading From Policies
Interest Groups Directly Affected bv Policies
2.011
Influence Consumption
3.0111
Limit Production
4.01111
Industrial Quotas
4.01112
Consumer Rationing
4.01113
Taxation on Ore/Product
5.01111
Government
Consumers
Producers
Processors
5.01112
Government
Consumers
Producers
Processors
5.01113
Government
Consumers
Producers
Processors

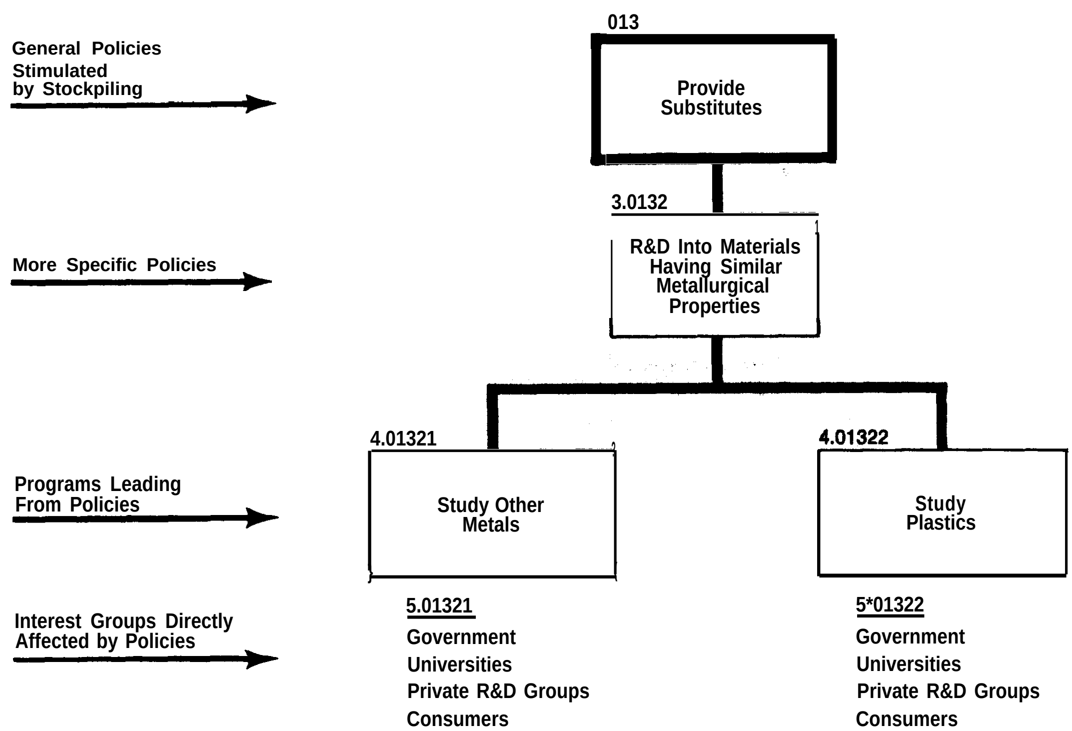

General Policies Stimulated by Stockpiling
More Specific Policies
Programs Leading From Policies
Interest Groups Directly Affected by Policies
2.011
Influence Consumption
3.0112
Institute Conservation Policies
4.01121
R&D for More Effective Usage per Unit Weight
4.01122
Tax Benefits For Long-Term Depreciation
5.01121
Government
Consumers
Processors
Producers
5.01122
Government
Consumers
Processors
Producers


General Policies Stimulated by Stockpiling
More Specific Policies
Programs Leading From Policies
Interest Groups Directly Affected by Policies
2.012
Encourage Recycling
3.0121
Improve Methods For Economical Reclamation
4.01211
Provide Incentives For Gatherinq Scrap
.01212
R&D Into Techniques for Separating Alloy Components
5,01211
Government
Scrap Collectors
Scrap Processors
5.01212
Government
Scrap Collectors
Scrap Processors
University Labs & Research Labs

