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# GEOPOLITICS OF ENERGY

MELVIN A. CONANT, *Director*
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PRINTED AT THE REQUEST OF

HENRY M. JACKSON, *Chairman*

COMMITTEE ON INTERIOR AND
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# MEMORANDUM OF THE CHAIRMAN

*To Members of the Senate Committee on Interior and Insular Affairs:*

This report on the "Geopolitics of Energy: 1976–2000" represents a pioneering effort to look at energy in its real setting—one which affects, and is affected by, a broad range of domestic and foreign interests.

Energy is a critical resource and the importance of adequate energy supplies cannot be overstated. The security of our oil supplies has become a vital policy goal with the Nation's increasing dependence on foreign oil. While this is generally recognized, there is little understanding of the fact that the terms on which we may obtain oil are deeply interwoven in a complex interrelationship of political, military and economic factors—that access to energy now engages the full range of interests and powers of states. It is these interrelationships which are the subject of this report.

The report was prepared by Melvin A. Conant at the request of the Honorable Robert F. Ellsworth, Deputy Secretary of Defense. Mr. Conant brought to the report an unusual background in national security studies, on the faculty of the U.S. National War College, with the Council on Foreign Relations, experience in the international oil industry and more recently as Assistant Administrator for International Energy of the Federal Energy Administration. His associate, Fern Racine Gold, shared fully in the preparation of this study.

The Committee is grateful to Mr. Ellsworth for his permission to reproduce this study for the benefit of Senators and others concerned with the implications of our unprecedented reliance on foreign energy supplies.

HENRY M. JACKSON, *Chairman.*

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# GEOPOLITICS OF ENERGY

## Scope of the Study

"The Department of Defense holds that this Nation must have the capability to meet the essential energy requirements of its military forces and of its civil economy from secure sources not subject to military, economic, or political interdiction.

"While it may be that complete national energy self-sufficiency is unnecessary, the degree of our sufficiency must be such that any potential supply denial will be sustainable for an extended period without depredation of military readiness or operations, and without significant impact on industrial output or the welfare of the populace."

(*Department of Defense*, January 9, 1975).

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"Oil will remain a source of political and economic power for the exporters until the end of this century, at least * * * World oil consumption has begun to rise, and will increase as the years pass. Oil will retain its role as a source of energy * * *"

(Prince Fahd ibn 'Abd al-'Aziz,
Crown Prince and First Deputy Prime Minister,
Saudi Arabia, July 2, 1976).

The facts brought home by the Arab oil embargo were not unknown prior to 1973. The embargo did, however, mean that these facts could not only no longer be ignored but, on the contrary, were of such major consequences to the industrialized countries as to demand Government attention. Post-1973, the dependence of the developed countries on foreign sources of energy was blatantly clear. It was also evident that control of those energy resources had passed from the Western countries and the international oil industry to a small group of less-developed countries (LDC's) wherein these resources were located. It is the basic premise of this study that this "geopolitics of energy" has major implications for U.S. economic, political, strategic, and national security interests; it is these implications and the further changes they will induce in the international environment in which the United States must operate that is the focus of this report.

Part I of the study is devoted to an appraisal of the worldwide energy situation as it will evolve over the remainder of the century. Part II, then, takes the energy situation as given and attempts to draw the implications of that situation for U.S. interests and options. In effect, given the geopolitics of energy and likely changes in the international environment, part II involves discussion and recommendations as to the energy policy options which would give the United States and its allies greater assurance of energy supply.

# PART I.—INTRODUCTION

## CENTRAL ISSUES

It is the first objective of this study to highlight and interpret those aspects of energy supply which will engage the interest of states from now until the early decades of the 21st century. The study traces and amplifies themes which will preoccupy the great industrial states until such time as solar power, nuclear fusion, or some other source relieves them of the challenge of securing access to adequate and continuous supplies of energy.

### A. The Issue of Access

(1) Access to raw materials generally and to energy in particular is certain to be a major preoccupation in international political relations. The issues involved reflect a changing international environment in which the availability of basic commodities is no longer guaranteed by traditional colonial relationships or power, defined in military terms.

In an earlier era, the question of access would have been resolved by the actions of great powers. Today, the growing unwillingness to use direct military force gives other factors, such as political control of energy resources, greater significance in the calculation of power. The contemporary international environment tends toward a wider definition and dispersion of the elements of power and raises possibilities of still different international relationships in the future.

(2) Access will be determined by an interplay of geographic factors and government policies based on a complex mix of political and economic considerations whose ingredients will vary state by state. In any event, the terms under which those who control resources make them available to those who depend on them will reflect the changed international environment and evoke further changes of great international consequence. Access will not be determined solely by need and certainly not by any industrialized state acting unilaterally.

(3) These considerations have great implications for international power relationships. Changes in the distribution of power are likely not only in terms of North-South relations but in the relative positions of countries in the developed world as well, including East-West relations and relations among the countries of the Western alliance.

Access to energy, the key raw material in world trade, will be of major consequence to virtually all states well into the next century. We do not yet know the extent to which energy producers, and producers of other commodities, will attempt to link interests in a common cause. We do know that access raises acute questions for which no present policy seems adequate.

(4) In the case of energy, we share the belief that in the early decades of the next century another profound revolution—comparable to that which followed the use of coal and oil—is anticipated. The use

of new sources of energy could free many states from most geographic restraints. Until then, the interests of great and smaller powers will be engaged in the pursuit and wise utilization of energy resources—resources as vital to their societies' well-being as food and water. To the extent that governments fail to use the transitional period to reduce dependence on imported energy, and to develop alternatives to oil, competition for available supply will be intensified.

## B. The Geopolitics of Energy

(1) Geopolitics as an approach to the study of international relations stresses the importance of locational factors in influencing the relations among nations. Thus, geopolitics emphasizes geographic factors as important determinants of government policy and major determinants of the relative power positions of states. In this report on energy, these locational factors are emphasized, as they must be, in considering access to raw materials generally.

(2) In turn, the importance of various geographic factors changes with developments in many areas, including the passage of time, advances in technology, the need for access to raw materials, changes in national and international political goals and judgments as to legitimate means.

(3) Moreover, geographic and locational factors vary in importance with changes in the international system itself; there are new international actors (new nations as well as multinational corporations, international organizations, regional economic and military organizations, etc.); the legitimacy and adequacy of traditional actors, of national-states themselves, is a subject for debate. Power becomes more widely dispersed; superpowers often find themselves confounded by lesser states who find room for maneuver within the stalemate created by nuclear weaponry. Interdependence, in terms of mutual dependence as well as interpenetration, is a reality. And it is within this continuously changing international environment that geopolitics and access to raw materials will evolve.

(4) In a circulatory manner, geopolitical factors and access to raw materials will again, in turn, have an impact on the international system.

(5) Are there then geopolitical factors related to energy and raw material supplies which suggest the outline of new international relationships for the decades ahead? Which areas, by dint of their control over which geographic factors will be strategically and economically important in the future? What combinations of states are made likely by these geographic factors? If energy is a vital interest of the world community, will there be "energy heartlands," other than the Middle East, of undisputed significance, access to which will be of prime importance?

(6) Moreover, because all major primary energy resources depend on a host of additional actions necessary to: (a) Transform them into usable form; and (b) transport them to consuming areas, factors other than resource location are essential aspects of the geopolitics of energy; the logistical supply lines, the technology, and the processing facilities without which the raw resource is of little value will also have implications for international politics.

(7) Finally, the continuous interaction between factors influencing supply—reserves, processing, new discoveries, growing energy consumption, and energy research and technology—and factors influencing demand—economic growth, resource requirements of a particular economic system, and availability of substitutes—which gradually give different resources and geographic factors different importance over time, is also an important aspect of the geopolitics of energy.

### C. National Interest and National Security

(1) Energy has not yet come of age as a high priority item in national security considerations. To date, there is no comprehensive definition of U.S. energy interests and scarcely one for other industrial states of the non-Communist world. With no clear conception of energy interest, there can be no strategic energy policy.

For the United States, a great deal of what passes for "energy initiatives" and "energy policies" therefore, reflects tactical actions in which energy has seemed too often to have been the device or the lure for accomplishing some other, non-energy, purpose overseas. Nor have energy objectives been discussed and formulated with all Government interests appropriately represented. Energy objectives have been lost in a myriad of other concerns and a quagmire of domestic politics.

(2) In the process of defining and implementing a more adequate energy policy, the United States will become more aware of the extent to which degrees of dependence upon energy in international trade affects the selection of allies, modifies alliances and may create the need for new ones. Those geological accidents which concentrated energy resources in preindustrial societies brings the issue of overall "North-South" relations into the search for access in which the United States may actually find itself pitted against traditional allies, or pursuing such divergent causes as to affect the durability of our relationships.

### D. Scope of Government Interest

(1) States dependent on imported energy resources have two cardinal objectives: First, to pursue policies designed to secure access to that additional foreign supply which is essential to their national requirements; and, second, to reduce the necessity for access to foreign supply.

In assuring itself of access to foreign supply, a government has a variety of options: It may seek bilateral relationships with key producers; it may create a system of preferred sources; it may participate in such more general undertakings as the EC-Arab dialog, trade arrangements such as the Lome Convention, et cetera, join in technological assistance efforts; or participate in still wider international efforts such as the International Energy Agency, the Conference on International Economic Cooperation (CIEC), and commodity agreements. It may, of course, do all of these.

In reducing the necessity for access to foreign supply, a government can implement policies of conservation, give incentives for development of energy alternatives, encourage research, et cetera. These are essentially internal actions which a government may take to reduce demand and encourage indigenous production. The success of these policies will

be determined by timely actions, political will, appropriate economic policies and regulation, and the extent to which nature favors the country with energy resources.

(2) The issue of access to energy resources actually involves three interests which each energy-deficient state shares with all others:

(a) A state's supply of imported energy must be adequate in volume; there is a level of imports below which national security is jeopardized.

(b) The supply of imported energy must also be continuous. Interruptions or occasional shortfalls in supply can have serious economic and political implications for industrialized States. It is, of course, this vulnerability to disruptions of supply which gives resource-rich states a lever to use against states dependent on imported energy.

(c) Imported energy must also be available at "reasonable" prices—the most difficult to define of the three aspects of access. Clearly, price should bear some relationship to the cost of alternative forms of energy—available and prospective; price should also reflect the fact that present energy sources are diminishing and nonrenewable. Price should reflect "ability to pay."

These three factors of adequate volume in continuous supply at reasonable price constitute an interrelated triad of energy interests. Failure to obtain any one of the three could have disastrous consequences for the economic well-being, political stability, and national security of the consuming country.

## CHAPTER I.—HIGHLIGHTS OF THE CONTEMPORARY GEOPOLITICS OF ENERGY

### A. Introduction

The 20th century has witnessed the greatest shift in energy sources the world may have experienced since the spread of the use of fire.

In the first quarter of this century coal was indisputably the major source of energy for the industrial world. The energy requirements of great states could be met totally from within their borders or supplemented from nearby resources (in the case of Japan).

Coal would have remained by far the key energy source had not the discovery of large volumes of oil in southern Russia, in the Middle East, and latterly in the United States, quickened interest in the comparative ease of its extraction and transportation, and its conversion to meet a host of requirements.

What were the circumstances which produced the revolution in oil beginning in the midfifties, and which brings its availability to the highest order of national interests? These may be quickly highlighted by statistical references to the growth in energy consumption, beginning with 1960 (the year OPEC was founded): In that year, the world's energy consumption approximated 132 QBTU; 10 years later, it was some 217 QBTU; 5 years later, in 1975 it was estimated to have been 225 QBTU. Fifteen years from now—in 1990—it could be 415 QBTU; an over threefold increase in total world energy consumption in only 30 years.

But of those increases, what was the share of oil (and natural gas)? In 1960 they represented 48 percent of the world's energy consumption. Ten years later, it was 63 percent; by 1975, it was some 67 percent and by 1990 assuming a very large increase in the role of nuclear power it could be about 58 percent. The volumetric implications are staggering. Eight billion barrels of oil were consumed worldwide in 1960; 17 billion barrels in 1975 and possibly 30 billion barrels by 1990: a nearly fourfold increase in the use of oil and gas in 30 years.

Coal, on the other hand, which had been the primary source, was nearly 47 percent of the world's consumption of energy in 1960, but sank close to a level of 30 percent in 1975.

The convenience of oil, therefore, its scant labor requirements, its extraordinary range of uses, and perhaps most important of all, its relative cheapness plus the enormous expansion in producing capacity and huge reserve discoveries all combined to make it and its products the most attractive and primary source of energy.

The key decision which catapulted oil into what would eventually be energy's first place came with the pre-World War I undertaking by the British Admiralty to convert its battle fleet to oil, a decision quickly followed by every major power.

A whole set of geopolitical factors emerged with this far-reaching commitment: Access to oil imposed new and greater commitments on foreign and defense policies. For the British especially, given the size and role of the Royal Navy, the Middle East which was still considered the bridge to India and the East, to be defended against Russian ambitions, now acquired an additional strategic purpose: access to, and protection of, the oil fields of Persia and the Gulf.



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Prior to World War II, French, German, and American commercial interests sought access to that oil. While the strategic importance of oil may have been influential, it was not necessarily the predominant factor in impelling countries to move into the area. In the German case, the desire for general strategic advantage vis-a-vis Britain may have outweighed considerations of oil per se; similarly in the case of France, traditional rivalry with Britain may have provided the essential reason for a French presence in the Middle East, not predominantly a French need for oil. For the United States commercial interests dominated. Perhaps mainly in the case of Japan, which, however, looked to Southeast Asia for supplies, did a recognition of the strategic importance of adequate oil supplies motivate foreign activities.

After World War II, the threat of Soviet expansion into the Middle East, and the creation of Israel added new dimensions to U.S. interests. The increasing importance given to oil in world energy trade rapidly expanded the catalog of U.S. concerns. Nevertheless, the United States did not debate the longer range implications of this greater stress on oil generally, and its exclusive access to the oil of Saudi Arabia. This is still true, although allies and others find it disingenuous of the United States to continue explaining that there is no "special relationship" regarding the immense oil resources of that kingdom on whose policies and actions the energy interest of so many depend.

Nevertheless, industrial nations generally have not had energy policies appropriate to the extent of their dependence. It is not surprising, therefore, that by the beginning of the 1960's when oil consumption began truly to soar and to rank high among any country's strategic interests, political developments among the producer countries' shattered the imperial system; control over oil passed to the other side. The speed of the change has been such as to allow little time for careful consideration of policy alternatives necessary to regaining the requisite assurance of supply.

## B. Energy Needs of the Industrial World (1960–75)

The exponential growth in the imported energy requirements of the leading industrialized states is the basic condition which initiates a discussion of the geopolitics of energy. Three sets of data display the situations: (1) The increase in energy consumed by these states; (2) the extent to which these needs have been met by oil and through oil imports and (3) the importance of the Middle East and Africa as the source of supply. From Table I, note:

(1) Over the period 1960–1975, energy consumption doubled generally and for Japan it trebled; Europe and Japan's dependence upon imported oil remained, for all practical purposes, total;

(2) From 1960–75 the importance of oil to the U.S. economy rose from 20 to 35 trillion Btu: import dependence of the United States rose from 23 percent to 39 percent. It was in this period that the United States ceased to be able to meet its energy requirements from indigenous resources and ceased to be the emergency oil supplier to Japan and NATO allies.

(3) The Middle East and Africa remained the single most important source of oil for West Europe and Japan, and its importance to the United States nearly tripled from 1960–75.

(4) Throughout 1960–1975, only the U.S.S.R. was and remained energy self-sufficient and hence had no supply vulnerability.

TABLE I

| | Energy consumption (QBTu) | | | | Oil and gas as a percent of energy consumed | | | | Percent of oil consumed met by imports | | | | Middle East and Africa supplied percent of oil imports | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1960 | 1965 | 1970 | 1975 | 1960 | 1965 | 1970 | 1975 | 1960 | 1965 | 1970 | 1975 | 1960 | 1965 | 1970 | 1975 |
| United States | 44 | 53 | 67 | 73 | 73 | 74 | 76 | 75 | 22 | 20 | 23 | 39 | | 10 | 8 | 23 |
| West Europe | 26 | 34 | 46 | 50 | | | 64 | 71 | 100 | 100 | 100 | 100 | 72 | 83 | 94 | 95 |
| Japan | 4 | 6 | 12 | 14 | 39 | 60 | 72 | 78 | 100 | 100 | 100 | 100 | 74 | 82 | 92 | 77 |
| U.S.S.R | 26 | 34 | 45 | 60 | 38 | 50 | 58 | 59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## C. Sources of Oil

The locations of the immense reserves from which the world draws its oil are quickly summarized.

From the beginning of the modern use of petroleum the greatest reserves of all have been found in the Middle East; the greatest single-nation production, until recent years, came from the United States and the Soviet Union. Presently, the USSR seems to lead, with Saudi Arabia narrowing the gap (at 8+MMB/D) and having no technical difficulty in surpassing the Soviet Union. But oil in world trade—which is the essential point for it provides the supplementary amount for importing countries—has been predominantly from the Middle East. Today, that oil accounts for nearly 75 percent of oil in world trade.

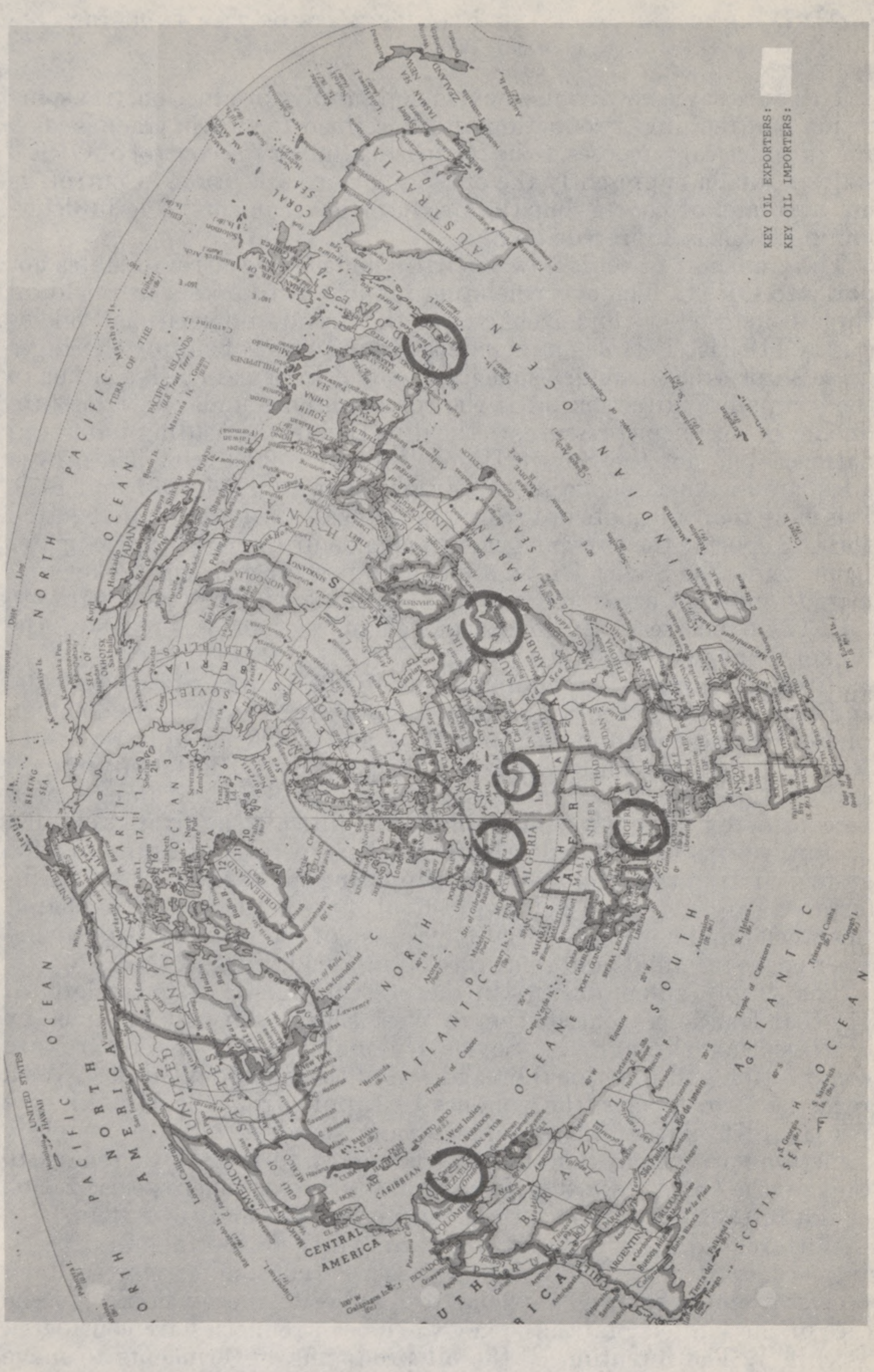
Reserve figures indicate the volumes of oil in a given field, country or region which can be extracted profitably at prevailing prices and with available technology. Producing capacity informs as to how much can actually be extracted with existing producing facilities.