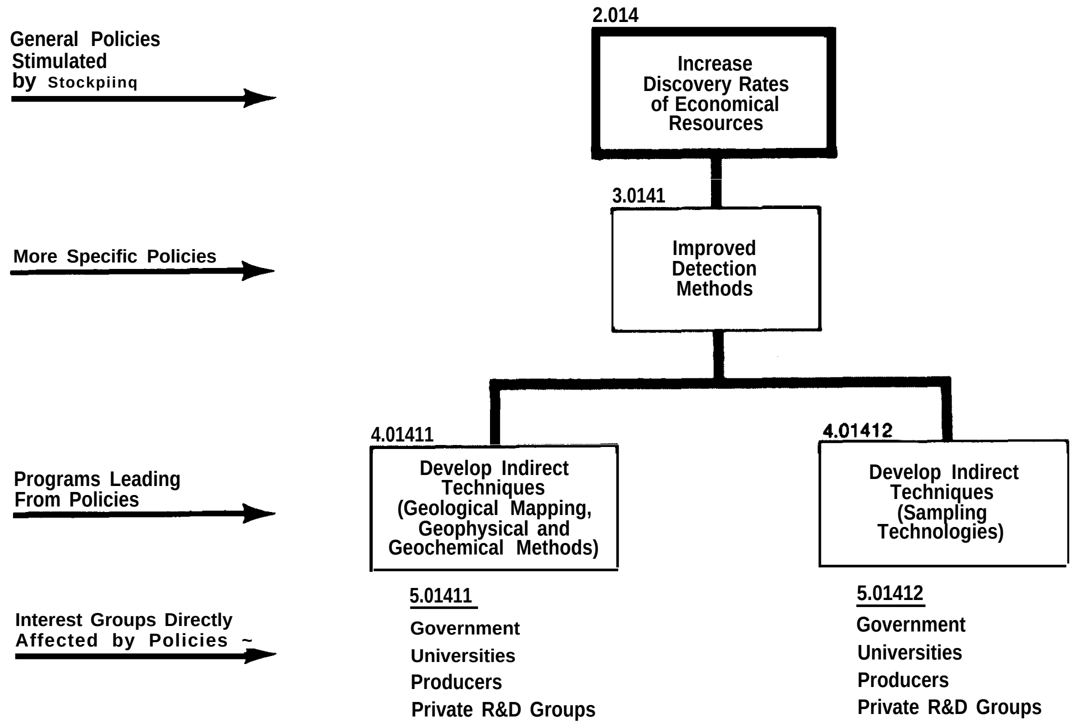

General Policies Stimulated by Stockpiling
More Specific Policies
Programs Leading From Policies
Interest Groups Directly Affected by Policies
2.012
Encourage Recycling
3.0122
Institute Conservation Policies
4.01221
Refundable Tax On Material Offered as Scrap
4.01222
Set Ratio of Production of New Material To Salvaged Scrap
5.01221
Government
Consumers
Producers
Processors
5.01222
Government
Consumers
Producers
Processors

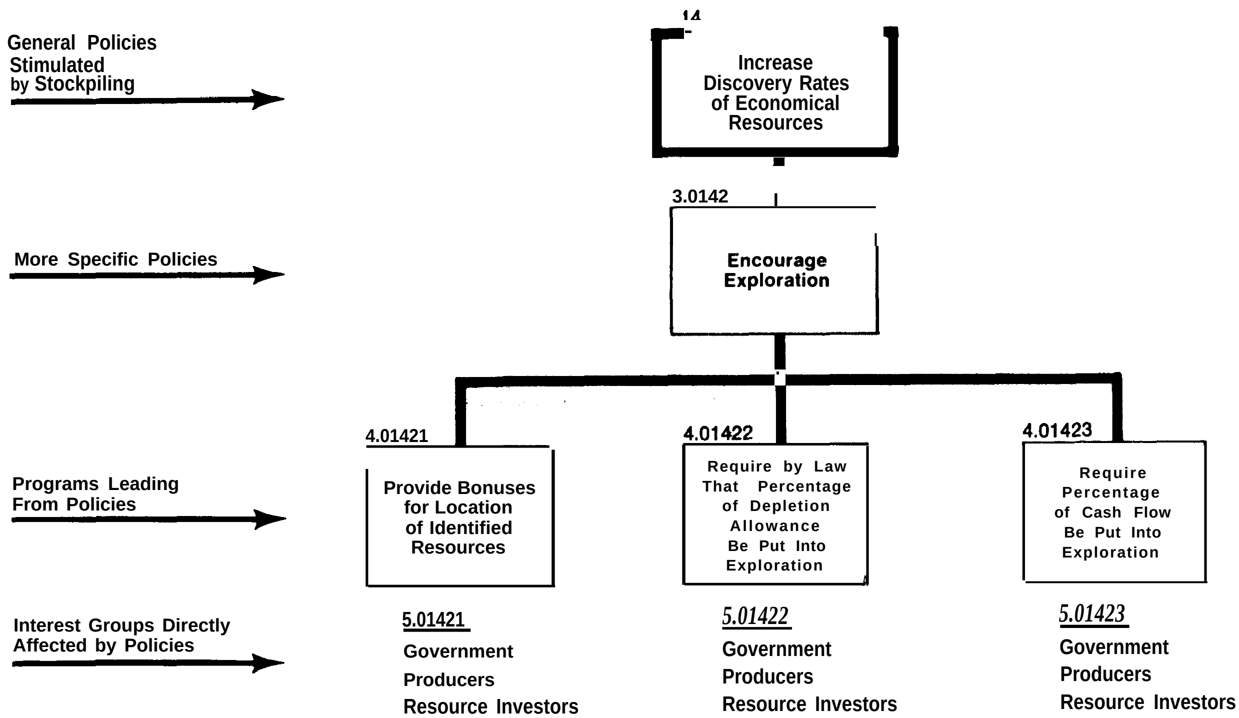


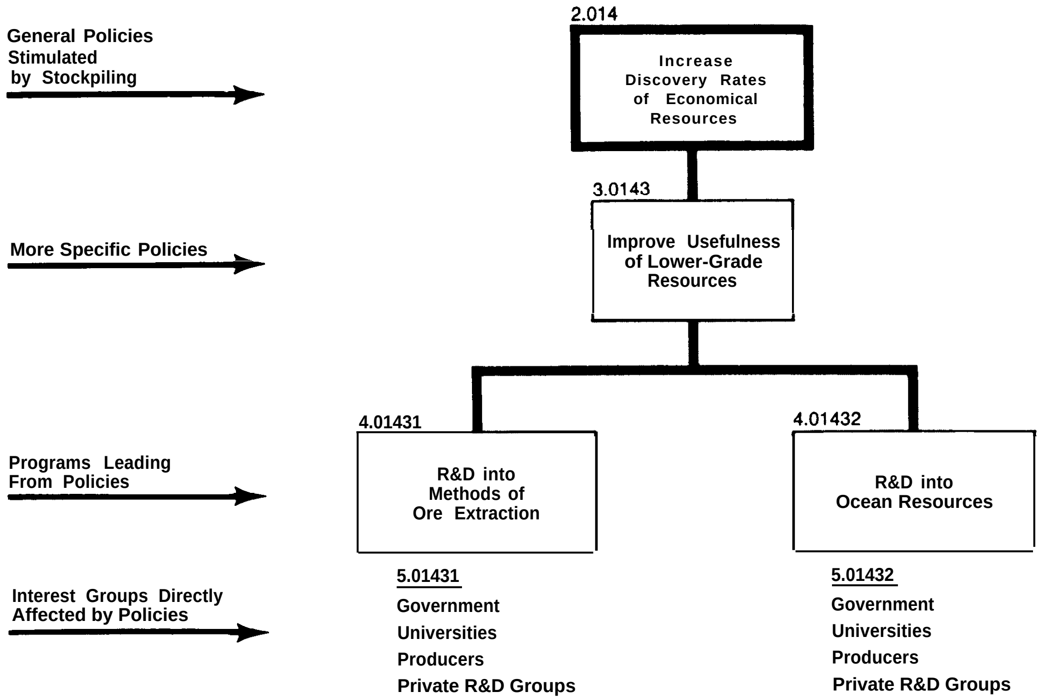
.013
General Policies Stimulated by Stockpiling
Provide Substitutes
z
More Specific Policies
R&D Into Other Materials Having Similar Structural Properties
Programs Leading From Policies
4.01311
Study Other Metals
4.01312
Study Plastics
Interest Groups Directly Affected by Policies
5.01311
Government
Universities
Private R&D Groups
Consumers
5.01312
Government
Universities
Private R&D Groups
Consumers



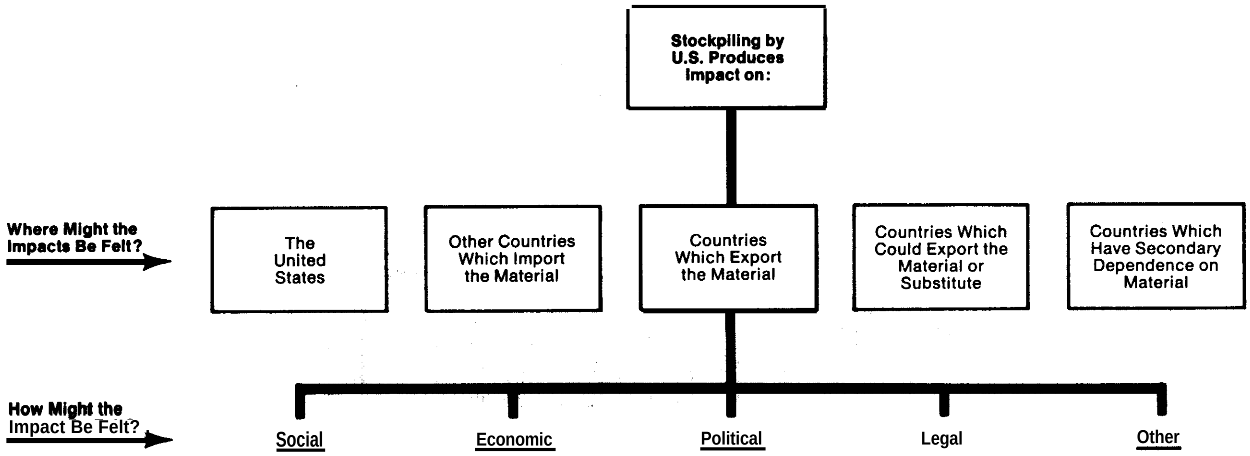
013
General Policies Stimulated by Stockpiling
Provide Substitutes
3.0132
More Specific Policies
R&D Into Materials Having Similar Metallurgical Properties
Programs Leading From Policies
4.01321
Study Other Metals
4.01322
Study Plastics
Interest Groups Directly Affected by Policies
5.01321
Government
Universities
Private R&D Groups
Consumers
5*01322
Government
Universities
Private R&D Groups
Consumers