The reserves of key producers with their present producing levels, and "spare capacity" indicated, and their share of world trade in oil, give the fullest picture of the contemporary importance of these states.

OPEC members dominate world oil; their oil production approximates 30MMB/D. Communist nations produce an added 10.4MMB/D and the rest of the world adds about 14MMB/D.

OPEC oil reserves also dominate: nearly 500 billion barels, compared to 112 billion barrels for the Communist states and an equivalent amount for the rest of the world combined.

But the nations of the Gulf have an importance of their own. They actually produce 20MMB/D (and may have the capacity to produce 25MMB/D); their reserves are presently calculated to approach 365 billion barrels.


KEY OIL EXPORTERS:
KEY OIL IMPORTERS:
NORTH PACIFIC OCEAN
NORTH ATLANTIC OCEAN
INDIAN OCEAN
SOUTH ATLANTIC OCEAN
SOUTH PACIFIC OCEAN
AUSTRALIA
NEW ZEALAND
CORAL SEA
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ARABIAN SEA
CARIBBEAN SEA
SOUTH CHINA SEA
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180° W
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20° W
40° W
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100° W
20° E
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120° E
140° E
160° E
0° N
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40° S
60° S

## D. Logistic and Refining Requirements of the Industrial World

There are three key requirements in oil supply: production, transportation and refining. Production of oil destined for world trade is now, for all practical purposes, to be regarded as under the control of OPEC states. Canada is presently the only important exception. "Control" is not absolute, of course, but the producer governments' role in determining levels is unprecedented.

The transport of oil is now virtually under the control of states not party to OPEC. The overwhelming majority of tankers in world oil trade belong or are under charter to the private international oil industry (British Petroleum included). In the event of supply shortages these ships are still under sufficient control to be responsive either to the companies' direction or, if the companies are under extreme producing government pressure, to the direction of the leading industrial nations (but not the Soviet Union). As for tonnage, it has proven adequate in the three major supply problems of 1956, 1967 and 1973. It is more than adequate in 1976, including vessels of lesser size required for U.S. ports; the present general surplus of tonnage approximates 40 percent. The Soviet Union appears to possess sufficient tanker tonnage to meet its needs and supply commitments. The states party to OPEC do not seem to have acquired more than 3 percent of the tanker tonnage in world oil trade.

Pipelines exist overwhelmingly within the United States, Canada, and Europe, and in the Soviet Union. They are essential ingredients in the secure and continuous supply of oil and gas. None of these are, of course, under the control of any state party to OPEC. Only the oil and gas pipelines supplying West Europe with Soviet oil and gas need be considered presently vulnerable to a politically motivated closure, or for reasons of economic warfare. The pipelines of Iran, and the system of Iraq and Saudi Arabia supplying oil to the Eastern Mediterranean are under the exclusive control of the host country (or shared in transit) and none is essential (by reason of the volumes shipped and alternative terminals and routes) to oil in world trade.

The supply vulnerabilities in the present logistic system relate to: (1) that fractional contribution to West Europe's energy provided by or transiting through the Soviet Union; and, (2) the future size composition and functional breakdown of the world tanker fleet. With regard to the former, the volumes of supply from the U.S.S.R. are not, in 1976, important amounts by any standard but are obviously something to watch, especially with regard to gas. With regard to tankers the trend toward larger size and greater tanker specialization could, in the future reduce the flexibility of the logistic system.

With regard to refineries: there is presently no shortage in processing crude in any of the leading energy consuming states. Each possesses ample refining capacity to handle its energy needs (in the case of the United States, the key Caribbean refineries are considered "secure"). The intention of the oil producing governments to move downstream have, to date, been unfulfilled. Refineries are under the control of industrial nations. In product supply, only the Caribbean refineries raises questions of sealane security.

Moreover, in no instance do OPEC members separately represent an important segment of world oil consumption; nor collectively, do their internal needs total a significant amount: 2MMB/D. The vital, large volume markets for OPEC oil lie solely in the industrial nations.

In summary:

| Function | Controlled by— | |
|---|---|---|
| | OPEC states | Industrial nations |
| Production | × | |
| Logistics | | × |
| Refining | | × |
| Markets | | × |

## E. International Oil Industry

Credit for the place of oil in world energy goes to the private oil companies, especially the "international majors", whose extensive interests, management skills, application of capital and technology to oil exploration and field development, logistic systems, processing facilities and then delivery to consumers were woven into an integrated operation of enormous influence and benefits.

Fom the outset, the domination of international oil by British and American companies has been a "constant"; in 1976, it is still possible to note that there are no close "seconds". Some erosion of their role has come from ENI, CFP, and other national companies of very diverse national origins and from the scores of "independents" that entered international oil post-1950. But it has been the direct actions of producer governments which have inflicted the greatest changes on the international oil industry.

Quite apart from the actions of *producer* governments in asserting control over the disposition of their oil, the actions of *consumer* governments to limit the corporate freedom of the international oil industry have been long-standing, persistent and increasigly successful in "sunshine" measures forcing disclosure of information on prices, profits and planning. The erosion of the role of the international majors has thus derived from both the producers' and consumers' side.

Nevertheless, certain of the functions exercised by the majors continue to be irreplaceable: the management of worldwide movements of varieties of crude, and access to tankers, refineries and markets on the commending scale necessary to move huge quantities of petroleum.

Their earlier role as capital generators has diminished greatly in importance at least within the producing nations. Even research/technology may no longer be so closely held by the majors. However, extensive experience in the application of technology is a very complex undertaking and is still considered to be a special province of theirs as is the application of these skills to field development in enormously difficult and exacting undertakings such as the North Sea and Alaska.

The international majors have lost much of their power to determine producing volumes and prices, and are beginning to lose the ability to make plans and commitments independent of consuming governments as well. The majors are widely regarded as being responsive or captive

to policies and directions by their own governments and that they are, in effect, and have always been "instruments of foreign policy" (as Acheson unfortunately and inaccurately described them).

Depending on one's viewpoint, the fact that the companies have not been such is either to their credit, or can be attributed to the failure of governments to define their energy interests and the parameters within which the companies would operate. In any case, the companies' role is still indispensable to all interests—if more limited than before in setting the economics of oil trade.

## F. Policies of Energy-Deficient States

There have been two phases in the history of the oil policies of these states: *first* came the period of the imperial system in which governments/oil companies competed for oil concessions; government support for these arrangements was always thought to be the ultimate guarantee of their durability. However, oil policies of governments were at least as much an aspect of familiar imperial rivalries as they reflected an awareness of the importance of access to the commodity itself.

Of course, for the international oil companies, then, as now, dominated by British and American giants, priorities were reversed: their commercial interests were paramount; for them, the issues of rivalries between states were aspects of the perennial problem of access to ever greater volumes of oil—to be taken advantage of when necessary. The international oil companies did not encourage their governments to develop energy policies whose objectives could serve to limit the commercial freedom of action deemed essential to their worldwide operations. Support or protection from governments? Yes; guidance or direction? No.

The *second* phase—which began in the years between the two world wars—was characterized by the rise of government oil companies or chosen entities whose purposes were interrelated: (1) to provide for national involvement in the supply of a commodity becoming critical in its importance; and (2) to challenge British and American domination of oil in world trade. In the first purpose, the central concern was to extend a more effective reach over the activities of one's chief suppliers and to appraise better the terms on which oil was imported.

In the second objective, governments—more for purposes of showing the flag than for commercial advantage—encouraged international oil activities of national companies. These two purposes, often linked, have grown in importance and consequence.

The rise of *consumer* governments' oil companies has been nearly simultaneous with the emergence of *producer* governments' oil entities reflecting at least a shared interest in the terms on which oil in world trade is supplied.

Involvement by governments of producers and importers of oil has come to overshadow the importance of the commercial stakes; the supply of oil has become so critical a national interest that factors other than the economics of trade necessarily intrude. A result is that governments may now engage all of the instruments at their disposal to better assure themselves of an adequate and continuous provisioning

of oil at an acceptable price; another result is that, from the viewpoint of producers and consumers of oil, other interests become involved in access to oil: military assistance, technology, investments, economic and political objectives, all complicating infinitely the context in which energy resources are traded.

In the process, national oil companies of consumer countries have begun to acquire a potential for thus acting directly or indirectly as instruments of policies which reflect a broader range of concerns than the commercial terms on which oil is supplied. The national oil companies of producer countries largely set these terms today, and these conditions may also reflect a very broad range of producer interests of which trade is only one, albeit a very key one.

The outstanding example today of the complexities now embedded in the process of attempting to assure supply were all too apparent in the negotiations which led to the creation of the International Energy Agency for consuming/importing nations.

Its ostensible purpose was to agree on an equitable means for sharing available oil in the event of another emergency; agreement has been reached on details including an emergency stockpile program which eventually may provide for 90 days of imports. But from the time the U.S. Government pushed hard for the IEA, the consuming nations were (and remain) apprehensive that if another embargo or cut off comes it will probably be aimed largely at the United States, while they will all be implicated by virtue of their sharing oil in world trade.

Behind the clear hesitation of other consumers to commit, in advance, to such sharing was the more basic issue; should the IEA prove to be confrontational in the eyes of the producers wouldn't Europe and Japan be risking far more than the United States? Thanks mainly to the skill of Etienne Davignon, who rallied the Common Market, the IEA was brought into existence thus meeting one of the fundamental pillars of United States strategy for dealing with OPEC—a united front of consumer nations.

Nevertheless, no IEA member forgets for long how intricately interwoven is diplomacy, politics, energy and economics, and how inadequate the IEA alone will prove to be if much more is not brought forward to engage positively the interests of the producing world to meet the rising demands for oil of the industrial world.

Such an effort began in December 1975 at Paris in the launching of CIEC (Conference on International Economic Cooperation), the result of a Saudi and French initiative, to start the process of discussing the interrelated issues of energy, other commodities, economic development, and financial questions. The CIEC approach was opposed initially and, according to some consistently by the United States, but generally desired by others who saw in it, at least, a step away from confrontation and possibly a step toward some more satisfactory set of understandings in which reliable access to energy would be a critical part. It can be considered to be another effort to foster some more mutually satisfactory relationship between the suppliers and consumers of raw materials than the former imperial system provided. It is not at all certain that CIEC will succeed for great interests are being engaged and many of them do not yet seem to be susceptible to compromise.

## G. Energy and the Soviet Union

Of all the leading industrial nations, only the U.S.S.R. is presently energy self-sufficient. Soviet oil and gas production appear to meet current domestic requirements. So far as can be determined, U.S.S.R. internal energy meets an overall demand of 60 QBtu out of a supply which appears to draw upon coal for 34 percent; gas for 23 percent and oil for 36 percent.

The principal current energy problem confronting the U.S.S.R. is the increasing difficulty it has in meeting the energy requirements of the East European countries while insisting it be the principal supplier. Current East European consumption of oil approximates 1.8 billion barrels per day; the U.S.S.R. supplies 90 percent of the region's imports mainly from its own resources with the balance obtained primarily from North Africa and the Persian Gulf.

The further exploitation of Soviet energy resources has entailed immense costs. Topography, logistical and technical difficulties, and the long pipeline systems required to tap East Siberian basins will continue to be impediments to development.

To date, Soviet efforts to acquire the technology (drilling, offshore designs and recovery techniques) presently possessed very largely by Western and Japanese oil companies, which is thought to be essential to further development of Soviet energy resources, have been unavailing. The Soviets persist. The oil industry still seems to want direct access to Soviet production more as an alternate source, than as an additional source to supplement Middle East crude; the Soviets have, so far, declined to conclude such arrangements.

A question about Soviet policy and energy which has long haunted observers is whether the Kremlin could succeed in alining "radical" producing governments to its side in a program of economic warfare endangering supply to the free nations of the West and Japan.

There were opportunities for such efforts in the Suez crisis of 1956, the June war of 1967 and during the October war and embargo of 1973–74. Moreover, it would seem that in all three instance there was more than enough anti-westernism to warrant Soviet expectations of an increase in its influence. Furthermore, huge Soviet outlays for loans, development projects and military equipment and training at various times and places since World War II: Iraq, Syria and Egypt, and now Somalia, must have seemed to the Kremlin reason enough to believe it was creating that permanent presence in the Middle East which it had long sought but always seemed elusive. Still, none of these initiatives proved durable enough, to date, to endanger oil supply. Until now at least, the U.S.S.R.'s campaign against "oil imperialists" has failed.

Why it has been unsuccessful is conjecture, but three considerations seem valid:

(1) The Soviets have failed to identify their own objectives and ideology with those of even "radical" regimes in the Middle East and North Africa despite occasional and relatively short-lived tactical relationships which have not been pervasive enough to become "permanent" or "strategic". However radical many Arabs may seem, it is still probably the case that few have been willing to invite in another alien direction, having discarded that of the West.

(2) The Soviets could not penetrate deeply enough in Kuwait, Iran and Saudi Arabia whose oil interests dwarfed the only oil producing client state the Soviet Union acquired: Iraq. Without strong influence in these other producers, Iraq was never enough. Moreover, Kuwait, Iran and Saudi Arabia have been conservative forces in the region with the least of inclinations to stake their futures in the Communist world.

(3) The Soviets have never been able to persuade the producing countries that any possible distruption of oil supply to the West caused by the actions of the producing governments vis-a-vis the international oil companies, could be offset by an immediate replacement of the companies' functions from the talents available in the producing states with assistance from the Soviet Union (The example of Iraq is discouraging.). Finally, there was never any prospect that the Communist world's purchases of oil from the Middle East would ever be of such magnitude as to provide even approximately or even for a short time, a level of revenues which could be earned in present and foreseen Western and Japanese markets.

There is a possible, fourth, explanation: the U.S.S.R. may have judged that its efforts to disrupt oil arrangements with the West could provoke a response, from the United States which in time of crisis, might lead to general war. And for that, no crisis, however genuine or Russian-initiated, was yet worth such an outcome. Or is it possible that short of a general war, the Soviets may have been unsuccessful in their search for willing allies because the Kremlin would or could not offer assistance on the scale potential clients deemed necessary?

## H. Policies of Producing States

As for the evolution of the policies of key producing states, the critical observation is that each key oil exporting nation (and nearly every one of lesser consequence in oil trade) has passed through a variety of colonial experiences under Western empires; if the country may not have been a colony in a formal sense, its leadership and people regarded themselves as being such. If the exploitation of oil resources took place during a neo-colonial experience then the asumption of national control over the disposition of their oil came at a time regarded by them as marking the end of that experience. Thus, for virtually all of them, "oil" has profound significance in their political and economic emancipation. The list includes: Mexico, Venezuela, Algeria, Libya, Iran, Iraq, and Kuwait.

Producers intend to "right the wrongs of history" and to gain back, through price essentially, the value of their resource which had been exploited for the benefit of the foreigner, as they see it, and as it really was.

In their escape from a "colonial" relationship and their effort to assert national control over oil, Mexico led the way in 1938 with its expropriation of the holdings of foreign oil companies; that was nearly 40 years ago. Yet there is scarcely a more volatile political issue today than the one that Mexico will determine the disposition of oil, not foreigners and foreign interests.

Iran—under Mossadegh—was particularly explosive in implication because of the incendiary effect throughout the Middle East which a

successful assumption of national control of oil would have on oil concessions and the role of major oil companies. While Mossadegh failed, largely because of the British and United States oil companies' embargo, the outcome came to be regarded as, in fact, an Iranian victory. In the end, the near monopoly of the Anglo-Iranian Oil Co., was replaced by a consortium, with significant U.S. company participation, which was to function under very different circumstances. The eventual acquisition by Iran of control over its oil was seen to be an essential part of economic and political independence and the Iranian example would have implications for oil developments in other LDC's.

Indonesia was also a pacesetter. General Ibnu was convinced that as long as the colonial-style concession system prevailed, the corrosive domestic politics of oil could not be contained. He insisted that a new regime was essential and the companies were forced to comply. Production-sharing/service contracts which very largely and quickly removed the political stigma from foreign exploitation of Indonesian oil became the general rule.

In the case of Nigeria, exploitation of its oil reserves began after political independence but its disposition today is seen against the background of its colonial experience and a chaotic post-independence period which was further complicated by the machinations of foreign powers. Nigeria's attitudes and oil policies, therefore, are based in the same belief that economic independence is a prerequisite to political independence that motivates other LDC's.

Canada and Australia may be thought to be exceptions to the general observation linking oil with "colonialism" but they are not. No one who has followed political developments in either country can be unware of the widespread attitude which holds that their resources are for them to develop; in both cases, the belief is strong that their energy industry has been dominated for too long by foreign interests, nearly 90 percent of Canada's oil being controlled by U.S. oil companies' subsidiaries, and Australia's experience not much different. In the matter of the disposition of their oil, their sensitivities are as acute as those of OPEC exporters.

Some regard Saudi Arabia as the truly signifiant exception to the colonial experience of other producers. Originally, Saudis preferred U.S. oil interests over the British largely because the United States was "different" and could be a counterweight to British domination of the Persian Gulf.

To date, the Saudi-American relationship has remained largely free of the antagonism which has characterized the relationships between other producers and those who controlled the disposition of their oil. Nevertheless, given the enormous importance of Saudi oil, it is necessary to consider present and future prospects in the light of three observations: *first*, it is entirely conceivable that at a critical moment some of the Saudi leadership will make political capital out of the incontrovertible fact that U.S. oil companies have, from the outset, monopolized the exploitation and disposition of the immense Saudi resources: *second*, the assumption by Saudi Arabia of political control over oil has come at the same general time as that of other OPEC states so that the political pizzazz of taking national control over oil links Saudis to other producers; and, third, the Saudis cannot isolate

themselves from their setting in the Gulf. They will not be immune to political forces and trends in the area.

Earlier, we asserted that Western oil exploitation was guided more by imperial and other political and commercial considerations than by a consistent geopolitical assessment of oil requirements.

Had there been such an assessment, governments might possibly but not necessarily have detected the early warning signals of political change and sought to deal with it. As it was, when the storm broke, the politicization of oil spread at a rate which precluded the chance for timely adjustment on the part of the foreign companies, and their governments, even if they were disposed to attempt to adjust—which they were not.

Some of the producers' dislike or apprehension of the international oil companies comes from the obvious link of British imperial interests to a British control of a significant share in two of the "Seven Sisters" whose presence was everywhere that oil was needed. The other five of the "Sisters" have been American-controlled and here the general dislike or apprehension reflects their being the symbol of "international capitalism" as far as the majority of socialist leadership in LDC's are concerned. And all of the key oil producing and exporting nations are also LDC's.

## I. Key Observations of Energy (1976)

(1) Unavoidable dependence of virtually all major energy deficient states upon Middle East oil is the primary fact; so great is the present producing capacity of the Middle East that, if all other sources of oil in world trade shut down, major industrial states might have their energy import requirements met from that region alone. Of the spare capacity for production, presently shut-in for whatever reasons, the Middle East accounts for some 6.7 million barrels a day; actual non-Middle East production today, in world trade, amounts to 6.9 million barrels a day.

(2) For the past several decades, outside of the Middle East and Communist World, there have been no discoveries of very large oil reserves other than Libya, Nigeria, North Sea, Alaska, and possibly Mexico. A conservative estimate of the time required to explore, prove, develop and produce a truly significant amount of oil for world trade is from 5 to 10 years. It would be fortunate, and not to be counted on, if such discoveries were to come at a rate which more than equaled the world's increased use of petroleum.

(3) There is no prospect, therefore, of any diminished importance for Middle East oil over the next decade and probably for years afterwards.

(4) The U.S.S.R. (and PRC) are not now major contenders for Middle East oil. Competition for Mideast oil is between NATO allies, and Japan.

(5) Generally, OPEC is less significant today than is OAPEC; more exactly, Saudi Arabia's present spare producing capacity and potential production are the most important factors; Saudi production is about 8.6 million barrels per day; its production capacity is estimated at 11.5 and its potential at 20 million barrels per day is technically feasible. Any Saudi decision on volumes and prices is important.

The key question of OAPEC is the potential divisiveness within the Gulf, especially as between Iraq, Iran, Kuwait and Saudi Arabia, and the problems/opportunities this presents to the great industrial, importing nations.

(6) The United States' "special relationships" with Iran and Saudi Arabia are far and away the most significant links between producers and great industrial oil importers. Yet Europe and Japan are far more dependent on Saudi and Iranian oil than is the United States which suggests that the Saudi and Iranian connection could prove troublesome in terms of intra-Western alliance relations. Also, given the general hostility in Saudi-Iranian relations, U.S. "special relationships" with both, simultaneously may be increasingly difficult to manage over time.

(7) OPEC member states—all LDC's—control the production of most oil in world trade.

(8) Producing countries control a significant portion of the sealanes which begin with their terminals and loading facilities, and extend throughout the Gulf, into the Indian Ocean, to the Red Sea and Suez, the Mozambique Channel, Straits of Malacca, and Lombok—all these are susceptible to interference or closure by producers and/or LDC's.

(9) Control of the rest of the logistic system—tankers, pipelines and processing facilities (and energy technology)—still lies with the industrial world as do the great oil markets. Only some 3 percent of the world's tanker fleet of 320 million tons is regarded as presently under the control of the OPEC states. Only pipelines delivering oil to terminals for tankers is in their hands; none of those serving consumer nations directly are affected. The consuming nations have ample refining capacity today and are dependent on no one else's.

(10) Europe, Japan, and the Middle East have superport facilities commensurate to their present needs. The United States cannot take full advantage of the economics of VLCC's. The United States is crucially dependent upon smaller vessels whose replacement has lagged behind the construction of VLCC's.

(11) Member states of the International Energy Agency, through their agreed plan for the sharing of available oil supplies in the event of supply disruptions for any reason, may have the possibility of withstanding supply interruptions or cutbacks better than at any previous time. At the least, the emergency sharing mechanism suggests a possibility that this is so, therefore, introducing uncertainty into the calculations of the oil producers.

(12) International oil companies remain essential to consuming and producing nations alike, largely because of their logistics systems and access to processing facilities which permit them to handle very large volumes of oil. At least 80 percent of world oil trade is handled by these international oil companies, or 24 million barrels per day. Producer nations largely determine prices and consuming governments have not yet found means to influence the level; arrangements regarding prices and volumes are still "concluded" between companies and producer governments, although the latter are key.

(13) In the very years when oil became of such critical importance to the industrialized countries, control over access to the resource was wrested by producers from the oil companies of consuming states. As of mid-1976 no general arrangement between the producers and

consumers of oil has been reached providing dependable assurance of supply; there is not even agreement on a process for doing so.

(14) It is still the case that no major industrial, oil-importing state has a comprehensive, disciplined energy policy and program. Even if they had well-defined goals and commitments, there could be no way of fundamentally altering the basic aspects of the contemporary geopolitics of energy. Very substantial efforts, persisting over a great many years, are the inescapable conditions for eventual escape from the current situation in which the industrialized states are dependent on oil resources which are controlled by a small group of LDC's.

## CHAPTER II.—OIL—1976–2000

### A. General Observations

#### I. INTRODUCTION

The geopolitical significance of oil derives from two central factors: (1) oil, as fuel and feedstock, is the lifeblood of the industrialized economies; and, (2) oil reserves and production tend to be geographically concentrated in particular less developed countries (LDC's). In effect, oil reserves and production are most abundant in a small number of developing countries, while the need for adequate and continuous supplies of oil is most urgent in the developed, industrial states.

Having said this it cannot be emphasized too strongly that in no case can forecasts of many years ahead be regarded as more than reasonably intelligent estimates which suggest trends or general orders of magnitude and can claim no greater precision.

#### II. CONTINUED IMPORTANCE OF OIL

Oil will continue to provide the bulk of total energy needs at least until 1985, and almost certainly for a period extending into the 1990's. The forecasts considered in the preparation of this study indicate that oil will constitute some 50 percent of the total free world energy supply in 1985.

However, there is a strong possibility that the forecasts underestimate and abreviate the importance of oil:

(1) Oil is considered the "swing" fuel, compensating for all shortfalls in the production of alternative energy sources; to the extent that shortfalls do materialize in the production and development of coal, natural gas, and nuclear energy, oil will be called upon to play a greater role.

(2) *a.* The forecasts assume that, in the future, GNP growth rates will be below historical trend; if future GNP growth rates return to trend or exceed the forecast assumptions, oil will be called upon to supply a greater share of increased energy requirements. Given the tendency for forecasts to be overly influenced by current and short-term events, there is a reasonable chance that the assumed growth rates are, in fact, too low.

*b.* To the extent that reduced oil demand was a result of recession rather than higher prices, economic recovery should spur oil demand.

(3) It now appears that the higher price of oil has been absorbed, at least in the industrialized states. To the extent that the price of energy alternatives has moved in line with world oil prices the incentive for substitution, at heavy capital investment cost, is reduced while the incentive for developing indigenous



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sources of oil have increased, i.e., the switch from oil to other sources may be delayed.

(4) The crisis mentality which developed as a result of the 1973 embargo has receded and there appears to be much less sense of urgency regarding the need to develop costly alternatives to oil, at least among the public.

In addition, the inability of governments to elaborate comprehensive energy policies results in the slower development, by Government and/or private enterprise, of alternative energy sources.

The leadtimes associated with developing alternatives or additional energy sources are long. The following estimated leadtimes (years from decision to start up)—probably optimistic—are indicative:

| | *Years* |
|---|---|
| Development of proved, but nonproducing field, Middle East | 1–2 |
| Production from extensions of oil fields, United States | 1–3 |
| Offshore (United States) from lease to peak production | 9–14 |
| Surface coal mine | 2–4 |
| Underground coal mine | 3–6 |
| Oil, geothermal, synthetic powerplants | 5 |
| Coal-fired powerplants | 5–8 |
| Hydroelectric dam | 5–8 |
| Production of oil and gas from new fields, United States | 3–12 |
| Uranium exploration and mining | 8–10 |
| Nuclear powerplants | 7–10 |
| Coal gasification | 10–15 |
| Tar sands and oil shale | 5–10 |

Add to these figures the delays in decisionmaking resulting from ambiguous government policy and the fact that start-up is not the point of maximum contribution from these sources, and the impact of very long leadtimes is made clearer.

By 1985, the OECD estimates that conservation efforts—i.e., the more efficient use of energy resources and the use of quantitatively less energy—might reduce energy consumption in the OECD area by 15–20 percent of previously (pre–1973) projected total primary energy requirements without producing a negative impact on economic growth. Conservation, substitution and some reductions in oil demand growth rate caused by higher oil prices are likely; however, the combined impact of these factors will not be substantial enough to unseat oil from its major role. Moreover, the IEA has indicated that its members' current conservation activities are grossly inadequate and unlikely to reduce demand significantly.

Only in the period after 1985 and probably closer to 1990, could alternative energy sources—shale oil, oil from tar sands, coal gasification, nuclear—begin making their presence felt.

This brings the analysis to a consideration of the crucial nature of timing. It is entirely possible that alternative energy sources will not come on fast enough to prevent the emergence of sporadic enegry shortages and the development of a generally tight oil supply/demand situation. It will prove very difficult to coordinate the many aspects of energy supply/demand and sporadic shortages and strains can be anticipated, beginning as early as the first years of the next decade.

The dominant place of oil in the total energy supply is secure through 1985. Moreover, the factors enumerated above make it extremely unlikely that oil will be unseated even by 1990. If remedial

action is not taken promptly the remainder of the century may look very much like today in terms of oil's dominant place in energy supply. Moreover, even if the role of oil as an energy source can be reduced toward the end of the century, oil as a petrochemical feedstock will remain important with ever-increasing volumetric demands.

## III. IMPORTANCE OF OIL IMPORTS

The industrialized states will remain dependent on oil imports; it is of great importance that even if and when oil imports should become a smaller percentage of a nation's energy budget, the volumetric demand for oil is virtually certain to increase. However, there are differences among the free world countries as to: (1) the importance of oil to the economy; (2) the degree of dependence on imports; (3) potentials for energy conservation in general and oil conservation in particular; (4) the likelihood of increased indigenous production; and (5) vulnerability to oil shortages.

(a) Oil will constitute the bulk (70 to 75 percent in 1980, and 65 to 70 percent in 1985), of Japan's primary energy consumption. Moreover, virtually 100 percent of Japan's oil supply will still be imported in 1985. The longer-term outlook is not favorable and there is no possibility for the discovery of sizable domestic reserves. In the short term, Japan can hope only to diversify its sources of oil imports to reduce its current overwhelming dependence on Middle East supplies (75 percent of Japan's crude oil imports in 1975), while creation of a very substantial strategic reserve of crude could reduce Japan's vulnerability to supply disruptions. Longer-term, only the development of alternative energy sources—particularly nuclear—will reduce Japan's dependence on oil, and hence, on oil imports. Energy dependence, however, will remain a fact of life and of gravest strategic consequence for Japan since it has no sizeable reserves of any energy resource—neither coal, nor natural gas, nor uranium, nor oil.

(b) Europe, too, will remain heavily dependent on imports of oil. Oil will account for 50 percent of energy consumption in 1980 and 1985. The addition of North Sea oil and gas may ease the import dependence situation somewhat—particularly for Britain—but oil-import dependence of 70 to 85 percent is forecast for the European community (Europe of the Nine) in 1985. Overall energy independence for Europe seems out of the question, and overall energy-resource import dependence will still be in the 50-percent range in 1985, and perhaps for the remainder of the century.

(c) U.S. dependence on oil imports is expected to increase rapidly. Alaskan oil will reverse the decline in U.S. production, but neither the North Slope, nor offshore discoveries, nor enhanced recovery techniques will result in oil independence. Offshore oil, the great American hope, takes from 9 to 14 years to progress from a lease sale to peak production, suggesting only a marginal impact before 1985. In 1985, when oil represents close to 40 percent of U.S. energy consumption, the United States may still derive 50 percent of its oil supply from imports. Fifty percent oil import dependence through the 1990's is not unlikely. Note—oil represents a smaller share in total energy supply for the United States than is the case for either Europe or Japan. In addition, U.S. oil import dependence is less than for the other two

areas. Finally, the U.S. energy resource base is far more favorable than that of either region.

(d) Soviet producing fields are in decline and new potential producing areas are located in harsh physical environments, far from markets in European Russia and Eastern Europe. The Soviets, relying on their own capabilities, will be able to develop the East Siberian fields but the process will be a long one. Western assistance at some later date cannot be ruled out but the longer it takes to get agreement the less impact Western assistance may have. East Siberian oil might not make any significant contribution to Soviet oil supplies before 1985 and 1990 may be a more realistic date. At that time, Siberian oil may only compensate for the exhaustion of the older fields.

The period 1976–85, will see the Soviets hard pressed to fulfill the traditional goals of Soviet oil policy; additional oil supply for the conversion of the Soviet domestic economy to oil; oil supply sufficient to meet some percentage of East Europe's oil requirements; and, oil supply sufficient to provide Soviet oil exports to Western Europe.

It will become increasingly difficult for the Soviets to strike an acceptable balance among these goals. Some slowdown in the conversion to oil may be anticipated. Alternatively, the Soviets could prefer to seek additional oil from the Middle East. In Eastern Europe, the Soviets will be loathe to relinquish the control that the role of primary oil supplier provides, but it is anticipated that the Soviets will continue to encourage East Europe to look to the Middle East oil market. The Soviets are pledged to provide 67 percent of East European oil needs, a decline from the recent 90 percent policy. Some leveling of exports to Western Europe is likely, particularly as higher prices mean equivalent income from reduced quantities of exports. Also, the Soviets will attempt to shift exports from crude to refined products.

Interestingly, the Soviet Union is believed to contain vast undiscovered reserves of oil. In the post-1990 period then, the Soviets may well regain their position of overall energy independence. However, well before that date, Comecon as a bloc will be in deficit and Comecon countries, including the U.S.S.R., will be factors in the Middle East oil market. The point must be emphasized that Soviet shortages in oil will be due not to the depletion of their oil resource base—however much individual fields may decline—but to their anticipated difficulty in exploiting reserves in timely fashion.

Given rapidly expanding Soviet domestic and East European oil demand and higher oil prices, Soviet exports to the West will be maintained at some level unlikely to exceed current volumes of oil exports destined for Western Europe (320 million barrels in 1975). Oil exports to Japan might increase. With regard to Western Europe, Soviet exports represent a diversification of supply but it is unlikely that the volume of Soviet exports will be critical; something less than 1 million b/d appears likely. Soviet oil exports will not attain a level which would give the Russians a capacity for engaging in economic blackmail. To do so, the Soviets would have to have the ability to bring at least some Middle East producers along with them in such an undertaking. Neither Western Europe nor Japan will substitute future dependence on Russian supplies for current dependence on Middle East oil. One million b/d will not give the Soviets any leverage and even this level of exports is in question.

It is also not anticipated that Russian oil will be viewed as competition by the Middle East states. That is, strains between LDC oil

exporters and the U.S.S.R. based on competition for Western markets will not develop as Russian exports level off and the oil supply/demand situation becomes tighter in the mid-1980's.

Development of indigenous alternatives, substitution, conservation, and reduced oil demand will not eliminate dependence on imported energy resources—particularly for Europe and Japan. The energy mix may change somewhat, but it is clear that dependence on imported energy sources, beyond, but including oil, will be a fact of life for the industrialized states. In addition, Comecon will also be in the competition for Middle East oil supplies.

## IV. IMPORTANCE OF OPEC OIL

Given the oil-import dependence of the industrialized countries and the rejection by all forecasters of the possibility of any huge discoveries in the period to 1985, or even their development if such discoveries did occur, dependence on imported oil is tantamount to dependence on OPEC oil, in general, and OAPEC oil, in particular.

The North Slope of Alaska and the North Sea, discovered in the late 1960's and the early 1970's, respectively, were the first major discoveries in several decades of exploration; they were also the only ones (unless the optimistic predictions for Mexico's Reforma field are validated). Moreover, in today's energy-hungry world, major finds on the order of the North Sea or Alaska are not sufficiently large to challenge the dominant position of the Middle East. Since 1960, discoveries outside the Middle East have added less to reserves than production has subtracted. It would take the discovery of several staggeringly large fields before the role of the Middle East could be challenged.

The forecasts suggest that OPEC's contribution to world oil supply in 1985 will range from 55–64 percent. The Middle East and North Africa represent 43–54 percent of oil supply in 1985. Beyond 1985, in the absence of immense discoveries, only the Persian Gulf states will have spare producing capacity and the importance of Saudi Arabia will be overwhelming.

All forecasts point to the development of a tight oil supply/demand situation in the mid-1980's. If, as seems likely, the forecasts have understated the importance of oil in energy supply, the tight market may develop sooner than expected. Moreover, the implication of a tight supply/demand situation, given the assumption that significant alternatives will not make a major contribution to energy supply by 1985, and probably only in 1990, is that competition for Middle East oil will be increasingly intense. Not only will the competition pit the United States against its traditional allies in Europe and Japan, but the Comecon countries, including the U.S.S.R., may join the competition.

## V. SUMMARY

(a) Oil will continue to provide the major portion of total energy supply certainly through 1985 and probably into the 1990's.

(b) The industrialized countries will remain dependent on oil imports to meet the lion's share of oil demand.

(c) Dependence on imports, given little likelihood of major new oil discoveries, is equal to dependence on OPEC oil—particularly Middle East and North African oil.

(d) Energy import dependence is an inescapable fact of life for Europe, Japan, and the United States; even assuming that natural gas and nuclear energy play larger roles in energy supply; natural gas, uranium, and possibly enriched uranium will also have to be imported.

(e) Most countries, worldwide, will encourage exploration and development of indigenous resources. It is unlikely that autarky will be achieved for many states but any success could reduce the volume and cost of imported oil, and will therefore be a major national economic and, sometimes, strategic objective. Nevertheless, a greater use of domestic oil would also delay the shift to other forms of energy.

(f) Particular stress must be given to the complexity of and interrelationship between all steps in energy development and supply. Delays or inadequacies in providing any part of the infrastructure will affect the whole. Thus the large scale on which these undertakings are required may lie beyond the experience and capability of great private enterprises. The presence of Government has come to be an essential but by no means always a beneficial or efficient factor.

(g) The period 1977–85 may seem to offer an improved supply/demand situation as North Slope oil comes onstream, North Sea oil becomes available in quantity and spare producing capacity exists in the Middle East. However, if the forecasts underestimate oil's continued importance, shortages could develop even in this early period.

(h) Beyond 1985, the oil supply/demand situation is tight, resulting in increased competition for oil from the only area likely to have spare producing capacity at that time—the Persian Gulf States and particularly Saudi Arabia. A tight supply/demand situation shifts the balance of bargaining power to producers, in the absence of any mitigating or countervailing factors.

(i) The tight oil supply/demand situation and the inevitable lags in the development of alternatves means that sporadic supply difficulties—based either on genuine or politically contrived shortages—may be typical of the remainder of the century.

## B. Reserves

### I. CONCENTRATION OF RESERVES

In 1975, the Middle East and Africa accounted for 69 percent of total world proved crude oil reserves (77 percent of Free World proved reserves); Middle East and African consumption however, represented only 5 percent of world consumption. OPEC reserves constituted 68 percent of total world proved reserves (76 percent of Free World), while the narrower, all-Arab OAPEC held 54 percent (60 percent Free World). At the same time, North America, Western Europe (and Japan without any) held only 12 percent of world reserves but all three areas accounted for 65 percent of world consumption (1975).

It is extremely unlikely that this pattern will change significantly. Instead, the trend will be toward the increasing concentration of reserves in fewer and fewer states—specifically, the Persian Gulf states—as consuming states produce at capacity levels exceeding additions to reserves. It is not anticipated that additions to oil reserves located in the industrialized countries will exceed the growth in oil consumption. Accelerated exploration, enhanced recovery techniques, conservation efforts, and slower growth in oil consumption will not

prevent a decline in the reserves-to-production ratio. Moreover, given the long leadtimes between discovery, development and full production, additions to reserves now might not make a contribution to oil supply until the first years of the next decade at the earliest.

## II. RESERVE CATEGORIES

With higher oil prices, it has become fashionable to go beyond the sphere of proved reserves to talk about additional reserve categories which, at higher prices, may be economic.

Proved reserves, according to the American Petroleum Institute, represent those "quantities of crude oil in the ground which geological and engineering data demonstrate with reasonable certainty to be recoverable from known reservoirs under existing economic and technical operating conditions."

Typically the rate of recovery from a functioning field is low—perhaps 30 to 40 percent on average [1]—and additional oil is available only with the use of enhanced recovery techniques. Moreover, it is typical that in the course of developing a field, reserve estimates will be altered as a clearer picture of the field's characteristics emerges. Oil potentially recoverable from existing fields in the form of extensions to the perceived size of the field or through secondary and tertiary recovery is designated probable reserves.

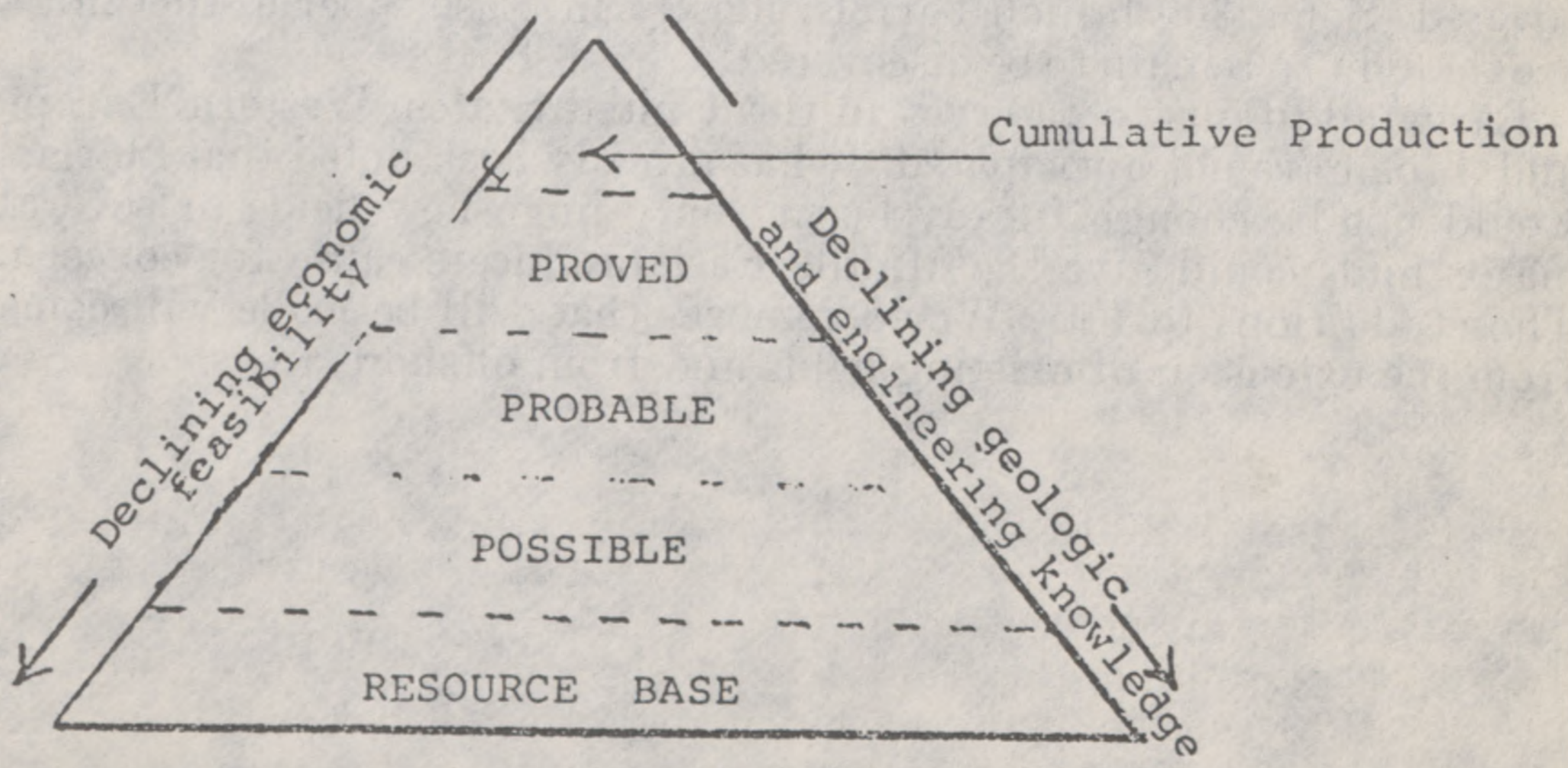
Proven reserves plus probable reserves equal total discovered reserves.