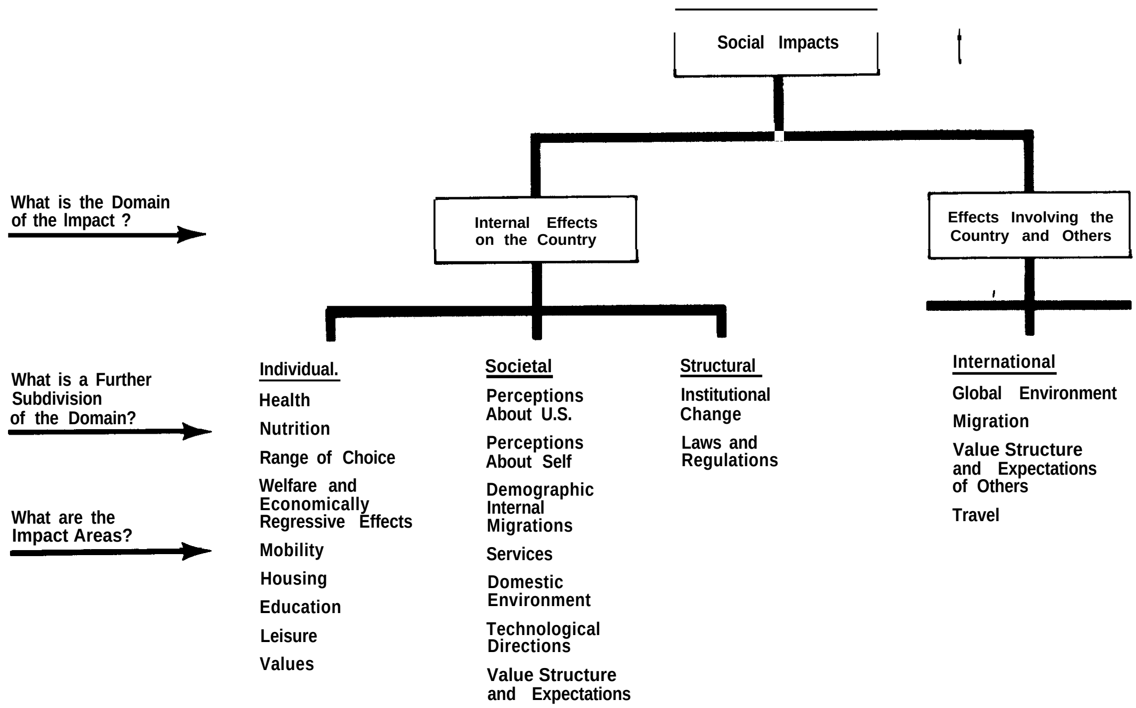

General Policies Stimulated by Stockpiinq
More Specific Policies
Programs Leading From Policies
Interest Groups Directly Affected by Policies
2.014
Increase Discovery Rates of Economical Resources
3.0141
Improved Detection Methods
4.01411
Develop Indirect Techniques (Geological Mapping, Geophysical and Geochemical Methods)
4.01412
Develop Indirect Techniques (Sampling Technologies)
5.01411
Government
Universities
Producers
Private R&D Groups
5.01412
Government
Universities
Producers
Private R&D Groups

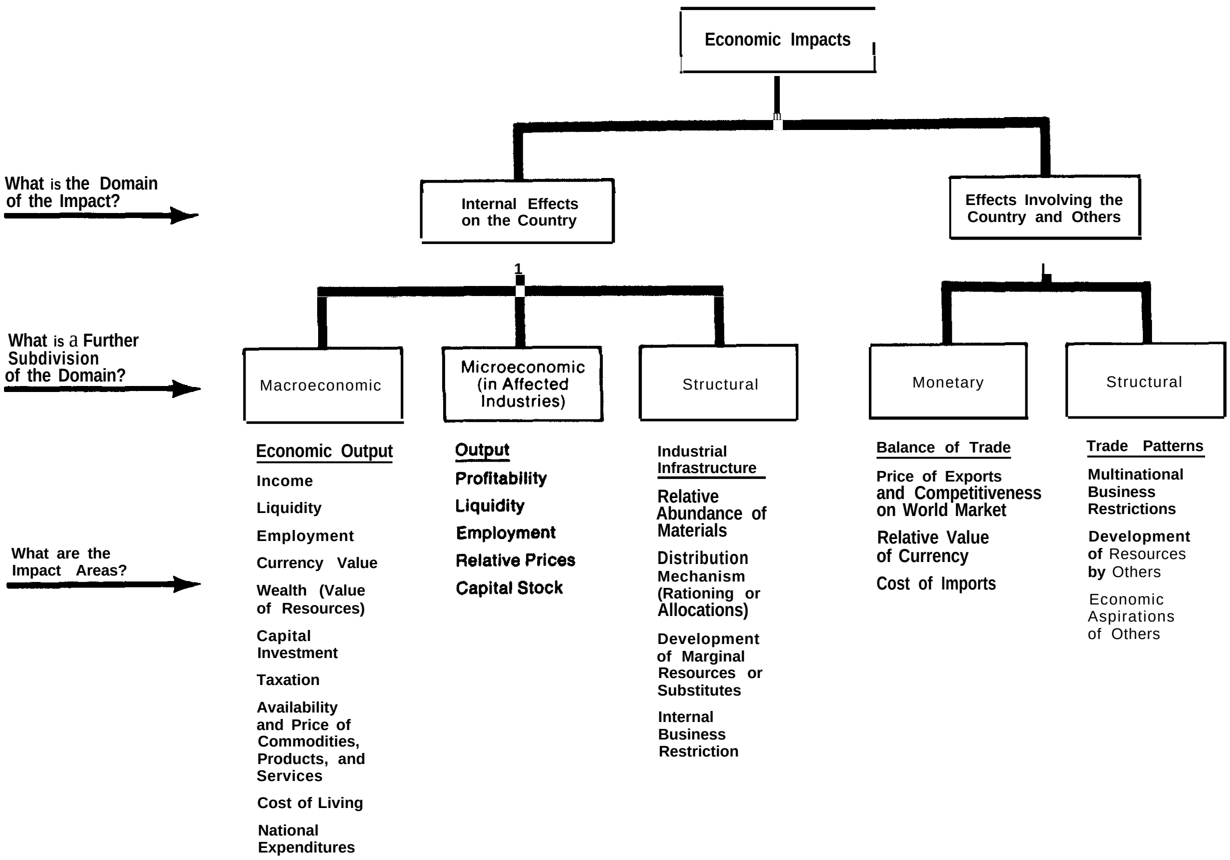

General Policies Stimulated by Stockpiling
More Specific Policies
Programs Leading From Policies
Interest Groups Directly Affected by Policies
14
Increase Discovery Rates of Economical Resources
3.0142
Encourage Exploration
4.01421
Provide Bonuses for Location of Identified Resources
4.01422
Require by Law That Percentage of Depletion Allowance Be Put Into Exploration
4.01423
Require Percentage of Cash Flow Be Put Into Exploration
5.01421
Government
Producers
Resource Investors
5.01422
Government
Producers
Resource Investors
5.01423
Government
Producers
Resource Investors