It is also possible to estimate undiscovered reserves through geological inference or the use of other sophisticated techniques. Undiscovered reserves are called possible reserves reflecting somewhat less certainty as to their existence and size.

Combining discovered and undiscovered reserves and assuming a recovery factor of 40 percent provides a figure for ultimately recoverable reserves.

The total oil resource base is merely a measure of the total amount of oil believed to be in the earth leaving aside the question of the economic and technical feasibility of recovery.

Graphically, the reserve categories are related as follows:




[1] With 20 percent as a minimum.

The suggestion is often made that at higher prices, probable reserves should become economic and exploration for undiscovered oil should intensify. In the presence of an hospitable investment climate this may actually occur, but it says nothing about the constraints imposed by deficient geological/engineering knowledge, heavy capital investment requirements, availability of necessary equipment and environmental considerations. In addition, the price will have to be high enough and increased price will have to be reflected in the market (that is, free of government price controls). Finally, and most crucially, the oil must actually be there to be found and developed.

This is not to suggest that the move toward developing probable reserves and accelerated exploration will not take place; rather the suggestion is that the progression will never be as smooth, as rapid, or as cost free as a diagram might indicate.

### III. ULTIMATELY RECOVERABLE RESERVES

World total recoverable reserves of 2 trillion barrels are believed to exist; 55 percent or 1.1 trillion barrels have already been discovered. The addition of probable reserves to proven reserves does not alter the concentration of oil resources noted earlier. Of the 1.1 trillion barrels of discovered ultimately recoverable reserves (proven plus probable) some 513 billion (47 percent) are located in the Middle East.

Even the inclusion of undiscovered reserves leaves oil reserves concentrated in areas outside the industrial countries. Of the 925 billion barrels thought still to be discovered, 33 percent may be located in the Communist countries—principally the U.S.S.R. and China; 17 percent may be found in the Middle East and less than a quarter of this undiscovered reserve might be found in North America, Western Europe, and Japan combined.

Total ultimately recoverable reserves (proved plus probable plus undiscovered) in the Middle East are estimated at over 663 billion barrels. Some 513 billion have already been discovered but relatively little has been produced, leaving huge reserves for future exploitation. The largest undiscovered reserves are believed to be located in the Soviet Union and China. It is believed that out of some 478 billion barrels of recoverable reserves only about 178 billion have been discovered. Some 300 billion barrels, mostly in East Siberia, therefore, are thought to remain to be discovered.

Large additions to reserves in the United States, Western Europe and Japan are not anticipated. It has already been noted that "large" would not be enough in any event; only huge new fields or several major finds could give the Middle East producers cause for concern. Those additions to Free World reserves that will be made will come from the extension of existing fields and from offshore areas.

WORLD ESTIMATED CRUDE OIL RECOVERY, JAN. 1, 1975

[In billions of barrels]

| Region | Discovered ultimately recoverable | Expected undiscovered recoverable | Total recoverable |
|---|---|---|---|
| Russia, China, et. al | 178 | 300 | 478 |
| Ncrth America | 173 | 155 | 328 |
| United States | (157) | (85) | (242) |
| Western Europe | 27 | 57 | 84 |
| Middle East | 513 | 150 | 663 |
| Africa | 89 | 71 | 160 |
| South America | 84 | 82 | 166 |
| Far East | 41 | 90 | 131 |
| Antarctic | | 20 | 20 |
| Total | 1,105 | 925 | 2,030 |

Source: "World Oil," September 1975, p. 49 (based on article by John D. Moody and Robcrt W. Esser) in Congressional Research Service report, p. 41.

# C. Production

## I. INTRODUCTION

Reserves set an outer limit on what can be done; but reserve figures alone say little about what actually will be done. Clearly, different levels of reserves sustain different levels of production depending on demand, price, availability of logistic supports for exports, geological characteristics of the producing area, technological capability, conservation considerations and the political and economic objectives of the producing government. For example, the United States, with some 40 billion barrels of proved and probable reserves, produced some 3 billion barrels a year, while Iraq, with 35 billion barrels of proved and probable reserves produced only 820 million barrels in 1975. The essential point here is that the intensity with which any given quantity of reserves will be exploited will be determined by a host of factors—some economic and some political.

## II. PATTERN OF PRODUCTION

There is a positive correlation between reserves and production, however. Therefore, it should not be surprising to find production concentrated in areas outside the industrialized states. The Middle East accounts for 37 percent of total world production; Africa, 9 percent; Latin America—including the Caribbean—8 percent; the Far East, 4 percent; and, the Communist world, 22 percent (all 1975). Only 20 percent of total world production originates in North America and Europe and virtually zero in Japan. There is little likelihood that this pattern will be altered.

In the United States, the addition of Alaskan and offshore production will reverse the declining trend in U.S. production for the 1977–

85 period. Beyond 1985, production may well return to its declining trend, although the decline will be from the higher levels attained by then. European production will increase for the next several years as the North Sea fields are developed and brought to full production. Beyond 1985, production will level off, perhaps to 1990, before declining. In any event, just as reserve additions fall below production levels—drawing down reserves—in the same way production levels will lag behind growth in consumption and increased production will not obviate the need for substantial oil imports. With these countries producing at capacity, production in the industrialized countries may well peak and begin to decline some time after 1985. Japanese indigenous production will remain totally insignificant throughout the remainder of the century, unless offshore discoveries affect this otherwise grim outlook.

Soviet production rates of increase may slow until East Siberia is brought onstream—an event not likely before 1985, at the very earliest. At that time, Siberian production may not add much to production, but merely compensate for declines in the older fields.

The concentration of significant oil production in a small group of nations will be intensified throughout the remainder of the century. The developed countries' share in total production fell from 29 percent in 1965, to 20 percent in 1975. By contrast, Soviet-bloc production increased from 18 percent of the world total in 1965, to 22 percent in 1975. The comparable figures for the Middle East and Africa are 35 percent in 1965, and 46 percent in 1975. As production peaks in other areas and begins to decline, Middle East and African production will represent an ever-larger proportion of world production.

### III. SECONDARY AND TERTIARY RECOVERY

Very considerable reliance is now put on the additional oil to be recovered from the wider use of techniques which allow substantial increases in field exploitation. Most estimates of the percent of oil in place that can be produced from primary—unaided—recovery efforts approximates 20 percent for presently known U.S. fields. U.S. experience in these techniques is probably greater than anyone else's; hence discussion of their value is limited to the United States. Iran, and Saudi Arabia are accumulating experience.

According to one major company's assessment—and it does not differ significantly from that of other sources—of the "attainable" potential for recoverable oil in the United States, there are some 252 billion barrels with 106 billion barrels having been produced through 1974.[2] The remainder, 146 billion barrels is "available" assuming production and recovery techniques, and the economics, justify the effort. It is guessed that fully effective recovery techniques could increase the percent of recovered oil from 20 percent to a range of 37 to 47 percent; future discoveries may be exploited to some 32 percent, the lesser percent reflecting an assessment that future fields will probably lie in regions offshore or in smaller, deeper and lower quality reservoirs onshore—fields more difficult to reach and more costly to tap.

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[2] The company's forecast includes offshore to 2,000 meters' depths—farther out and in deeper waters than is usually assessed.

Thus the importance of enhanced recovery techniques is highly significant. However, what is not understood is that secondary recovery techniques—the use of water, steam, gas, chemicals pumped back into a reservoir to send oil to the well—have been successfully applied in comparatively few fields and only when the field's characteristics are fully determined and correctly employed; it is a very great skill matched to a complex and sophisticated field management endeavor. It is not a common undertaking applicable to all or even, perhaps, most fields. Moreover, for the U.S., Government price controls on "old" oil may work against further employment of secondary recovery techniques.

The vaunted tertiary recovery techniques which use more advanced technology to exploit a source still further have not really been employed outside of laboratories; their availability on any significant scale is not for another decade at least. No meaningful figure can be given for how many additional barrels can be obtained from the use of such techniques. It is *possible* that if all these techniques were successfully employed, the oil resources from *existing* U.S. fields may approach 65 billion barrels, 25 of these coming perhaps from the successful application of secondary and tertiary recovery techniques. It is not possible to estimate the percentage of recovery potential for the great majority of overseas fields.

## IV. OIL SHALE AND TAR SANDS

### *Introduction*

The quantities of oil to be found in oil shale deposits and the tar sands are believed to exceed by far current estimates of total world resources of conventional petroleum (277 billion tons). In addition, oil shale and tar sands deposits, as far as is presently known, are concentrated in the Western Hemisphere—Canada, the United States, and Venezuela. In spite of quantity and location, development of these alternative sources of oil has been slow. Moreover, in spite of the increased price of oil and the resultant relatively greater economic attractiveness of oil from shale and tar sands, it is not expected that either of these sources will make a significant contribution to world energy supply before the 1990's.

### *Oil from shale*

With regard to oil shale, the U.S. Geological Survey estimates that total worldwide shale oil resources could amount to 23 trillion tons of crude oil. However, this figure represents the total world oil shale resource base without regard to the economic and technological feasibility of production. Of the relatively available oil shale deposits, the U.S. Green River deposits may include 560 billion barrels of oil in higher grade shale (25 gallons per ton shale) and about 1,100 billion barrels in lower grade deposits yielding 15 to 25 gallons of oil per ton.

Oil from shale has been produced in Scotland, China, Australia, South Africa and the U.S.S.R. In the United States, oil has been produced from shale only in experimental runs and in one large pilot operation. Plans for two commercial-scale operations of 50,000 b/d each are in the process of implementation and were to be onstream in 1977 and 1979, respectively, Seventy-two percent of U.S. oil shale lands,

containing nearly 80 percent of potential oil, is federally owned. Recent lease sales have interested the oil industry, but the oil potential of tracts leased so far is small. Expected production from these areas by 1985 is estimated at 300,000 to 500,000 b/d, or 1 to 2 percent of total oil consumption at that time.

Given the sheer quantity of oil potentially available from oil shale deposits and their concentration in the United States, what factors inhibit the further production of oil from shale? The technology is not firmly established, and the financial incentives appear to be inadequate to stimulate more rapid R. & D. development. Of the two processes now used for producing shale oil, the process involving mining followed by surface processing is further advanced but far from proved; in situ processing has been demonstrated on even a smaller scale than the first method.

Beyond the technological limitations of oil shale development, there are also serious doubts as to the availability of mining personnel and equipment. The production of 1 million barrels a day of oil from oil shale by the surface process requires the mining of 570 million tons of oil shale annually. This approximates the annual level of U.S. coal production and when combined with anticipated growth in the coal and uranium mining industries is beyond the capacity of available labor and capital resources.

The environmental problems associated with such large-scale mining are obvious. Surface disruption, pollution from refining, and the disposal of waste rock remain unresolved impediments to further oil-from-shale development. In addition, surface processing puts extreme demands on available water resources. It is estimated that in order to develop an oil shale industry of 3 to 5 million barrels per day in the Green River area, essentially all available water in the region would have to be devoted to the shale oil industry. For all these reasons, oil from shale is not expected to make a significant contribution to energy supply before the late 1990's or the early years of the 21st century.

*Oil from the Tar Sands*

The promise of oil from tar sands is almost as great as oil from shale, but here also its commercial availability is unlikely before the late 1990's. Total resources of oil in the Canadian (Alberta) tar sands are estimated at between 280 and 560 billion barrels and further tar sand oil resources are believed to exist in the Canadian Arctic and the Cold Lake area. U.S. tar sands might contain some 28 billion barrels, almost equivalent to current estimates of proven U.S. oil reserves. Venezuela's Orinocco deposits may be the largest single source, with about 655 billion barrels of oil, one-tenth of which is recoverable with present technology. Moreover, data on tar sands are incomplete but it is clear that they represent a major part of world petroleum resources.

A commercial scale tar sands plant owned by the Great Canadian Oil Sands Co. (GCOS) has been in operation in Athabasca for a number of years. Forty-five thousand barrels of crude per day are being produced from the Athabasca tar sands. It is anticipated that production will shortly increase to 65,000 barrels of crude a day. By 1985, oil produced from tar sands is expected to total between 700,000

and 800,000 barrels per day absent any determined government support. Its prospective price per barrel—competitiveness with conventional oil—has escalated sharply in the last several years; government support or subsidization will probably be required. Shell recently canceled plans to participate in the development of the Athabasca tar sands largely because the terms demanded by the Canadian Government appeared exhorbitant. With regard to Venezuela there are serious political impediments as well as technological difficulties to tar sand development; having only recently nationalized oil company operations it will be difficult for the Government to negotiate agreements with the very same companies for development of the Orinocco tar sands.

## V. RESERVE-TO-PRODUCTION RATIO

The concept of reserves/production ratio is designed to lend insight into the longevity of oil reserves at prevailing production levels. In actual fact, production levels are not usually constant year after year and reserve estimates change as actual development reveals additional information regarding the charcteristics of the field. In addition, the utility of the concept is suspect since, to date, no government has been able or willing to define an optimum reserve/production ratio. In effect, the question, "how many years of potential production at what levels is adequate?" has never been resolved.

In 1975, the total world reserve/production ratio was 35 years.

The Congressional Research Service report, "Towards Project Interdependence: Energy in the Coming Decade," contains an interesting calculation. Given Free World oil production increases of 4 percent a year, and a 4-percent increase in oil demand per year, 844 billion barrels of recoverable reserves would be required in 1985 to maintain a reserve/production ratio of 35 years. Subtracting cumulative production through 1985, from recoverable reserves, demonstrates that 490 billion barrels would have to be added to reserves by that date. By way of comparison, total world oil production between 1918 and 1973 was just below 300 billion barrels and the rate of discovery of new oil reserves has averaged only 15 to 20 billion barrels a year since the 1940's, a figure which includes the enormous fields of the Middle East and U.S.S.R. If one excludes those reserves for reasons of security considerations, and looks only at the rate of discovery outside the Middle East and the Soviet bloc, our questionable ability to obtain sufficient reserves of greater reliability is evident: In the period 1950–73 only some 105 billion barrels of proved reserves were found or an annual rate of 4.5 billion barrels.

If Exxon forecasts of the future rate of discoveries at 15 billion barrels a year prove out, annual production will exceed discoveries by increasing amounts, drawing down reserves. On the other hand, the estimates of undiscovered reserves suggest that it is technically feasible that reserves exceeding the last 55 years of production could be added to recoverable reserves but progress is likely to be slow as additional reserves will be costly and new reserves will be located in harsh physical environments. Only a fraction of additional reserves would be located in the industrialized states in any event. In addition, the issue of timing makes it unlikely that additions to reserves will be made and developed in time to meet oil demand increases.

Recalling the tentative utility of the reserve/production ratio concept, the implication is still that in the period beyond 1985, shortages will develop, and by the turn of the century scarcity is a fact of life.

Particular countries will not approach a 35-year reserve/production ratio and will even fail to maintain their current reserve/production ratio. U.S. reserves represent 13 years of production at current levels of production. It is not anticipated that the United States will maintain this ratio; rather, a deterioration will occur as production increases with Alaska onstream and additions to reserves are slow in materializing. In Europe, the current reserve/production ratio is misleading since North Sea reserves are included while North Sea production is not completely available. The Soviets will increase production and reserves, but they may not maintain their current reserve/production ratio of 25 years.

It is not profitable to delve more deeply into the reserve/production ratio analysis. Rather, what is important is that it is unlikely that additions to reserves will be either adequate or timely enough to maintain prevailing reserve/production ratios. Moreover, the industrialized States will suffer the most rapid deterioration. Beyond 1985 Middle East spare capacity comes under pressure as alternative sources fail to make major contributions to energy supply.

## D. Consumption and Demand

The advantages of oil as a fuel source include: (1) availability in sufficient quantity at, until recently, low cost; (2) ease of transportation; and, (3) versatility and easy substitution for other energy sources. World oil consumption quintupled over the past 25 years. U.S. consumption almost tripled from 6 million b/d to 17 million b/d in the same period, while oil consumption in the Communist countries increased by a factor of 10. Japan's oil consumption was 25 times higher in 1974 than in 1950, and the same time period witnessed a fourteen-fold increase in West European oil consumption. In the past, the growth in oil consumption has exceeded the overall energy consumption growth rate (Free world energy supply grew at a rate of 5.4 percent a year in the period 1965–73, oil supply, in the same period, grew at a rate of 7.4 percent a year).

All forecasts suggest that slower economic growth will result in a slower rate of growth in energy consumption. Higher prices, in addition to slower rates of GNP growth, will result in some moderation in the oil consumption growth rate.

However, even at slower rates of economic growth and with higher oil prices, oil consumption will continue to increase and the absolute level of oil consumption will remain high and require substantial oil imports. The situation may not be as unfavorable as it might have been in the absence of slower energy growth rates and higher oil prices, but oil demand and oil-import dependence remain high.

The following table, taken from various available forecasts, suggests the demand for oil over time, the likely level of non-OPEC supply and the implied level of imports needed to balance free world demand and supply.

FREE WORLD OIL DEMAND, INDIGENOUS SUPPLY AND IMPORTS TO BALANCE

[In millions of barrels per day]

| Source | Demand | | Production [1] | | Implied imports to balance | |
|---|---|---|---|---|---|---|
| | 1980 | 1985 | 1980 | 1985 | 1980 | 1985 |
| Exxon | 59 | 64–70 | 22 | 24–30 | 37 | 40 |
| Eberstadt: | | | | | | |
| Base | 52 | 61 | 22 | 24 | 30 | 37 |
| High | 56 | 68 | 22 | 24 | 34 | 44 |
| Congressional Research Service | 56–58 | 62–68 | 23 | 28 | 33–35 | 35–40 |
| OECD: $9 case | 53 | 64 | 28 | 37 | 25 | 27 |
| Other | | 56–61 | | 22–25 | | 34–36 |

[1] Production excludes OPEC production.

Note the narrow range of difference among the forecasts. In addition, it is clear that increasing volumes of oil will be in demand requiring increasing levels of oil imports. To the extent that developments in alternative energy sources included in the forecasts fail to materialize, the volume of oil demanded will be greater than indicated above. More rapid economic growth than that assumed in the forecasts would have a similar effect.

Beyond 1985, probably nearer to 1990, oil demand growth may continue to moderate as conservation efforts take effect and alternative energy sources begin to make a contribution to total energy supply. At the same time however, oil production in the industrialized states may peak and level off or even decline suggesting a continued need for oil imports.

Oil imports will increasingly have to come from OPEC countries and more particularly, the states of the Persian Gulf. Competition for Persian Gulf oil will be intense. Even assuming that oil does come to meet a smaller percentage of the energy budget, the volume of oil required to meet the world's growing energy budget will be even greater in the future.

## E. OPEC

### I. INTRODUCTION

Producing capacity defines the limits of production at a particular point in time. On the basis of reserves alone, it seems likely that future OPEC production could meet the needs of world energy supply. The question is whether OPEC will have sufficient, installed capacity to meet that part of world demand not satisfied by production elsewhere in the world. To the extent that that capacity exists, the next question must be, what factors—economic and political—will determine actual production levels in OPEC countries?

### II. PRODUCING CAPACITY

Considerable excess producing capacity is currently available in OPEC. However, as world oil demand has begun to pickup, spare capacity is already declining.