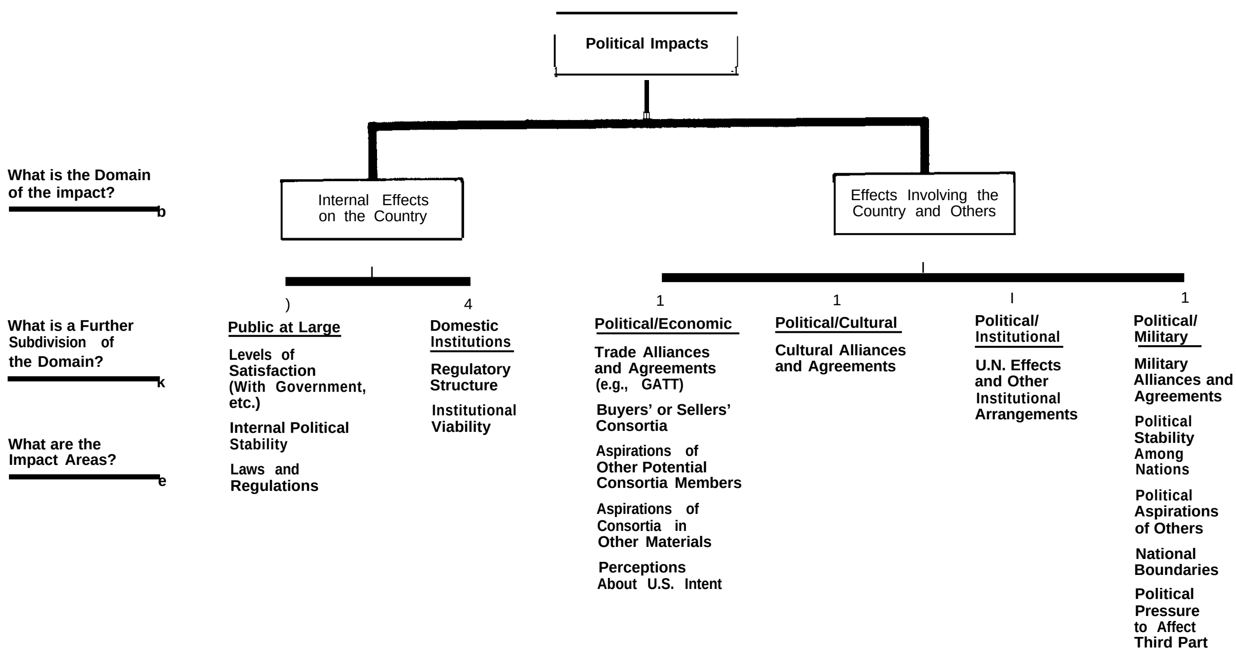

General Policies Stimulated by Stockpiling
More Specific Policies
Programs Leading From Policies
Interest Groups Directly Affected by Policies
2.014
Increase Discovery Rates of Economical Resources
3.0143
Improve Usefulness of Lower-Grade Resources
4.01431
R&D into Methods of Ore Extraction
4.01432
R&D into Ocean Resources
5.01431
Government
Universities
Producers
Private R&D Groups
5.01432
Government
Universities
Producers
Private R&D Groups