CANADIAN, MEXICAN [MBD] AND OPEC PRODUCTION

| Country | September 1973 pre-embargo production | December 1973 embargo production | Arab December 1973 production shortfall due to cutbacks | Percent | Installed production capacity | Production October 1976 | Shut in October 1976 | Percentage shut in |
|---|---|---|---|---|---|---|---|---|
| Algeria | 1,100 | 820 | 280 | 25 | 1,000 | 1,000 | 0 | 0 |
| Iraq | 2,167 | 2,150 | 100 | 5 | 3,000 | 2,400 | 600 | 20.0 |
| Kuwait [1] | 3,520 | 2,470 | 1,190 | 31 | 3,500 | 2,660 | 840 | 24.0 |
| Libya | 2,286 | 1,770 | 590 | 26 | 2,500 | 2,100 | 400 | 16.0 |
| Qatar | 608 | 460 | 190 | 29 | 700 | 460 | 240 | 34.3 |
| Saudi Arabia [1] | 8,574 | 6,700 | 3,000 | 32 | 11,500 | 9,250 | 2,250 | 19.6 |
| U.A.E | 1,654 | 1,310 | 460 | 31 | 2,380 | 2,010 | 370 | 15.5 |
| Total, Arab OPEC | 19,909 | 15,680 | 5,910 | 27 | 24,580 | 19,880 | 4,700 | 19.1 |
| Ecuador | 210 | 220 | ---------- | | 225 | 200 | 25 | 11.1 |
| Gabon | [2] 161 | NA | ---------- | | 250 | 220 | 30 | 12.0 |
| Indonesia | 1,338 | 1,500 | ---------- | | 1,700 | 1,540 | 160 | 9.4 |
| Iran | 5,793 | 6,100 | ---------- | | 6,600 | 6,510 | 90 | 1.2 |
| Nigeria | 2,100 | 2,250 | ---------- | | 2,500 | 2,100 | 400 | 16.0 |
| Venezuela | 3,387 | 3,400 | ---------- | | 2,600 | 2,360 | 240 | 9.2 |
| Total, non-Arab OPEC | 12,989 | 13,470 | ---------- | | 13,875 | 12,930 | 945 | 6.8 |
| Total, OPEC | 32,989 | 29,150 | ---------- | | 38,455 | 32,810 | 5,645 | 14.7 |
| Canada | 1,745 | 1,800 | ---------- | | 1,800 | 1,358 | 442 | 24.6 |
| Mexico | 470 | 500 | ---------- | | 1,000 | 900 | 100 | 10.0 |
| Total, Canada and Mexico | 2,215 | 2,300 | ---------- | | 2,800 | 2,258 | 542 | 19.4 |
| Total | 35,113 | 31,450 | ---------- | | 41,255 | 35,068 | 6,187 | 15.0 |

[1] Includes one-half Neutral Zone which amounted to approximately 560 MBD in October. E.K. Bauer/P.L. Pohl, Dec. 15, 1976.
[2] Capacity.

NA–Not available.
Source: Federal Energy Administration, Washington, D.C.

In spite of the decline in spare producing capacity within OPEC, it is generally accepted that existing OPEC capacity could meet world demand for OPEC oil until 1985; only after 1985 are additions to producing capacity considered essential to meet world demand. Because of different causes which result in "spare" capacity, it may be that real "spare" is the Saudi difference between its self-imposed ceiling of 8.5 and its capacity to produce some 12 million barrels per day.

It is still speculative but it could be the case that technical limitations of Saudi fields may impose an additional restriction, namely that the Saudis, were they to wish to do so, could not within a period of 6 to 12 months actually reach the 12-million-barrel-per-day level. It is strange that we cannot be specific but expert appraisals differ widely. At the least optimistic, some argue that available spare capacity today for all of OPEC may not exceed 1.5 million barrels per day. If this is the case, then the moment for a Saudi decision, whether to increase permitted production, with or without a price increase, or a lowering of production, may be at hand. Only if the choice is for the former, could the world demand be met.

Given forecasts of free world import demand ranging from 27 to 44 million barrels per day in 1985, adequate producing capacity may exist in OPEC to meet 1985 import demand, at the lower levels of possible demand. The Persian Gulf, will represent well over 50 percent of total OPEC productive capacity in 1985, and OAPEC capacity will account for over 60 percent of 1985 OPEC productive capacity. Also note the dominant position of Saudi Arabia; Saudi capacity alone

will represent 30 to 40 percent of Gulf productive capacity in 1985. Producing capacity alone will not determine actual producing levels. Possible producing levels, given producing government economic needs and goals, are suggested below. These figures are based on indications received from statements of producing government policy; that is, Kuwait has determined to restrict production levels to 2.5 million barrels per day for conservation reasons. Venezuela has also limited production for conservation reasons. Iran and Iraq are committed to expanding production to 8 million barrels per day and 5 million barrels per day, respectively, by 1985. Other figures also reflect anticipated production figures.

POSSIBLE PRODUCTION LEVELS—MIDDLE EAST AND OTHER OPEC NATIONS, 1980 AND 1985

[Millions of barrels per day]

| | 1980 | 1985 |
|---|---|---|
| Saudi Arabia | [1] 7.9 | [1] 9–11.0 |
| Kuwait | 2.5 | 2.5 |
| Iraq | 4.0 | 5.0 |
| UAE | 2.5 | 3.0 |
| Qatar | .5 | .5 |
| Iran | 8.0 | 8.0 |
| Persian Gulf | 24.5–26.5 | 28–30.0 |
| Libya | 1.7 | 1.7 |
| Algeria | .7 | .7 |
| OAPEC(Iran subtracted) | 18.9–20.9 | 22.4–24.4 |
| Indonesia | 2.0 | 2.5 |
| Nigeria | 2.5 | 3.0 |
| Gabon | .3 | .3 |
| Venezuela | 2.0 | 2.0 |
| Ecuador | .7 | .7 |
| OPEC | 34–36.0 | 39–41.0 |

[1] Clearly a low range; the higher limit should probably be closer to 12 million barrels per day for 1980 and 15 million barrels per day or above by1985. (Conant).

Source: Congressional Research Service, "Towards Project Interdependence," p. 55.

Other forecasts of actual OPEC production are similar:

[Millions of barrels per day]

| | 1980 | 1985 |
|---|---|---|
| Exxon | 31–36 | 34–40 |
| OECD | 28 | 30 |
| Other | | 27–35 |

In general the trouble with the forecasts is that OPEC production is considered as a residual. In other words, Free World demand is calculated and Free World production is calculated; it is assumed that OPEC production will inevitably cover the difference. There seems to be no inherent reason why this should be the case.

Forecasts of Free World OPEC oil import requirements are presented below:

FREE WORLD OPEC OIL IMPORT REQUIREMENTS

[Millions of barrels per day]

| | 1980 | 1985 |
|---|---|---|
| Exxon | 37 | 40 |
| Eberstadt: | | |
| Base | 30 | 37 |
| High | 34 | 44 |
| Congressional Research Service | 33–35 | 34–40 |
| Other | | 34–36 |

The suggestion is that the oil demand/supply situation will be increasingly tight and moreover, there is no inherent reason why OPEC production should attain the forecast levels. Competition for available supplies will be intense and prices will rise. OPEC oil production may barely cover free world oil import requirements in 1985. In 1985, only Saudi Arabia, Kuwait, and Venezuela may have spare capacity. Beyond 1985, decreases in oil demand attributable to greater contributions from alternative energy sources and higher prices may not be adequate or timely enough to prevent serious shortages.

Indeed, the possibility of shortages begins in 1980 and merely becomes more acute by 1985. Beyond 1985, world oil production may peak and serious shortages can be averted only with the timely contributions of alternative energy sources.

## III. DETERMINANTS OF SUPPLY

Having suggested the bare adequacy of OPEC production levels for meeting free world oil import requirements, it seems reasonable to ask: (1) What factors will encourage or discourage OPEC production at even these just adequate levels; and, (2) what factors might induce higher or lower production levels? In addition, the answer to these questions may lend some insight into future oil prices. Finally, it should be remarked that it will be a combination of economic and political factors which will determine actual OPEC production levels. In effect, given what can be done, what will be done?

Factors which assist in the determination of production levels include:

(a) *Population.*—On the assumption that countries with larger populations need higher revenues to provide some minimum of economic and social investment necessary to: (a) maintain political stability; and, (b) encourage economic development and self-sustaining economic growth, high population countries need to maximize oil revenue. While population undoubtedly has some effect on the need for oil revenues, the goals of the government provide a more direct link to revenue needs than pure population statistics. The more ambitious the government's goals regarding the future of the country, the higher the revenue needs.

(b) *Structure of the Economy.*—To the extent that ambitious government goals can be underwritten by income from various sources, the need for oil revenues may be less compelling. While it is not anticipated that any producing government will settle for less than its subjective judgment as to an equitable return for its oil, with a watchful eye on other producers, additional sources of income may permit a country to produce less oil currently so as to extend the life of its reserves. Oil as a percent of gross national product, oil as a percent of government revenue, and oil as a percent of exports will give some indication of the importance of oil in any given economy.

(c) *Development Plans.*—Government development plans, even with the recognition that, for many of the OPEC countries planned allocations are rarely actually spent, given some indication of the directions a country's leaders would like to take and the price they are willing to pay. Development plans will suggest the need for imports and hence, the income needed to pay for imports. Development plans

will suggest the possibilities or limitations on the development of other sources of revenue. Development plans then can be useful indicators of a country's future income requirements.

(d) *Oil Reserves.*—The suggestion here is that governments with lower reserves may be more cautious in their allowable levels of production. To extend the life of reserves, conservative production levels might be adopted. Presumably countries with larger reserves can produce at higher levels and still be sure of future production. By the same token a country with low reserves but considerable potential for developing alternative sources of revenue may elect to produce at higher levels to finance maximum development of promising economic sectors.

In addition, price becomes an important consideration; if prices are high, countries with low oil reserve possibilities may be better able to obtain a high rate of income from lower levels of production, freeing the government from the choice between conservation and needed revenues. The structure of the oil market will also be important. In a market with little spare capacity, and a tight oil supply/demand situation, the need for deliberate production restraint is reduced.

None of the factors are deterministic—that is, while it may seem rational to an outsider that a single factor influence production in a particular way, it is conceivable that from a different perspective the same factor suggests a different course of action. Moreover, the factors may pull in opposite directions. In effect, all the factors suggested do not necessarily point in a single, unambiguous direction. In addition, the factors are not independent of each other and a complex mix of these factors, and others, will determine actual production levels.

It is suggested here that it is precisely a complex mix of economic factors and political objectives which will determine the now famous absorptive capacity which, in turn, is supposed to determine production levels. A definition of absorptive capacity can not be separated from the goals of statesmen—from the visions leaders see with regard to the future economic and political structure and role of their nation, domestically and internationally, including the emphasis placed on military expenditures. It will never suffice to say that a particular nation can not make use of the funds generated by oil production in domestic economic development because the use of funds is tied to the horizons and images in the minds of statesmen. Additional income itself will broaden these horizons. Increased international influence will be accompanied by additional external goals, increased international responsibilities and greater opportunities for adventure.

Perhaps the greatest of these responsibilities derives from the very importance of oil, not merely to these LDC's, but to the industrialized nations as well. Production levels will also need to reflect a careful consideration of the world need for oil and the certain dependence of the free world on oil imports. The desire for maximum oil income must not overstep some invisible, but nevertheless real line where the threat of oil shortages or oil prices so high as to result in shortage because of a real inability to pay, exceeds any possible cost of action by the industrialized states against the "irresponsible" oil producers.

The issue of international responsibility is a real one. It is inconceivable that the Western world could tolerate being brought to its knees by the deliberate inaccessibility of oil. To date, even the 1973

embargo did not force the West against the proverbial wall, where the only escape would be through force of arms. A careful balancing of producers' and consumers' needs is fraught with the danger of miscalculation. But this very task of balancing is now the job of oil producers who will have to set production levels with one eye fixed on their own needs and the other glued to the needs of the major powers. To the extent that their own needs include survival of the state and the regime, the need to supply adequate oil supplies is a means of insuring the first.

Given the outlook for a tight oil supply/demand situation post-1985, it will be difficult to convince the oil importers that the oil producers are doing their best; competition and conflict are inherent in this situation.

## F. Refining

### I. INTRODUCTION

By far most of the trade in oil represents traffic in crude oil. Exports and imports of oil products are much less significant in world trade, reaffirming that most nations have opted for refining self-sufficiency. Products represent only 15 percent of total oil trade. Today, oil products account for 30 percent of U.S. oil imports, originating largely in the Caribbean, and the United States accounts for over 40 percent of world oil products trade; other industrialized states have elected a far greater degree of products self-sufficiency. The last full year of data make this point:

IMPORTS AND EXPORTS, 1975 [1]

[In thousands of barrels daily]

| Country/area | Imports | | Exports | |
|---|---|---|---|---|
| | Crude | Products | Crude | Products |
| United States | 4,105 | 1,920 | 5 | 205 |
| Canada | 815 | 35 | 600 | 200 |
| Latin America | 2,040 | 300 | 1,135 | 2,040 |
| Western Europe | 11,680 | 930 | 60 | 185 |
| Middle East | 140 | 110 | 17,680 | 825 |
| North Africa | 85 | 90 | 2,350 | 55 |
| West Africa | 5 | 45 | 1,960 | 15 |
| East and South Africa | 340 | 145 | ---------- | 35 |
| South Asia | 295 | 95 | ---------- | 5 |
| South East Asia | 1,155 | 410 | 1,175 | 280 |
| Japan | 4,565 | 380 | ---------- | 5 |
| Australasia | 225 | 120 | ---------- | 50 |
| U.S.S.R., Eastern Europe | 235 | 70 | 720 | 750 |
| China | | | | |
| Total | 25,685 | 4,650 | 25,685 | 4,650 |

[1] Includes quantities in transit, transit losses, minor movements not otherwise shown, military use, etc.

Source: British Petroleum, "Statistical Review of the World Oil Industry," 1975.

Typically refining facilities have been located close to markets rather than at the source of production, minimizing the need for specialized products tankers. With the development of extensive refining capacity, consuming governments captured the value added and some countries even offset the price of crude imports with products exports. Most recently developing countries in general, and oil producers in particular, have indicated their determination to capture

more of the benefits of their natural resources by insisting on local processing of raw materials. The intention is to replace crude exports with the export of the more valuable oil products. An increasing proportion of world oil trade would then reflect trade in products.

## II. DEMAND FOR REFINED PRODUCTS

Demand for refined products is concentrated in the industrialized countries. North America, Western Europe and Japan accounted for 80 percent of total free world demand for refined petroleum products in 1975 (a total of 36,025,000 barrels a day for the three areas). In the same year, South America, the Middle East, Africa, the Far East, and Oceania combined accounted for only 20 percent. Questions regarding refined products have less to do with the level or growth in demand and rather more with how that demand will be satisfied and from where.

## III. REFINING CAPACITY

Current refining capacity is concentrated in the developed countries.

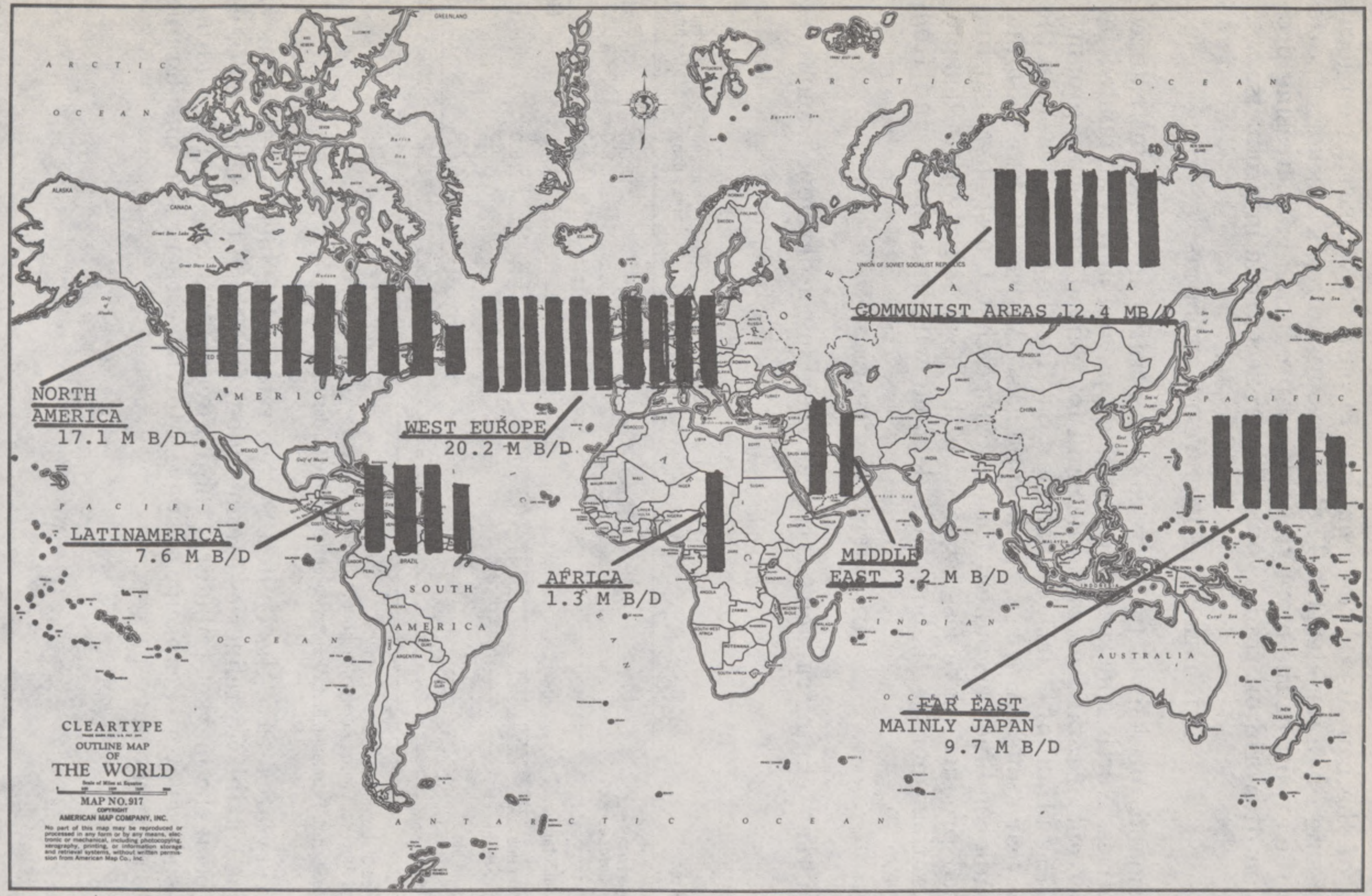
REFINING CAPACITY, 1975

| Area | Thousand barrels daily | Percent of total |
|---|---|---|
| North America [1] | 17,560 | 24 |
| Western Europe | 20,920 | 29 |
| Japan | 5,345 | 7 |
| Subtotal | 43,825 | 60 |
| Middle East | 2,800 | 4 |
| South America [2] | 7,630 | 11 |
| Far East | 4,375 | 6 |
| Africa | 1,240 | 2 |
| Sino-Soviet bloc | 12,250 | 17 |
| Total | 72,120 | 100 |

[1] United States and Canada.
[2] Latin America, Central America, and the Caribbean.

Source: British Petroleum, Statistical Review of the World Oil Industry, 1975.

Every area, save the United States, retains product self-sufficiency. If the Caribbean refineries are included, for which the United States has been the market tributary, the United States has virtual refining self-sufficiency and capacity to spare. Moreover, there is a considerable spare capacity in every area.




PREPONDERANCE OF REFINING CAPACITY OUTSIDE OPEC STATES (adapted from Int'l Petroleum Encyclopedia, 1975)

## IV. PLANS FOR EXPANSION OF OPEC REFINING FACILITIES

U.S. Government figures for Middle East refining capacity are slightly different than those reported above. A continuing problem with an analysis of this type rests in the fact that the statistics differ from source to source. However, the data are not sufficiently different, in this instance, to invalidate certain propositions.

The Federal Energy Administration estimates total Middle East refining capacity at 2.5 million barrels a day in 1974. Of this amount 900,000 barrels a day was devoted to internal demand, leaving 1.6 million barrels a day of exportable capacity. In 1978, the same study indicates that total Middle East refining capacity will be 2.8 million barrels a day, with some 1.8 million available for export. If some of the less certain refinery projects announced in the wake of the 1973 embargo should come to fruition another 1.1 million barrels a day of OPEC capacity would be available in 1978. The FEA used a utilization factor of 93 percent which appears appropriate given the relative ease with which the oil producers could compel the purchase of oil products. In terms of 1973 demand for refined products, 2.8 million barrels a day represents only 6 percent of total free world demand; 2.8 million barrels a day also represents only 4 percent of 1975 total world refining capacity. However, it represents 60 percent of world trade in oil products in 1975. Moreover, between 1972 and 1973, free world demand for refined products increased by some 3.4 million barrels a day, or about 8 percent; OPEC capacity of 2.8 million barrels a day would have accounted for over 80 percent of that growth. Excess capacity in the West will become increasingly burdensome and there is the possibility that some refining capacity in the industrialized countries will become redundant. In addition, world trade in oil products is in for a period of rapid growth.

Further extension of OPEC refining capacity could add some 1.2 million barrels a day between 1978 and 1980 and another 4.6 million barrels a day by 1985. It is doubtful that these levels will actually be achieved. The OPEC countries have been slow in getting underway with the grandiose refinery projects proposed in the euphoria caused by higher oil prices in 1973. The absolute number may be wrong, it may take longer than currently anticipated to bring these projects to fruition, but the trend appears certain.

The special security implications of increasing product dependence, compared with crude is evident; a crude shortfall may be compensated by drawing on other seources. A product shortfall may have no comparable alternative source depending on OPEC states' policies which may require use of their refineries or the extent to which there is adequate surplus capacity in export refineries, located elsewhere to meet the shortage. Moreover, product shipments generally require specialized tankers which make up a small share of the world's fleet; there may not be enough to provide product supply from refinery locations more distant than the original refineries whose shortfall caused the difficulty.