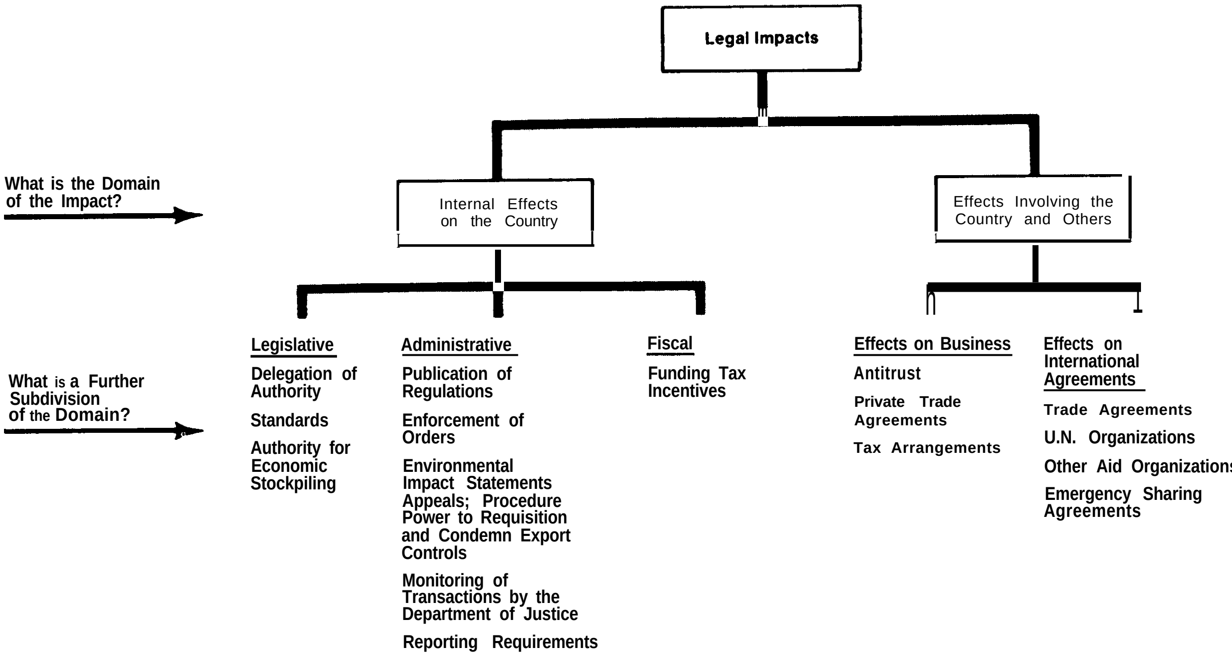
D-1 Stockpiling Impacts Tree






Economic Impacts
What is the Domain of the Impact?
Internal Effects on the Country
Effects Involving the Country and Others
What is a Further Subdivision of the Domain?
Macroeconomic
Microeconomic (in Affected Industries)
Structural
Monetary
Structural
What are the Impact Areas?
Economic Output
Income
Liquidity
Employment
Currency Value
Wealth (Value of Resources)
Capital Investment
Taxation
Availability and Price of Commodities, Products, and Services
Cost of Living
National Expenditures
Output
Profitability
Liquidity
Employment
Relative Prices
Capital Stock
Industrial Infrastructure
Relative Abundance of Materials
Distribution Mechanism (Rationing or Allocations)
Development of Marginal Resources or Substitutes
Internal Business Restriction
Balance of Trade
Price of Exports and Competitiveness on World Market
Relative Value of Currency
Cost of Imports
Trade Patterns
Multinational Business Restrictions
Development of Resources by Others
Economic Aspirations of Others


Political Impacts
What is the Domain of the impact?
Internal Effects on the Country
Effects Involving the Country and Others
What is a Further Subdivision of the Domain?
What are the Impact Areas?
Public at Large
Levels of Satisfaction (With Government, etc.)
Internal Political Stability
Laws and Regulations
Domestic Institutions
Regulatory Structure
Institutional Viability
Political/Economic
Trade Alliances and Agreements (e.g., GATT)
Buyers' or Sellers' Consortia
Aspirations of Other Potential Consortia Members
Aspirations of Consortia in Other Materials
Perceptions About U.S. Intent
Political/Cultural
Cultural Alliances and Agreements
Political/ Institutional
U.N. Effects and Other Institutional Arrangements
Political/ Military
Military Alliances and Agreements
Political Stability Among Nations
Political Aspirations of Others
National Boundaries
Political Pressure to Affect Third Part



C. IMPACTS EVALUATION MATRICES

As discussed in the chapter describing methodology (chap. I), the importance of the various impacts from the lower level of the impacts tree were weighted for each candidate stockpiling policy. These weighting matrices were evaluated according to the weights given on each table. These matrices are as follows:

Interest groups affected by SP 1

Important Impact Areas	Resource Development Industry	U.S. Energy Industries	U.S. Minerals Industry	U.S. Transportation	U.S. Business in General	Multinational Business	U.S. Labor	Private Land Owners	Environmentalists	Industries Using the Material	Private R&D Groups	Universities	U.S. Government	Other Importing Nations	Principal Exporters	The Involved Cartel	Other Exporting Countries	Other Potential Exporters	Countries Using Products from Materials
22. Balance of trade	3	3	3	2	2	3	2	0	1	2	0	0	3	3	3	3	3	3	2
53. Internal political stability	2	2	2	1	3	3	3	1	1	1	0	0	3	2	3	3	3	3	2
58. Buyers' and sellers' consortia	2	2	2	1	2	3	1	0	0	2	0	0	2	2	3	3	3	3	2
[illegible] Aspirations of other potential consortia members	1	1	2	1	1	2	1	0	1	1	0	0	2	2	2	2	2	2	2
66. Political stability between nations	1	1	1	1	1	2	1	1	1	1	1	1	3	3	2	3	2	2	2
[illegible]. Economy output	2	2	2	1	3	3	3	1	2	1	1	1	3	3	3	3	3	3	2
52. Levels of satisfaction with government	1	1	1	1	2	2	2	1	1	1	1	1	3	1	1	2	1	1	1
[illegible] Trade alliances [illegible] agreements	1	3	3	2	2	3	2	0	1	2	0	0	2	3	3	3	3	2	2
59. Aspirations of other potential consortia members	1	1	2	1	2	3	1	1	1	1	1	1	2	2	2	3	2	2	1
18. Relative abundance of materials	3	2	3	1	1	2	1	1	1	3	0	0	2	2	2	2	2	2	2
TOTALS	17	18	21	12	19	26	17	6	10	15	4	4	24	12	24	27	24	23	18

77-119 0-76-22

Interest g oups affected by SP 2

Important Impact Areas	Resource Development Industry	U.S. Energy Industries	U.S. Minerals Industry	U.S. Transportation	U.S. Business in General	Multinational Business	U.S. Labor			Industries Using the Material	Private R&D Groups		U.S. Government	Other Importing Nations	Principal Exporters	The Involved Cartel	Other Exporting Countries	Other Potential Exporters	Countries Using Products from Materials
57. Trade alliances and agreements	1	3	3	2	2	m	2	0	1	2	0	0	2	3	3	3	3	3	2
54. Laws and regulations	2	2	2	2	3	m	3	1	2	3	1	1	3	1	2	2	1	1	1
19. Distribution mechanisms	2	2	2	2	3	m	3	1	1	2	1	1	3	1	2	1	2	2	1
17. Industr m 'A frastructure	2	2	2	2	3	m	3	1	1	2	1	1	3	0	0	0	0	0	0
20. Development of marginal resources	3	3	3	2	2	m	1	3	3	2	1	1	2	2	2	2	2	2	1
21. Domestic business restrictions	2	2	2	2	3	m	3	1	2	3	1	1	3	1	2	2	1	1	1
55. Regulatory structure	1	3	1	1	3	m	3	1	1	1	1	0	1	1	2	2	1	1	1
56. Institut m viability	1	1	1	1	2	N	2	0	1	1	1	0	3	1	1	1	1	1	1
11. Selected industrial output	3	3	3	3	2	ml	2	1	1	1	0	0	1	0	0	0	0	0	0
12. Selected industrial profit	3	3	3	3	2	N & j	2	1	1	1	0	0	1	0	0	0	0	0	0
TOTALS	20	24	22	20	25		24	10	14	18	7	5	22	10	14	13	11	11	8

Interest groups affected by SP 3

Important Impact Areas	Resource Development Industry	U.S. Energy Industries	U.S. Minerals Industry	U.S. Transportation	U.S. Business in General	Multinational Business	U.S. Labor	Private Land Owners	Environmentalists	Industries Using the Material	Private R&D Groups	Universities	U.S. Government	Other Importing Nations	Principal Exporters	The Involved Cartel	Other Exporting Countries	Other Potential Exporters	Countries Using Products from Materials Materials
22. Balance of trade	3	3	3	2	2	3	2	0	1	2	0	0	3	3	3	3	3	3	2
58. Buyers' and sellers' consortia	2	2	2	1	2	3	1	0	0	2	0	0	2	2	3	3	3	3	2
1. Economic output	2	2	2	1	3	3	3	1	2	1	1	1	3	3	3	3	3	3	2
17. Industrial infrastructure	2	2	2	2	3	3	3	1	1	2	1	1	3	0	0	0	0	0	0
52 Levels of satisfaction with government	1	1	1	1	2	2	2	1	1	1	1	1	3	1	1	2	1	1	1
53. Internal political stability	2	2	2	1	3	3	3	1	1	1	0	0	3	2	3	3	3	3	2
18. Relative abundance of materials	3	2	3	1	1	2	1	1	1	3	0	0	2	2	2	2	2	2	2
19. Distribution mechanisms	2	2	2	2	3	3	3	1	1	2	1	1	3	1	2	1	2	2	1
57. Trade alliances and agreements	1	3	3	2	2	3	2	0	1	2	0	0	2	3	3	3	3	3	2
59. Aspirations of other potential consortia members	1	1	2	1	2	3	1	1	1	1	1	1	2	2	2	3	2	2	1
TOTALS	19	20	22	14	23	28	21	7	10	17	5	5	26	19	22	23	22	22	15

Interest groups affected by SP 4

Important Impact Areas	Resource Development Industry	U.S. Energy Industries	U.S. Minerals Industry	U.S. Transportation	U.S. Business in General	Multinational Business	U.S. Labor	Private Land Owners	Environmentalists	Industries Using the Material	Private R&D Groups	Universities	u+S ● Government	Other Importing Nations	Principal Exporters	~@ Involved Cartel	Other Exporting Countries	Other Potential Exporters	Countries Using Products from Materials
17. Industrial infrastructure	2	2	2	2	3	3	3	1	1	2	1	1	3	0	0	0	0	0	0
19. Distribution mechanisms	2	2	2	2	3	3	3	1	1	2	1	1	3	1	2	1	2	2	1
20. Development of marginal resources	3	3	3	2	2	3	1	3	3	2	1	1	2	2	2	2	2	2	1
21. Domestic business restrictions	2	2	2	2	3	3	3	1	2	3	1	1	3	1	2	2	1	1	1
32. Range of choice	1	2	1	1	2	1	2	1	1	2	0	0	3	0	2	2	2	2	0
57. Trade alliances and agreements	1	3	3	2	2	3	2	0	1	2	0	0	2	3	3	3	3	3	2
54. Laws and regulations	2	2	2	2	3	3	3	1	2	3	1	1	3	1	2	2	1	1	1
18. Relative abundance of materials	3	2	3	1	1	2	1	1	1	3	0	0	2	2	2	2	2	2	2
55. Regulatory structure	1	3	1	1	3	3	3	1	1	1	1	0	1	1	2	2	1	1	1
56. Institutional viability	1	1	1	1	2	2	2	0	1	1	1	0	3	1	1	1	1	1	1
TOTALS	18	22	20	16	24	26	23	10	14	21	7	5	25	12	18	17	15	15	10

Interest groups affected by SP 5

Important Impact Areas	Resource Development Industry	U.S. Energy Industries	u*S ● Minerals Industry	U.S. Transportation	U.S. Business in General	Multinational Business	U.S. Labor	Private Land Owners	Environmentalists	Industries Using the Material	Private R&D Groups	Universities	U.S. Government	Other Importing Nations	Principal Exporters	The Involved Cartel	Other Exporting Countries	Other Potential Exporters	Countries Using Products from Materials Materials
17. Industrial n-frastructure	2	2	2	2	3	3	3	1	1	2	1	1	3	0	0	0	0	0	0
18. Relative abundance of materials	3	2	3	1	1	2	1	1	1	3	0	0	2	2	2	2	2	2	2
19. Distribution mechanisms	2	2	2	2	3	3	3	1	1	2	1	1	3	1	2	1	2	2	1
20 Development of marginal resources	3	3	3	2	2	3	1	3	3	2	1	1	2	2	2	2	2	2	1
21 Domestic business relations	2	2	2	2	3	3	3	1	2	3	1	1	3	1	2	2	1	1	1
54. Laws and regulations	2	2	2	2	3	3	3	1	2	3	1	1	3	1	2	2	1	1	1
54. Levels of satisfaction with government	1	1	1	1	2	2	2	1	1	1	1	1	3	1	1	2	1	1	1
57. Trade alliances and agreements	1	3	3	2	2	3	2	0	1	2	0	0	2	3	3	3	3	3	2
32. Range of choice	1	2	1	1	2	1	2	1	1	2	0	0	3	0	2	2	2	2	0
9. Availability and price of commodities	3	3	3	1	1	2	1	1	2	3	1	0	2	2	2	2	2	2	2
TOTALS	20	22	22	16	22	21	10	14	14	23	7	6	26	13	18	18	16	16	11