## G. The World Tanker Fleet and the Logistics of Supply

### I. INTRODUCTION

The free world tanker fleet bears the major responsibility for the efficient transport of oil from producing areas to the consuming centers. Of the 25.7 million barrels a day of crude oil and the 4.7 million barrels a day of petroleum products traded internationally (representing 67 percent of free world oil consumption), approximately 95 percent was moved, at some point, by tanker. The adequacy, ownership and control of the fleet are, therefore, essential elements in the geopolitics of energy.

The adequacy of the fleet refers to the capacity to move oil in the required amounts. In addition, the fleet can be assessed in terms of its ability to transport other energy sources which, though of comparatively little importance currently, may become important in world trade in the future. Finally, adequacy may also be evaluated in terms of the capacity to serve particular destinations; adequacy presupposes some flexibility to deal with possible unforeseen developments requiring logistical changes or rearrangements.

Central to the questions of ownership and control is the avowed intention of the petroleum exporting countries to enter the transportation phase of the oil industry, and the consequences of such a change should it actually materialize. The magnitude of producer participation will be important as will be the sectors in which they elect to concentrate their activities.

A second consideration deriving from the possible shift of ownership of the tanker fleet to the oil exporting countries relates to the importance Western governments traditionally have placed on maintaining national shipping and shipbuilding capabilities. Because oil trade represents such a commanding position in world maritime trade (49 percent in 1975), developments in oil transport have important implications for the viability of national shipping industries.

Beyond concern with the tank ship fleet per se, but intimately related to the logistics of supply, is the question of the security of the sea lanes against limited war attacks and in general engagements. Concern with the security of existing routes should be supplemented with an appraisal of possible alternative routes and the implications for: (1) the defense of alternative routes, and, (2) the speedy delivery of oil in the event that the use of alternatives is necessary. In addition, the potential for U.S. interdiction of foreign supplies to third parties is of interest.

Finally, the security and defense of port and terminal facilities in both producing and consuming areas are of strategic importance. Port and terminal facilities could also be assessed in terms of their adequacy, that is, their ability to process exports and imports in quantities sufficient to meet national requirements.

Analysis will focus on these four areas:

(1) Adequacy of the tank ship fleet;
(2) Ownership and control of the fleet;
(3) Security of the sea lanes; and
(4) Adequacy and security of port and terminal facilities.

## II. ADEQUACY OF THE FLEET

The current tanker situation is one of very large excess capacity. In the depressed market conditions of 1975, surplus capacity, which was becoming a problem in 1971, burgeoned to 114 million deadweight tons (DWT)—or about 40 percent of available capacity. By the end of 1976, it is estimated [3] that surplus capacity could reach 150 million DWT.

At the end of 1975, the world tank ship fleet totaled 291 million DWT. In spite of declining oil demand and cancellations of orders for a number of new ships, the fleet expanded by 35 million DWT in 1975. The total order book at the end of 1975 comprised 610 tankers of 88.5 million DWT. Of these, tankers with an aggregate deadweight tonnage of over 50 million are due for delivery in 1976, and a further 26 million DWT are to be delivered in 1977. The 1977 world tanker fleet would then equal 367 million DWT, with no scrapping.

The adequacy of the fleet can be assessed only in relation to the quantities and types of commodities that the fleet will be called upon to carry and the destinations it will be called upon to serve. But the seriousness of the surplus capacity situation can be demonstrated by an example.

If free world oil demand of between 61–68 million barrels a day in 1985 is assumed (see Oil, 1976–2000) and assuming further that 60 percent of free world consumption flows in world trade, the tanker fleet would have to move between 43 and 48 million barrels a day, requiring a capacity of 172 to 192 million DWT. Under the worst possible conditions (which are extremely unlikely), that is, no new buildings beyond 1977 and the retirement of all tonnage built prior to 1971 (which then will be 15 years old in 1985), the tanker fleet would still total 231 million DWT in 1985, more than adequate to meet world oil trade needs.

Longer term, a narrowing of the surplus is possible. On the demand side, forecasts may well prove to be too low. Deepening U.S. involvement in the long-haul market will also result in greater tanker demand. On the supply side, new construction will increase but at a reduced rate; high replacement costs (combined with low freight rates) do not encourage new ships. High replacement costs also discourage scrapping, but the pressure for accelerated scrapping is inherent in the surplus capacity situation. Higher than anticipated oil demand, the beginning of exploitation of new reserves, reduced new construction and increased scrapping could reduce the surplus.

To the extent that oil producers enter the transport business through new construction rather than through the purchase of existing ships, the trend toward reducing the surplus will be slowed, but not reversed. In addition, the continued inability of the Independent Tanker Owners' Association to reach agreement on remedial action does not augur well for reducing the surplus or stabilizing the tanker market. The familiar boom-and-bust cycle is likely to continue to characterize the tanker market but the oversupply phase will prove persistent. Post-1985, if a tanker shortage develops, increasing freight rates would exacerbate the tighter oil supply situation anticipated.

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[3] John I. Jacobs and Co., Ltd. World Tanker Fleet Review, 1975.

In the short-to-intermediate term, the important point is that constraints on crude oil supply will not originate in a shortage of tanker capacity. Rather, excess capacity, while narrowing, will persist.

The situation with regard to product tankers is far different. It has already been suggested that an increasing share of internationally traded oil will take the form of oil products rather than crude oil. A tight refining situation on the U.S. east coast and the continued expansion of refining capacity in the oil producing countries will result in increased demand for specialized products tankers. One source suggests that the demand for products tanker capacity will reach 43–73 million DWT by 1980, and may reach 90 million DWT by 1985. According to this forecast severe imbalances may develop in the late 1970's or early 1980's. In 1985, the overall shortage in products tankers may reach 63 million DWT, to be diminished only to some extent through conversions.

It has also been suggested that dependence on imports of petroleum products is potentially more serious than dependence on imported crude when refining capacity is at normal near-full utilization and it is difficult to shift rapidly from one refining source to another. To the extent that oil exporters expand their capacity in the transport area by increasing their products tanker capability the degree of producer control over products may be even more serious, that is, even if spare-refining capacity is available, the logistical element may be missing to take advantage of it.

In the absence of currently available logistic systems (pipelines, LNG tankers and processing facilities), natural gas remains very much a "local" energy source tied closely to the location of production. Given declining United States, Canadian and probably, Dutch production in the next decade and demand for large volumes of natural gas, an additional quantity of NG may find its way into international trade. Much of it, however, is expected to move via pipeline from Iran and the Soviet Union to Western Europe.

At the end of 1975, the number of LNG carriers in service was 28 (capacity 1.7 million cubic meters). New LNG vessels on order total 39, with an aggregate carrying capacity of over 4.9 million cubic meters. However, the availability of adequate LNG tanker capacity is not the only factor limiting LNG trade; there are serious technological problems inhibiting the growth of LNG trade as the Algerian experience warns, coupled to staggering increases in capital costs.

A final consideration in this discussion of the adequacy of the world tanker fleet relates to the continuing trend toward larger tankers. In 1975, 58 percent of the world tanker fleet consisted of ships of 125,000 DWT and over. Indeed ships of 205,000 DWT and over constituted 50 percent of the tanker fleet and 76 percent of the tonnage built in 1971–75. The trend toward larger ships means that economies of scale may be realized; it also may mean less flexibility in the event of necessary rearrangements in the logistics of oil supply. Increased quantities of oil can be delivered to a single location but the number of locations serviced may decline.

The tanker fleet size-mix will have strategic implications; the United States lacks the super port facilities now serving West Europe

and Japan. The only deepwater U.S. port capable of handling 150,000 DWT tankers is Long Beach, Calif., with Cherry Point, Seattle, and Los Angeles limited to 125,000 DWT. Not until the early 1980's, at present planning levels and commitments, will the United States be considered able to take economic advantage of the VLCC. The Loop and Seadock projects would then give the United States two gulf facilities capable of receiving 500,000 DWT tankers. Until then, its dependence upon the smaller and medium size ships below 60,000 DWT is extreme. These vessels are not now in surplus and a program to insure their replacement is a matter of high national priority.

In conclusion, adequate general crude oil tanker capacity seems assured for some time to come. In the area of products trade the short-term outlook is not bright but building programs could remedy the situation. Tanker availability alone however, is not a sufficient condition for expanding world LNG trade where supply constraints arise from technological and economic factors. Finally, because the tanker size-mix may have some bearing on the flexibility and adaptability of the fleet, the future size distribution of the fleet will be of strategic importance.

## III. OWNERSHIP AND CONTROL

Excess capacity has driven freight rates down. The depressed character of the tanker market results in two conflicting trends. On the one hand, tankers are available for sale at relatively low prices. On the other hand, the tanker business hardly looks inviting. In the midst of these contradictory pressures, the oil producers have repeatedly indicated their intention to assume a role in the transportation end of the international oil industry.

Data on the "effective" nationality of the world tanker fleet are extremely difficult to obtain. Instead, tankers are often registered in particular foreign countries that specialize in providing favorable tax treatment for this type of business activity. A substantial proportion of the world tank ship fleet flies under "flags of convenience," particularly Liberian, Greek, and Panamanian flags.

TABLE I.—WORLD TANKER FLEET AT END 1975 (VESSELS 10,000 DWT AND OVER)[1]

[Million dwt]

| Flag | Oil company | Private | Government and other | Total | Share of total (percent) |
|---|---|---|---|---|---|
| Liberia | 26 | 64 | 0.3 | 90 | 31 |
| Norway | | 25 | .2 | 25 | 9 |
| United Kingdom | 22 | 11 | .2 | 33 | 11 |
| Japan | 4 | 27 | | 31 | 11 |
| United States | 4 | 5 | 1.0 | 11 | 4 |
| Panama | 5 | 4 | | 9 | 3 |
| France | 9 | 4 | .1 | 13 | 4 |
| Greece | | 16 | | 16 | 6 |
| Other Western Europe | 14 | 22 | .3 | 36 | 12 |
| Other Western Hemisphere | 6 | | .2 | 6 | 2 |
| U.S.S.R., Eastern Europe, and China | | | 8.0 | 8 | 3 |
| Other Eastern Hemisphere | 5 | 7 | .2 | 13 | 4 |
| Total | 95 | 185 | 10.5 | 291 | 100 |

[1] Excluding 43,600,000 dwt of combined carriers.

Source: British Petroleum, Statistical Review of the World Oil Industry, 1975.

It is possible, however, to identify the U.S.-owned and allegedly "controlled" fleet sailing under both the U.S. flag and flags of convenience.

TABLE II.—U.S.-OWNED TANKER FLEET 1974

[Million dwt]

| Flag | Number | Million dwt | 1974 total world's (dwt) fleet | United States as a percent of total |
|---|---|---|---|---|
| United States | 306 | 10 | | |
| United Kingdom | 84 | 9 | | |
| Panama | 116 | 5 | | |
| Liberia | 411 | 36 | | |
| All other | 135 | 9 | | |
| Total | 1,052 | 69 | 255.8 | 27 |

The U.S.-share constitutes over one-quarter of the world tank fleet with a capacity for transporting some 18 million barrels of oil.

The Soviet fleet constitutes some 3 percent of the world total and has the capacity to transport 2 million barrels per day of oil. Given Soviet self-sufficiency in oil and the use of pipelines to service Soviet customers in Eastern and Western Europe, the Soviet fleet is probably more than adequate to meet current Soviet needs.

The Soviets are expanding their tanker fleet, perhaps in anticipation of domestic requirements for Middle East oil. However, Soviet intentions are unclear since the deadweight tons of the ships envisioned in the Soviet plan (300,000 deadweight tons) exceed the capacity of Soviet Black Sea and Baltic ports. Thus there is a possibility that the Soviets will enter the world tanker market for shipments between two foreign ports. It is not anticipated that Comecon tonnage seeking employment in the international tanker market will be of sufficient magnitude to affect the market structure.

Instead, it is likely that the Soviets are preparing for two things. First as has already been demonstrated, some increase in Soviet imports from the Middle East is likely and enlargement of port facilities will occur. Second, Soviet spare capacity could be used strategically to support friendly producing or consuming governments in conflicts with the Western oil companies, other tank fleet owners, or particular consuming governments. The existence of the Soviet option may be important at some point in time (as it has been in the case of Cuba).

While the Comecon fleet is firmly under government control, the same cannot be said of the Western fleet. In 1975, 33 percent of the world tanker fleet was owned directly by the oil companies. It is also likely that these same companies dominated the private charter market as well (64 percent of the fleet). Only about 4 percent of the world tanker fleet was owned by governments; excluding the Communist countries, less than 1 percent of the total free world tanker fleet was government-owned. However, ownership alone does not exhaust the potential for control. Given government subsidies to national ship builders and shippers it seems likely that the extent of government influence in the shipping industry is far from adequately reflected in the 1 percent ownership figure.

A significant element in the continued role of the private oil companies in the producing states relates precisely to their ability to man-

age the complex logistical supply system in an efficient manner. In the long term this ability may be a wasting asset but given the likelihood that development of an OPEC or OAPEC tanker capacity will be slow, this oil company role may be significant for some years to come. In fact, the oil producers may prefer to refrain from potential competition among themselves and the necessity to take hard allocative decisions by permitting the oil companies to continue to perform this function.

As increasing quantities of oil are turned over to the national oil companies for direct sales, the oil producers will both expand their own tank ship fleets and enter the tanker charter market. In spite of their declared intention to expand their participation in the world tanker fleet, the oil producing states apparently have taken relatively little advantage of depressed prices for existing tankers to enlarge their fleets. In line with what appears to be a partiality for safe investments, the producers remain cautious. Current forecasts suggest a rapid expansion of producer-owned tanker capacity, but their involvement continues to represent only a small fraction of the world fleet.

TABLE III.—OPEC COUNTRIES: TANKER FLEETS, END 1975

[Millions of dwt]

| Country | Existing | On order | Total [1] |
|---|---|---|---|
| Kuwait | 1.3 | 1.2 | 2.5 |
| Saudi Arabia | .7 | .3 | 1.0 |
| Iraq | .4 | 1.5 | 1.9 |
| Abu Dhabi | .5 | ---------- | .5 |
| Unspecified Arab [2] | ---------- | .8 | .8 |
| Iran | .7 | ---------- | .7 |
| Libya | .4 | 1.0 | 1.4 |
| Algeria | .3 | .4 | .7 |
| Venezuela | .4 | ---------- | .4 |
| OAPEC | 3.6 | 5.2 | 8.8 |
| Total | 4.7 | 5.3 | 10.0 |

[1] Does not sum due to rounding.
[2] Country of registration not yet decided.

Source: John I. Jacobs and Co., Ltd., World Tanker Fleet Review.

The total OPEC fleet represents 3 percent of the total 1975 world tank ship fleet. The OAPEC fleet constitutes 88 percent of the OPEC fleet. The OAPEC-sponsored Arab Maritime Petroleum Transport Co. (AMPTC), founded in 1973, with an authorized capital of $500 million, recently placed orders worth $240 million for the construction of four supertankers to form the nucleus of the AMPTC fleet. Even an anticipated Arab fleet of 20 million deadweight tons by the early 1980's will represent only a marginal contribution to the world tanker fleet.

However, entry in the charter market is certainly a possibility and specialization in particular sectors of transport, for example, products carriers and LNG vessels would increase the importance of the producers' fleet if in fact they move in the direction of specialization—a trend not yet certain but anticipated. Algeria, however, is concentrating on LNG carriers; by 1979, Algeria will own 10 percent of the world LNG fleet capacity. Saudi Arabia has indicated its interest in product tankers. Concentration on products tankers would also en-

hance the position of the Arab fleet, particularly as shortages are forecast in this area.

While the total capacity of the producing countries' fleet is unlikely to make more than a marginal contribution to the total capacity of the world fleet, concentration in particular areas could give this fleet economic/political importance. Producer governments could relieve themselves of the burden of world surplus capacity by requiring use of their flag/charter tankers. Preference for such tankers is an avowed objective of producer governments even though it has not yet been applied in a manner which seriously affects either the economics of supply or its security.

Traditionally, control over transportation was considered a vital link in the chain of integrated oil operations. Interestingly, in terms of producer government participation in the world tanker fleet, it seems certain that expanded investments in oil transport would raise the cost to the producers of any future embargo or purposeful supply disruption. To the extent that the oil exporting countries expand their role in the oil supply logistical system, they may increasingly share the consumers' interest in the smooth and continuous flow of oil to market.

## IV. NATIONAL SHIPPING INDUSTRIES

Decreased oil demand, excess capacity, low freight rates and the increased participation of the oil producers in the world tanker fleet have raised serious questions regarding the viability of national shipping and shipbuilding industries. To the extent that the surplus capacity situation persists, national industries will be under additional strain. Historically, governments have considered a healthy shipping industry to be a necessary element of national security policy. It is difficult to think that this attitude will change. Subsidies and national preference laws may proliferate and the potential for international conflicts among these laws will increase over time.

## V. SECURITY OF THE SEA LANES

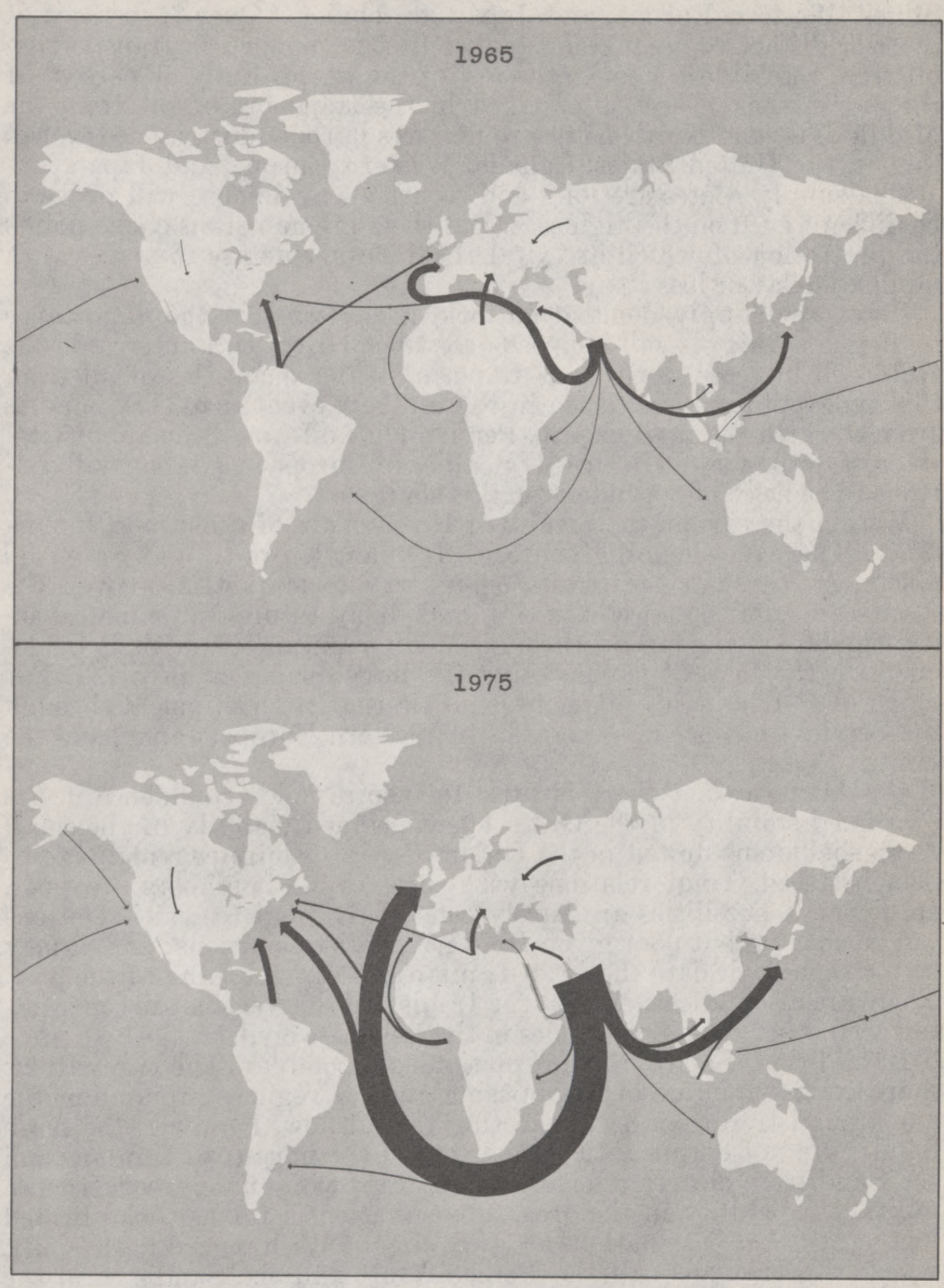
### EMPLOYMENT OF TANKERS, 1975

[Percent of world's active oceangoing fleet on main voyage]

| Voyages to— | Voyages from— United States | Caribbean | Middle East | North Africa | Others | Total |
|---|---|---|---|---|---|---|
| United States | 3 | 3.0 | 6.0 | 1.0 | 3.5 | 16.5 |
| Canada | | .5 | 3.0 | | | 3.5 |
| Other Western Hemisphere | | | 6.5 | .5 | 2.0 | 9.0 |
| Western Europe, North and West Africa | | 1.0 | 42.0 | 1.5 | 3.5 | 48.0 |
| East and South Africa and South Asia | | | 1.5 | | | 1.5 |
| Japan | | | 11.5 | .5 | 2.5 | 14.5 |
| Other Eastern Hemisphere | | .5 | 4.5 | | .5 | 5.5 |
| U.S.S.R., Eastern Europe, and China | | | 1.5 | | | 1.5 |
| Total | 3 | 5.0 | 76.5 | 3.5 | 12.0 | 100.0 |

Source: British Petroleum, Statistical Review of the World Oil Industry, 1975.

PRINCIPAL INTERNATIONAL OIL MOVEMENTS *




Exports from the Middle East region expanded rapidly as world oil consumption grew. The widths of the arrows in the maps above are proportional to the volumes of crude oil and petroleum products moved in international trade. The patterns changed significantly when the Suez Canal was closed to shipping in 1967.

* from Middle East Oil, Background Series, August, 1976, Exxon Corporation.

The importance of the sea lanes from the Middle East to the United States, Western Europe, and Japan are obvious. Over 75 percent of the world's active oceangoing tanker fleet is engaged in transporting oil from the Middle East to the rest of the world. Fully 66 percent of the world tanker fleet is engaged in the transport of oil from the Middle East and North Africa to markets in the industrialized world, that is, the United States, Canada, Western Europe, and Japan.

The supply routes are long and security and defense will prove to be difficult even on the high seas. But there are numerous choke points the protection of which are vital if oil shipments are to arrive with minimal delay or loss.

Given the supply/demand outlook, it is clear that the importance of Persian Gulf oil will increase over time. Direct U.S. interest in the Gulf will increase as the U.S. imports greater quantities of oil from this geographic source. Even in the unlikely event that U.S. imports from the area did not increase, Persian Gulf oil would remain of vital interest to the United States; U.S. allies in Europe and Japan will continue to be heavily dependent on this source.

Within the region, the Straits of Hormuz are of the utmost importance. The overwhelming share of Iranian, Kuwaiti, and Saudi oil must pass through the straits on its way to market. Moreover, the straits are vital because existing—and likely future—pipeline capacity capable of moving oil through Mediterranean terminals is inadequate to the task of transporting the huge quantities involved. For much of Persian Gulf oil there is no alternative to shipment through the Straits of Hormuz to markets in Western Europe, Japan, and the United States.

On the face of it there is little to inspire much confidence in the continued stability of the Gulf. The continued viability of the small Arab sheikdoms united in the Union of Arab Emirates remains to be demonstrated. Iraqi relations with most of its neighbors are poor. Iraqi-Saudi hostilities are barely concealed; Iraqi-Kuwaiti relations can be nothing but poor given Iraqi irredentist ambitions; and, it may be too soon to declare the Iraqi-Iranian hostilities a thing of the past. There are also indications that the Iraqis and the Syrians are confronting each other on opposite sides in the Lebanese civil war.

In addition, Saudi-Iranian relations are complex. The two nations share common interests in opposing radical regimes, upholding the monarchial tradition and protecting the oil flow. However, the Arab Saudis are not enthusiastic supporters of the non-Arab Iranians and the Saudis are clearly reluctant to see a growing, unopposed Iranian military capability in the area. The situation is further complicated by the fact that both nations are U.S. clients. With regard to the Gulf, which the Iranians call the Persian Gulf and the Saudis term the Arabian Gulf, the coincidence of certain interests should not obscure the real and basic lack of trust between the two countries.

In the event of armed hostilities, not all of these simmering conflicts imply a complete closure of the straits. If the Saudis had the capacity to send increased amounts of crude out through Tapline and/or by pipeline to a new Red Sea port, an Iranian-Saudi conflict

might see the Saudis trying to starve Iran by disrupting oil flows through the straits. Even in the absence of such alternative Saudi export routes, closure of the straits would be much more serious for Iran than for Saudi Arabia. At present the Saudis do not have the military capacity to oppose Iran in this way, while the Iranians could oppose the Saudis by barring Saudi traffic through the Gulf, perhaps in an Iranian effort to prevent possible increased Saudi oil exports from exerting downward pressure on prices.

Indeed, Iraqi-Kuwaiti, Iraqi-Saudi, or Iraqi-Iranian armed hostilities might leave the oil flow through the straits unimpaired. Yet radical regimes in the sheikdoms might allow terrorist and sabotage activities from their territories but this would surely open the way for swift Saudi or Iranian military intervention.

At second glance then, the Gulf and the straits do not appear as insecure as a first reading might suggest. Currently the states in the region reject a greater direct American military presence in the area as provocative of the very type of external interference they wish to avoid. Iran probably has the capacity to defend the straits against any equivalent power in the area not supported by large external assistance. But it is not likely the danger would come from such a source. The United States must then make the American security commitment to the Gulf so exceedingly continuous, clear and firm as to avoid any possible miscalculation by the Soviets and the Chinese, who apparently are active in the Dhofar rebellion in Oman. The U.S. defense objectives with regard to oil relate far more to European and Japanese dependence than to that of the United States. It is nevertheless of crucial importance. A related energy objective is, of course, to preclude any Soviet advances upon the oil reserves.

If the Suez Canal were to be used to transport additional quantities of crude, tankers would not thereby avoid the Straits of Hormuz. While the canal does not appear to be an attractive route today—with freight rates down and before the canal can handle larger ships—it should be recalled that the Suez Canal once handled virtually all Middle East oil shipments to European destinations. Present canal deepening and widening anticipates 53 foot depth by 1978—150,000 DWT laden or 270,000 DWT tanker in ballast—and to 67 foot depth for 270,000 DWT tankers fully laden by 1982. In the event of necessity the canal might be called upon again, particularly as its use would shorten the supply line to Western Europe. While the canal is undoubtedly far less important today than it once was, the security and defense of the canal deserve continuing attention. In turn this means a U.S. defense commitment to the Red Sea and the Mediterranean as well.

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CONCENTRATION ZONES
(INDICATIVE ONLY)
OF MARINE SUPPLY:
U.S. HEMISPHERIC -
WORLD ENERGY TRADE
AUSTRALIA
INDIA
PACIFIC OCEAN
ATLANTIC OCEAN
INDIAN OCEAN
NORTH PACIFIC OCEAN
SOUTH PACIFIC OCEAN
NORTH ATLANTIC OCEAN
SOUTH ATLANTIC OCEAN
ARCTIC OCEAN
SOUTH AMERICA
NORTH AMERICA
CENTRAL AMERICA
UNITED STATES
SOVIET SOCIALIST REPUBLICS
CANADA
BRAZIL
ARGENTINA
ALGERIA
LIBYA
SAUDI ARABIA
JAPAN
CHINA
INDIA
AUSTRALIA
ZIMBABWE
ANGOLA
MOZAMBIQUE
NIGERIA
ZAIRE
ETHIOPIA
TANZANIA
MEXICO
CUBA
VENEZUELA
COLOMBIA
PERU
CHILE
BOLIVIA
PARAGUAY
URUGUAY
Rio de Janeiro
São Paulo
Buenos Aires
Cape of Good Hope
Panama Canal
Suez Canal
Strait of Gibraltar
Strait of Malacca
Persian Gulf
Red Sea
Caribbean Sea
Mediterranean Sea
Gulf of Mexico
Hawaii
Alaska
Greenland
Iceland
Philippines
Indonesia
New Zealand
Tasman Sea
Coral Sea
South China Sea
Sea of Japan
Bering Sea
Sea of Okhotsk
Caspian Sea
Black Sea
Baltic Sea
North Sea
Hudson Bay
Gulf of St. Lawrence
Gulf of Alaska
Gulf of California
Gulf of Guinea
Gulf of Aden
Persian Gulf
Arabian Sea
Bay of Bengal
Andaman Sea
Timor Sea
Arafura Sea
Tasman Sea
Great Australian Bight
Great Barrier Reef
Great Dividing Range
Great Sandy Desert
Great Victoria Desert
Great Artesian Basin
Great Salt Lake
Great Bear Lake
Great Slave Lake
Great Lakes
Great Plains
Great Basin
Great Rift Valley
Great Wall of China
Great Hanshin Earthquake
Great Kanto Earthquake
Great Tokyo Earthquake
Great Chicago Fire
Great Depression
Great Leap Forward
Great Proletarian Cultural Revolution
Great Purge
Great Terror
Great Famine
Great Migration
Great Northern Migration
Great Southern Migration
Great Western Migration
Great Eastern Migration
Great Northern Migration
Great Southern Migration
Great Western Migration
Great Eastern Migration

Use of the canal however, does not obviate the necessity for defense of the African East, South and West Coasts. To the extent that the United States takes increasing quantities of Middle East and African oil, the very long supply lines around Africa and across the Atlantic must be kept open. The difficulty of defending such long supply lines and the "choke points" is obvious but its discussion is beyond the competence of this report. Also in terms of U.S. supply, the sealanes between Venezuela and the Caribbean refineries and the U.S. mainland must be maintained, a task possibly of great difficulty as World War II experience demonstrated. The Panama Canal is of little significance in terms of oil trade but this might not always be true—especially if Alaskan crude moves by sea to the U.S. Gulf or, in time of war if the supply route from Indonesia to the U.S. west coast was severed requiring west-bound oil traffic.

The "choke points" or "zones" of special concern are usually described as on the attached map. For U.S. supply, assuming a diminished dependence upon the Persian Gulf, supply from Alaska and the Caribbean, plus Nigeria, could be our greatest direct security concern but this would be almost irrelevant to European and Japanese concerns. The map is a reminder of the general significance to U.S. relations with NATO allies and Japan of our respective varying degrees of dependence upon Persian Gulf crude. For Japan, the Straits of Malacca, separating Malaysia and Indonesia need to be kept open. The Indian Ocean and the China Seas are also important although a longer route via the Pacific is possible.

On the other hand, U.S. interdiction possibilities, so far as it is the Soviet bloc which is the target, are currently limited on the seas. As things stand today, the Soviet Union is self-sufficient in oil and Soviet oil exports, for the most part, are transported by pipeline to Eastern Europe. In the future, tanker transport may be of increasing importance as the Soviet bloc finds itself in the Middle East oil market. Imports are likely to originate in Iraq for tanker shipment to Eastern Europe. Some Libyan oil may also find its way into the Soviet bloc market.

The growth of Soviet naval power is obviously of deepening concern. Over the past decade, the U.S.S.R. has increased its presence in the "choke points" close to the Persian Gulf in the form of naval visits, facilities and "client states", real or potential, permitting units to be located at virtually any segment of a tanker voyage from Hormuz south through the Mozambique Channel. An overt action by Soviet naval units to sink tankers opens up so many extreme consequences that such efforts would seem to be made only as a prelude to general war.

A more likely security problem would come from terriorist or revolutionary political groups who could, with comparative ease stop and sink a tanker at so many places as to make protective measures for individual tankers well-nigh impossible. Small vessels with conventional weapons could attack tankers in ballast and possibly destroy them without warning or without any message from the ship; the several total disappearances of VLCC's in recent years—while thought to be the result of internal blast—could, if repeated, have a consequence far greater than the loss of a single ship. Insurance rates would undoubtedly go to a war level; there would be an immediate

slowdown in tanker schedules and diversions. In the case of Japan, for example, or any heavily import dependent nation—a delay of a week's scheduled deliveries, in the absence of readily available crude stockpiles—could cause immediate shortages; some 30 million barrels would not have arrived. It may be the case that action by terrorist/revolutionary political groups could have an unprecedented effect.

Finally, a brief reminder of the unprecedented vulnerability of the United States, in particular, to a loss of a superport facility—such as Loop or Seadock—which could make extremely difficult and perhaps impossible the receipt of a very large share of overseas oil. Absent a proliferation of VLCC receiving terminals on all coasts, the loss of two giant discharge points could conceivably be as serious as a massive embargo launched from key producers. While defenders of the Loop and Seadock will argue that their loss would be an act of war; it may not be the case that the identity or authority of an attack will be that clearly known.

## H. "New" Oil

The continuing importance of oil in the economies of industrial nations is, as indicated earlier, assured. Neither efforts to increase coal production for domestic consumption, or for world energy trade, nor efforts to produce synthetic fuels or natural gas will significantly affect the dominance of oil. Nuclear energy will have such an effect but probably not until close to the end of the century. For the next quarter-century oil is to remain the single most important source of energy.

While the search for new oil reserves in other areas will intensify, the Persian Gulf region will remain the single most consequential source of oil entering world trade. Since the area is likely to be subject to acute pressures from states external to the region and to issues between Gulf states, its "stability" will be an ever-present question of widespread concern.

Unfortunately, stress is still placed—mainly in the United States—on the need for new but "non-OPEC" sources. The hunt will be unproductive. Whether or not a particular discovery is found in an OPEC state, or, being discovered, the country is accepted into OPEC, or the country takes advantage of OPEC pricing, may be quite irrelevant. The example set by OPEC will be quite enough so far as pricing is concerned. Moreover, danger of a sustained OPEC embargo is considered remote. OAPEC is a more likely source of action. Therefore, the search will be for oil outside the Persian Gulf.

The need for such a search is unarguable. Serious shortages anticipated beginning about 1985, which may be of mounting severity, will be reflected in the falling reserves-production ratio discussed earlier in this report. To meet "minimum" requirements, several sources warn that the world's proven reserves of oil should total at least 800 billion barrels by 1985; that is 225 billion barrels more than was on hand in 1970.

In order to avoid dependence upon the Middle East generally and thereby reduce vulnerability to interruptions, proved reserves in other areas will have to be more than doubled. The need then is for 600 billion barrels of new oil by 1985—or nearly 50 percent more oil than was found and developed since 1955. Of the 445 billion barrels actually found and developed since 1955, only 106 was discovered outside the

Middle East and Africa. (Note, also, that anticipated needs met, and to be met, in the period 1970–1985 will have consumed fully two-thirds of all the proved reserves in existence in 1970.) Does such "new oil" actually exist? No one knows.

Most petroleum (outside the Middle East fields) has been discovered in areas once thought to be barren or beyond reach. Knowledge of the geology of petroleum continues to expand. The requisite technology to extract oil grows exponentially. Many factors could explain the failure to improve upon the rate of discovery—from inadequate knowledge of geology, insufficient testings, poor appraisals, lack of corporate interest in certain regions, costs, inhospitable political conditions and plain bad luck. Each of these factors will continue to plague exploration and exploitation.

At some point in time, we may conclude there is in all probability no oil recoverable in sufficient volumes. We may be in the time when that signal is already being flown—or we may see the signal years from now or "never". All that one can prudently note is:

(1) The need for enormous new reserves is with us and the need is going to escalate further as each year passes without the requisite rate of additions to reserves. In considering 1970–1985, 6 of the years have already passed without very large finds outside the Middle East and we have nine to go until 1985.

(2) Competition for available supply will become intensified over the coming years even if huge new discoveries are made for the oil cannot immediately be brought to market nor, of course, can a field be brought quickly to its maximum production level and kept there.

In attempting to guess the location of significant resources, extreme caution is the rule. The actual amount of data available to substantiate a finding as to where prolific resources may exist can range from nearly zero to reasonably complete banks of knowledge; unfortunately, the greater part by far of offshore areas lie in the "nearly zero" category. Ultimately, it is still necessary to poke a hole, and then another. Only one example of the great range in estimates—and it is an important one for it relates to offshore undiscovered worldwide oil resources—two essentially conservative guesses: One indicates perhaps 50 billion barrels, the other, equally authoritative, refers to resources from 56 to 120 billion barrels. We are only beginning to find out which may be closer to the "truth." We won't know until the end of the century. Nevertheless, because these resources lie proximate to U.S. shores, their exploration and exploitation is generally acknowledged to be of very high priority.

Moreover, current forecasts deal very largely only with offshore regions reflecting that widespread belief, which amounts to a conviction, that great prospects lie under the oceans, not under land. Whether this is "true" or the petroleum industry is acting in these matters like sheep (as they usually do) cannot be known.

What is worth remembering is that not one of these forecasts would have been given such attention 15 years ago.

(If anything were needed to underscore the importance of a successful conclusion to the resources sovereignty/jurisdiction issues in the Law of the Sea negotiations, these offshore and basin areas should convince.)

In 1975, offshore production was a total of 357 MM tons (6.8 MMB/D) or 14 percent of the world's total production. Surprisingly, 1973–74 showed considerably larger offshore production of 503 MM tons and 463 MM tons respectively. The unexpected decline may be due to deliberate commercial policies to produce more from onshore fields, higher offshore costs, lower demand, et cetera; we cannot tell. Virtually all current offshore production comes from fields which are extensions of shore deposits. The following are widely regarded as of prime prospective interest: Arctica, north and east coasts of Latin America, the rim of the Caribbean, northeast offshore of United States of America; northwest and west Africa; both shores of Mozambique Channel; Bay of Bengal; west coast of Malaya, Surabaya Sea, west and south coasts of Australia and east China.

It is beginning to be thought that very large deposits are to be found in the comparatively small marginal basins, which received the sediments of great rivers; these are not part of shore deposits. Moreover, recent geological searches have resulted in wholly tentative observations that staggeringly large sedimentary deposits lie on the continental rises. The size of these deposits may be as much as half of all sediments deposited anywhere. Even abyssal plains show some such deposits and in midocean regions such as along the Atlantic Ridge.

None of these has been subjected to exhaustive surveys, not to speak of the essential test of drilling; none are presently being comprehensively surveyed and it may be the case that few will be given the vast expense and technological advances required. It is clearly a task which Government may have to help underwrite and, if necessary, undertake; the need to tap very large reserves is, as we have stressed, of greatest urgency. The gambles involved may lie beyond the financial resources of the industry. One of the most promising basins is in the Gulf of Mexico; "confirmed" reserves of 60 billion barrels are not unlikely; these reserves could sustain a 2.75 MMB/D production rate in 1980 and possibly 6 MMD/D in 1985; other areas needing earliest possible study and exploration lie offshore Alaska (and the Naval Petroleum Reserves).

The northwest and northeast Canadian Arctic zone may not be of highest priority but parts of offshore Greenland, the upper areas of the North Sea into the Spitsbergen Norway region could warrant whatever costs it may take to survey and explore. Middle range forecasts of exportable surplus from Norway and the United Kingdom's combined share of the North Sea could amount to 4.5 MMB/D by 1985 and 6 MMB/D by 1990.

All of these sites may not be as well endowed as the Soviet Arctic from the Barents Sea to the Bering Strait; but they are either under direct United States or industrial nations' control, or with comparatively short logistic lines. A comparable effort with Venezuela is necessary to determine the feasibility of exploiting to our maximum mutual benefit the tar sands of the Orinocco. Similarly, despite the evident political difficulties presently before us, an energy effort with Canada would seem to be of obvious priority.

Even moderate success in tapping these hemispheric sources would alter the geopolitics of oil for the United States and hence for the other industrialized countries as well. Given the long lead times involved in the exploration, development and exploitation of these areas, they are possibilities only in the long term.