Matrix l—Relevance of economic impacts to various SP's, sheet 1

IMPACT AREAS	SP 1	SP 2	SP 3	SP 4	SP 5	WEIGHT
1 Economic Output	4	2	4	2	2	5
2 Income	3	2	3	2	2	4
3 Liquidity	2	1	2	1	1	3
4 Employment	4	2	3	1	2	5
5 Currency Value	3	1	2	1	1	4
6 Wealth (Value of Resources)	4	2	4	2	2	5
7 Capital Investment	4	1	3	1	1	3
8 Taxation	4	1	2	1	1	3
9 Availability and Price of Commodities	4	3	4	1	4	3
10 Cost of Living	3	1	3	1	1	3
11 Selected Industrial Output	5	4	5	2	4	3
12 Selected Industrial Profit	5	4	5	2	4	3
13 Selected Industrial Liquidity	3	2	3	1	1	3
14 Selected Industrial Employment	5	4	5	2	4	3
15 Selected Industrial Relative Prices	5	3	5	2	2	3
16 Selected Industrial Capital Stock	4	2	4	1	2	2
17 Industrial Infrastructure	5	4	5	4	4	4
18 Relative Abundance of Materials	5	3	5	3	4	4
19 Distribution Mechanisms	5	4	5	4	4	4
20 Development of Marginal Resources	5	4	5	4	4	4
21 Domestic Business Restrictions	5	4	5	4	4	4
22 Balance of Trade	5	1	5	1	1	5
23 Price of Exports	5	1	5	2	2	4
24 Relative Value of Currency	3	1	3	1	1	5
25 Cost of Imports	5	1	4	1	1	4
26 Trade Patterns	5	2	5	2	2	4
27 Multinational Business Restrictions	5	2	5	2	3	4
28 Development of Resources by Others	5	3	5	3	3	4
29 Economic Aspirations of Others	4	2	4	2	2	3

RELEVANCE KEY
5= Great Relevance
3= Moderate Relevance
l= Little Relevance
0=No Relevance

WEIGHT KEY
5= Extremely important impact area
3= Important Impact Area
l=Of Little Importance
0=NO Importance

Matrix l—Relevance of social impacts to various SP'S, sheet 2

IMPACT AREAS	SP 1	SP 2	SP 3	SP 4	SP s	WEIGHT
30 Health	1	0	1	0	0	4
31 Nutrition	2	0	2	0	0	4
32 Range of Choice	4	3	4	3	4	3
33 Welfare and Economically Regressive Impacts	3	0	3	0	3	4
34 Mobility	5	0	2	0	0	4
35 Housing	1	0	1	0	1	4
36 Education	1	0	1	0	0	4
37 Leisure	4	1	3	2	2	4
38 Values-Domestic	3	0	3	0	2	2
39 Perceptions About U.S.	4	1	4	1	2	3
40 Perception About Self	4	1	4	1	2	4
41 Internal Migrations	0	0	0	0	0	2
42 Services	1	0	1	0	2	3
43 Domestic Environment	3	2	2	3	2	4
44 Technological Directions	5	3	4	5	3	2
45 Value Structure	3	0	3	0	1	2
46 Institutional Change	4	0	4	0	2	4
47 Laws and Regulations	4	3	4	4	3	4
48 Global Environment	3	0	3	0	1	4
49 Migration	1	0	1	0	0	3
50 Values and Expectations	3	0	2	0	1	4
51 Travel	1	0	1	0	0	2

RELEVANCE KEY
5= Great Relevance
3= Moderate Relevance
l= Little Relevance
0=N0 Relevance

WEIGHT KEY
5= Extremely Important Impact Area
3= Important Impact Area
l=Of Little Importance
0=NO Importance

Matrix I—Relevance of political impacts to various SP'S sheet 3

IMPACT AREAS	SP 1	SP 2	SP 3	SP 4	SP 5	WEIGHT
52 Levels of Satisfaction with Government	5	3	5	3	4	4
53 Internal Political Stability	5	2	4	2	2	5
54 Laws and Regulations	4	4	4	4	4	4
55 Regulatory Structure	5	4	5	4	4	3
56 Institutional Viability	5	4	5	4	4	3
57 Trade Alliances and Agreements	5	5	5	4	4	4
58 Buyers' and Sellers' Consortia	5	2	5	2	2	5
59 Aspirations of Other Potential Consortia Members	5	2	5	2	2	4
60 Aspirations of Consortia in Other Materials	5	2	4	2	2	5
61 Perception About U.S. Intent	5	3	5	3	3	4
62 Cultural Alliances and Agreements	3	0	3	0	0	2
63 U.N. Effects	4	0	4	0	0	3
64 Impacts on Other International Institutions	4	0	4	0	0	3
65 Military Alliances and Agreements	5	0	4	0	0	4
66 Political Stability Between Nations	5	1	4	2	1	5
67 Political Aspirations of Others	5	1	4	1	1	4
68 National Boundaries	1	0	1	0	0	5
60 Political Pressures on Third Parties	3	2	3	2	2	4

RELEVANCE KEY

5= Great Relevance
3= Moderate Relevance
l= Little Relevance
0=NoRelevance

WEIGHT KEY

5= Extremely Important Impact Area
3= Important Impact Area
l=Of Little Importance
0=No importance

INDEX

U S GOVERNMENT PRINTING OFFICE 1976 0 77 119