GEOPOLITICS OF "INTERNAL" SUPPLY
NORTH PACIFIC OCEAN
SOUTH PACIFIC OCEAN
INDIAN OCEAN
ATLANTIC OCEAN
ARCTIC OCEAN
SOUTH ATLANTIC OCEAN
NORTH ATLANTIC OCEAN
SOVIET GEOPOLITICS
AUSTRALIA
CORAL SEA
TASMAN SEA
NEW ZEALAND
JAPAN SEA OF
OKHOTSK SEA OF
BERING SEA
SOUTH CHINA SEA
ARABIAN SEA
RED SEA
CARIBBEAN SEA
MEDITERRANEAN SEA
PACIFIC TERR. OF THE
PACIFIC (ISLANDS (U.S. Trust Terr.)
PHILIPPINES
INDIA
CHINA
MONGOLIA
SAUDI ARABIA
LIBYA
ALGERIA
CANADA
UNITED STATES
MEXICO
CENTRAL AMERICA
ARGENTINA
BRAZIL
CHILE
COLOMBIA
PERU
BOLIVIA
PARAGUAY
URUGUAY
Rio de Janeiro
São Paulo
Buenos Aires
Tropic of Cancer
Tropic of Capricorn
Equator
Arctic Circle
Greenwich
Date Line
Hawaii
Alaska
Japan
Hokkaido
Honshu
Shikoku
Kyushu
Taiwan
Formosa
Okinawa
Guam
Marshall Is.
Caroline Is.
Gilbert Is.
Solomon Is.
New Caledonia
Fiji Is.
Samoa
Tonga
Easter I.
Galapagos Is.
Juan Fernandez Is.
Tierra del Fuego
Falkland Is.
Cape Horn
Cape of Good Hope
Cape Verde Is.
Canary Is.
Azores
Bermuda
Greenland
Iceland
Newfoundland
Labrador
Hudson Bay
Baffin I.
Ellesmere I.
Victoria I.
Banks I.
Vancouver I.
Aleutian Is.
Kamchatka Pen.
Sea of Okhotsk
Sea of Japan
Yellow Sea
East China Sea
Philippine Sea
Coral Sea
Tasman Sea
Arafura Sea
Timor Sea
Java Sea
Celebes Sea
Banda Sea
Arabian Sea
Red Sea
Caspian Sea
Black Sea
Mediterranean Sea
Caribbean Sea
Gulf of Mexico
Gulf of California
Gulf of Alaska
Bering Sea
Sea of Okhotsk
Barents Sea
Norwegian Sea
Greenland Sea
Baffin Bay
Hudson Bay
Gulf of St. Lawrence
Bay of Bengal
Arabian Sea
Persian Gulf
Gulf of Aden
Gulf of Guinea
Gulf of Suez
Gulf of Aqaba
Gulf of Oman
Gulf of Thailand
Gulf of Tonkin
Strait of Malacca
Strait of Gibraltar
Strait of Magellan
Drake Passage
Cape Horn
Cape of Good Hope
Cape Agulhas
Cape Leeuwin
Cape York
Cape Howe
Cape Reinga
Cape Farewell
Cape Race
Cape Hatteras
Cape Cod
Cape Fear
Cape Canaveral
Cape Sable
Cape Blanco
Cape Mendocino
Cape Flattery
Cape Prince of Wales
Cape Dezhnev
Cape Chelyuskin
Cape Kanin Nos
Cape North
Cape Wrath
Cape Finisterre
Cape St. Vincent
Cape Bon
Cape Matapan
Cape Sounion
Cape Hatteras
Cape Lookout
Cape Fear
Cape Romain
Cape Canaveral
Cape Kennedy
Cape Sable
Cape Breton I.
Cape Race
Cape Ray
Cape Spear
Cape Chidley
Cape Dyer
Cape Farewell
Cape Walsingham
Cape Wrath
Cape Clear
Cape Finisterre
Cape St. Vincent
Cape Bon
Cape Matapan
Cape Sounion
Cape Hatteras
Cape Lookout
Cape Fear
Cape Romain
Cape Canaveral
Cape Kennedy
Cape Sable
Cape Breton I.
Cape Race
Cape Ray
Cape Spear
Cape Chidley
Cape Dyer
Cape Farewell
Cape Walsingham
Cape Wrath
Cape Clear
Cape Finisterre
Cape St. Vincent
Cape Bon
Cape Matapan
Cape Sounion

# CHAPTER III.—COAL—1976–2000

## A. Introduction

Coal is nearly always touted as the world's energy resource whose more rapid exploitation could offer the prospect of energy autarky [1] with (or even instead of) increasing application of nuclear power. An example:

> If energy consumption from all fuels were to grow at the end of the present century at the annual 5 percent rate * * * cumulative energy requirements to the end of the century * * * might amount to 400 billion tons of coal equivalent. Not only could the estimated 4.3 trillion tons of estimated recoverable coal resources meet this entire growth of energy demands, but in the year 2000, at then prevailing rates of total energy consumption, enough coal would be left in the ground to meet the entire bill for a century and a half beyond.

On a less dramatic note, coal is still considered to be the available alternative to oil imports. It is our view that coal can in no realistic assessment be such a substitute for oil imports (nor for nuclear energy). However, it is our view that substantial increases in coal production could importantly diminish U.S. continued dependence upon imported oil—and for that reason alone needs to be exploited.

Looking to the end of the century the increasing use of nuclear power—not coal—may be the key factor displacing oil in electric power generation, the most critical growth sector in U.S. national energy consumption.

## B. Coal Resources

### I. LOCATION

The figures for coal are awesome; [2] its location is largely restricted to the northern latitudes; but its present and prospective importance in world energy trade is minimal which denies geopolitical importance to its location.

For any of the great possessors of vast coal deposits—the Soviet Union, United States and China—a 50 percent recovery rate would make available an amount of energy enormously greater than the total available from their oil and gas.

Current total resource estimates for the world's coal are measured at some 10.8 trillion tons. Of this amount, some 1.4 are considered to be known reserves and 0.6 trillion tons are economically recover-

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[1] In Joseph A. Yager and Eleanor B. Steinberg, *Energy and U.S. Foreign Policy: A Report to the Energy Policy Project of the Ford Foundation.* (Bollinger Press, 1974.) Quoting Darmstadter—the entire quotation, including the "data," is profoundly misleading (p. 454).

[2] The size of coal deposits reflect Survey of Energy Resources (SER) (Appendix) definitions:

> Total Resources are the sum of known "reserves-in-place" plus "additional" or inferred reserves.
>
> Economically Recoverable Reserves are those exploitable by present techniques and conditions of price, etc., ERR will always be less than "reserves-in-place" or additional, inferred reserves.

able under contemporary price, technological methods, et cetera (SER/52).

Obviously such figures indicate orders of magnitude only. While it is thought that data on coal are more reliable than that for any other energy source, SER explains that national formulae differ and, in each case, reflect judgments as to changes in technology, transportation costs, labor costs (and availability), government subsidies, environmental factors, population changes, and the economics of competitive fuels. (For the industrial world, for example, at least at the outset, the potential of the "breeder" reactor looms very large in considering coal investments since the value of the "breeder" is seen presently to lie particularly in electric power generation.)

Nearly 90 percent of the world's total resources of coal exist in the U.S.S.R., United States, and China and most of it rests above the 30° latitude. It it, preeminently, the energy resource under the direct control of the industrial world; the amount possessed by LDC's is wholly negligible (however valuable it may still be as an indigenous energy resource for a particular LDC). The volume of coal in world energy trade is limited largely to U.S. exports (presently some 10 percent of U.S. domestic production). As a percent of energy (Btu) in world trade, coal is generally unimportant, with Japan and Canada being overwhelmingly the major importers with some 20 MM tons and 17 MM tons of imports respectively.

The magnitude of the holdings for the three coal giants totally dwarf those found anywhere else in the world; and it is extremely unlikely that discoveries elsewhere will alter the relative importance of present producers for as many decades ahead as one can hazard a guess.

The U.S.S.R. itself probably possesses 50 percent of the world's total resources with the United States having some 19 percent and China possibly claiming about 8 percent (SER/28). Europe's share of the world's total coal resources is thought to be about 5 percent. All the rest of the world is estimated to possess some 4 percent of the world's total (with Australia having half of that 4 percent, India 21 percent and the remainder spread among 40 other nations). A summary (modified SER/52) of the key coal deposits illustrates clearly the overwhelming importance of certain nations or regions:

[In megatons]

| Country or region | Reserves in place [1] | Economically recoverable |
|---|---|---|
| 1. U.S.S.R | 273, 200 | 136, 600 |
| 2. United States | 363, 562 | 181, 781 |
| 3. Europe | 319, 807 | 126, 775 |
| 4. China | 300, 000 | 80, 000 |
| 5. "Oceania" (chiefly Australia) | 74, 699 | 24, 518 |
| 6. Africa | 30, 291 | 15, 628 |
| 7. Latin America | 9, 201 | 2, 803 |

[1] Note that reserves in place rank the United States and Europe above the U.S.S.R. while the more general measure used earlier of total resources gives a clear lead to the U.S.S.R. While confusing, the reserves in place figures reflect greater knowledge of deposits and their potential exploitability than do the total resource estimates. In the fullness of time, we expect the U.S.S.R. will rank highest in all 3 categories: total resources, reserves in place, and economically recoverable.

## II. INCREASED SUPPLY

Virtually every industrial state seeks now to redress the declining share of coal in its energy balance where only 15 years ago the emphasis was on greater use of oil as a less expensive, far less labor-intensive and generally much more convenient and cleaner source of fuel.

In 1960 coal represented 47 percent of world energy consumption; by 1965, it was 38 percent and in 1970 coal declined to 31 percent; by 1980—assuming moderate success in achieving greater production and use of coal, its share in world energy consumption could be 27 percent and 22 percent in 1990. As with oil and gas, percentage declines in share of energy consumed do not imply decreased volumes produced; to the contrary, for as far ahead as one can see there will be increased amounts of coal produced. Some 400 million tons were mined in the United States in 1960; by 1990 nearly 1 billion tons could be extracted. However, it is reasonable from these figures and conservative forecasts to believe that near-energy autarky for the leading industrial states is not be found from coal. Nor will increased coal production—conservatively estimated—eliminate dependence upon oil imports.

One expert and cautious source estimates free world supplies of coal up to 1985 as follows:

[In millions of tons]

| | 1975 (estimate) | Forecasts | |
|---|---|---|---|
| | | 1980 | 1985 |
| United States | 573 | 680 | 845 |
| OECD Europe | 320 | 309 | 297 |
| Rest of OECD | 120 | 160 | 180 |
| Non-OECD | 230 | 310 | 415 |
| Total | 1,243 | 1,459 | 1,737 |

Such increases (with the exception of Europe) translated into oil barrels per day, indicate the growth in coal supplies would, by 1980, be the equivalent of about 3 million barrels per day of oil and, by 1990 represent another, additional 3.6 million barrels per day—for an estimated *total additional supply of 6.6 million barrels per day to be achieved over 10 years.* Such an increase would be no greater than the increase in Saudi production alone from 1971 to 1975. In other terms, an increase in available energy on the order of 6.6 million barrels per day in 1985 would be some 4 percent of the estimated QBtu consumption of the industrial free world.

In the case of the U.S. increased coal production, translated into oil equivalents would be about 3 million barrels per day or a possible one-third of anticipated 1985 oil imports; thus in the case of the United States, and probably it alone of all the leading industrial states of the free world, diminished supply vulnerability could result from increased coal production. For OECD Europe as a whole there is less prospect of such a role for coal with no increase in production foreseen after 1975; the reserve base is smaller and the cost is immense. The

location of coal is limited geographically to Germany and France and each chooses rather to emphasize nuclear energy.

Since the increased production for the United States is all from domestic sources, it is clearly important that this increase be achieved—a forecast increase by 1985 of 272 million tons which is far below the current "conservative" FEA projected increase of 440 million tons by 1985.

Japanese dependence on imported oil cannot be significantly diminished as a consequence of increased world production of coal. It is not thought likely that increased production will enter world trade.

The contribution of coal in the form of synthetic crude or gas, much heralded as a key factor in U.S. energy supply has been downgraded continuously. Currently, it is estimated conservatively that U.S. production of these synthetics will not exceed 1 million barrels per day by 1985 (about 2 percent of the national QBtu consumption). Twenty plants producing SNG at 250 million cubic feet per day could cost some $30 billion (1976), are said to consume some 165 megatons of coal a year (in the process using up 4 QBtu) and then contribute only some 2 QBtu to the national energy balance in the form of gas (2 Tcf per year).

The FEA (NEO–76) forecast has 1.06 Tcf from gasification plants (and an additional 1 Tcf of substitute gas from petroleum products which are normally included in the general oil category so are not a net addition to energy supply). On this scale, emphasis on synthetic natural gas from coal could be justified, possibly, only if it resulted in lower imports. If these forecasts are correct, the 2 QBtu contributed would be the equivalent of 1 million barrels per day of oil or some possible 10 percent of 1985 oil imports.

Despite its advantage for the conservation of conventional oil and national energy security, it will not be easy to increase U.S. coal production and to arrest the decline in Europe's. The problems in doing so are familiar and the questions are of greatest importance to the timely revival of a declining industry: What of the comparative attractiveness of nuclear power (especially the "breeder")? Will coal be price competitive? Or will there be long term Government subsidization? What of the availability of labor? How to capitalize the application of existing and future technological improvements in coal extraction and processing? Who is to meet the urgent and basic need for a greatly improved and extended logistics systems for coal? Will there be a modification of environmental standards? Will there be compulsory use of coal in industry and electric power generation? Nearly 3 years after the onset of the oil embargo we are not close enough to any answers to any of these questions. Hence the conservative forecast of future production levels used in this report.

Miscalculations as to the factors determining supply and demand could gravely upset coal production targets. As in the case of oil and gas, each of the factors in the above paragraph are crucial to success; their *timing* and *interlocking* aspects make success in some, but not in others, insufficient, suggesting a requirement for "synchronization" which can be met proabbly only through early and continuous U.S. Government oversight and possibly involvement on an unprecedented scale.

## CHAPTER IV.—GAS—1976–2000

### A. Introduction

Natural gas, next to oil and coal, is the third most important source of energy for the industrial world. Current, significant production and the volumes in world energy trade lie wholly within the control of the industrial world; this is not always to be the case.

In the future, very considerable amounts of NG,[1] dwarfing present, producing sources, will come preeminently from the Middle East and the U.S.S.R. with a possibility that the Arctic may yet be one of the more prolific regions. A major reason why there is no early anticipation of NG in world trade from the Middle East lies in the absence of an adequate, logistics system—especially the absence of specialized tankers, and onshore facilities to gather, reduce and, at the other end, to receive and process gas for distribution. Were such available, NG could be an important source of energy for all the industrial world—but it would also compound the security implications of still further energy dependence upon the Persian Gulf states.

However, attractive as the commercial aspects of NG are, there is a critical security issue in that NG production may be easily and simply shut down. Moreover, unlike oil with its realtive flexibility in sources, gas supply arrangements are usually considered to be limited to a particular source for reasons of technical quality, the design of processing plants and the immense capital sums which must be committed to the whole undertaking. Additionally, because of the huge costs associated with LNG, there is a close meshing of supply to demand over many years; a producer seeks to have commitments for all that is available. If one source is shut down it is not likely another source could quickly substitute.

While in the balance of this century, the importance of natural gas in world trade may not be large its significance to particular countries, or sections of a country, can be very great indeed, such as to render a sector of one's energy consumption peculiarly vulnerable to supply cutoffs. This could be true even when the volume of imported NG is a very small fraction of the total. It is for these reasons that a nation's dependence upon imported NG raises serious questions of energy security and must be under continuous review.

The Energy Resources Council policy statement on LNG imports cautions that if all LNG applications pending before the USG were approved (3 tcf), plus the .4 tcf already approved, U.S. regions importing supply could be dependent from 15 to 30 percent on overseas sources for their gas needs. The Boston region, for example, could be over 40 percent dependent on LNG imports for its gas supply. In order

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[1] Generally, NG is gas piped to its destination; LNG—liquified NG—implies the necessity to transport by tanker requiring compression of volumes, usually through reduction of temperature.

to lessen the risk, the Energy Resources Council limits LNG imports from any country to no more than 1 tcf, with a maximum of 2 tcf a year imported from all sources; 2 tcf would be about 10 percent of total NG consumption in the early 1980's.

The possibility that NG will be a major factor in world energy supply depends on as many factors as there are in the case of oil: decisions by producer and consumer nations, price levels (and "guarantees"), competitiveness, alternatives, adequate and timely investments in fields, transport and receiving terminals, technology, assurance of continuous supply, et cetera.

## B. Location

Currently, while NG may be only some 6 percent of the world's total recoverable fossil fuel resources, NG provides for nearly 19 percent of the world's production of energy. If the world experiences a 4 percent annual increase in demand for NG it could take less than 50 years to deplete the resource to a level at which 10 years of reserve might remain. Thus the NG reserve-production ratio is as consequential as it is in oil.

With declining gas production in the United States, a trend only partly and perhaps temporarily reversed by the Alaskan finds, and the gradual depletion of Groningen and North Sea fields anticipated to occur over the next several decades, the natural gas prospects are not bright for continuing to meet the free world's industrial States' natural gas requirements out of its own or nearby resources. There are increasing prospects for growing reliance upon the still very largely untapped resources of the Middle East and the U.S.S.R.

Currently, we believe the U.S.S.R. may possess nearly 36 percent of the world's total gas reserves—easily the NG giant; the Middle East may have 24 percent—between the two over half, (and Iran is usually indicated as possessing nearly half of the Middle East's gas). The North American Continent may have 14 percent and West Europe may possess 10 percent of the world's total NG. (Contrast these estimates with NG consumption and the problem of a declining ratio between reserves and production outside of the Middle East and the U.S.S.R. becomes clear: with 60 percent of the world's NG consumption, North America (meaning overwhelmingly the United States) possesses 14 percent of the reserves; West Europe consumes 13 percent but has 10 percent of the world's total of NG, the U.S.S.R. consumes 19 percent but may possess 36 percent of the total).[2]

## C. Gas In International Trade

While West Europe may be considered presently NG "self-sufficient" in the sense of meeting current demand, future provision of gas out of world trade holds large uncertainties. For example, with the United States at current rates of production, having less than 11 years' use, an early Alaskan and possibly a Canadian Arctic contribution to supply is of very considerable importance to a nation whose energy balance has gas at 30 percent. For Europe, Groningen alone supplies

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[2] Data on NG reserves suffer from the same unreliability as oil's "authoritative" estimates. Forecasts of more than a few years ahead can be taken only to be indicative of trends and orders of magnitude.

40 percent of total European supplies (NG being 13 percent of energy consumption now but rising to perhaps 19 percent by early 1980's). In both cases—Europe and the United States—whether its percent of energy consumption met by NG rises or falls, the volumetric demand for gas increases; NG represents about 18 percent of world energy today; by 1990 it may be 13 percent but its volume could increase by 25 percent. Groningen could reach its producing plateau by 1978; will the gas production from the southern North Sea decline in the next decade to be replaced by other North Sea production? Europe's growth rate in use of NG, has been nearly 30 percent per annum; inevitably, it seems as if Europe's future gas growth will be constrained in the 1980's. NG "self-sufficiency" will no longer be 94 percent (1975) but perhaps, by 1985, 75 percent. For the United States, NG (and SNG) might be only 17 Tcf—against 21 Tcf production in 1975—and with Alaska might be near 19 Tcf in 1985; but in 1985 the share of gas in U.S. energy consumption may be down to 25 percent (30 percent in 1976).

Currently, the only significant gas exporters are the Netherlands, Canada, Iran, and the U.S.S.R. In 1974 the Dutch share of NG exports was 41 percent (to West Germany, Belgium, France, and Italy). Canada's share was 23 percent (all to the United States); the U.S.S.R. exported 12 percent of NG in world trade to East Europe and to West Germany, Italy, Austria, and Finland, with Iran's share of exports at 8 percent (to the U.S.S.R.). The United States and West Germany were the largest importers taking nearly 25 percent each of NG exports, with the U.S.S.R., Belgium, and France taking some 10 percent each. LNG, in 1974, was 11 percent of world gas trade with Brunei supplying 40 percent of LNG, Libya 28 percent, Algeria 20 percent, and Alaska 11 percent. Japan took over one-half (all of Brunei and Alaska). These accounted for virtually all of the world's international gas trade, an amount which was only some 10 percent of the world's marketed production. Thus international supplies of gas remain a supplemental and only a fractionally small piece of NG consumption; international sales were two-thirds of the NG flared. Unless some very massive and relatively accessible new reserves are discovered, and/or new transport technologies developed, gas' future may be limited and possibly confined to its natural "premium markets," and no substitute for oil or coal.

Nevertheless, the significance of OPEC NG proved reserves, as potential sources, remains very considerable:

| | *Tcf* |
|---|---|
| Iran | 200 |
| Saudi Arabia | 54 |
| Iraq | 20 |
| Kuwait | 42 |
| Libya | 27 |
| U.A.E. | 12 |
| Algeria | 106 |
| Nigeria | 40 |
| Venezuela | 36 |
| Indonesia | 6 |

The probable maximum LNG exports until 1985 may have been already defined—0.4 Tcf (largely Algeria) because of the inordinate delays from bad planning and poor technology and design, renegotia-

tions, persistent uncertainties over price, U.S. regulatory delays, et cetera, and the exceptional leadtimes involved. Again, depending on its destination and particular local importance, even this fractional contribution could have security significance.

If all current projects now before the USG were approved (Nigeria, Indonesia, Iran, and U.S.S.R.) their total NG import contribution would only amount to 2 Tcf/year, by 1990. For the EEC, imports might be 2.4 Tcf/year and for Japan a similar amount, by 1990, or, cumulatively, about one-third of the NG produced in the United States last year. Once more, these international contributions to energy balances will be dwarfed by oil in world trade.

### D. The U.S.S.R.

The prospect for Soviet NG could be very bright indeed. Not only may it be able to tap for its own domestic requirements huge quantities of NG but it should have available for export—as foreign currency earners or for purposes of economic warfare—substantial amounts for Europe, the United States and Japan.

For example, by 1980, the U.S.S.R. could be producing some 12.6 Tcf/yr., importing (for convenience sake) some 0.5 Tcf/yr., exporting perhaps 1.5 Tcf/yr. to Europe—which could represent by then 10 percent of Europe's consumption. LNG exports—not before the early 1980's—could mean 0.7 Tcf/yr. from west Siberia to the U.S. east coast and, from east Siberia to Japan and the U.S. west coast an unknown but presumably important quantity; these are all "potentials" based upon scant information. There is little doubt, however, that the U.S.S.R. could and, therefore, may be among the very leading exporters of NG by the end of the next decade should they intend to be such and succeed in mastering the very real problems of priorities, investment, technology and logistics. Currently, their NG exports are to Austria and Germany (of the West) but agreements have been/may be concluded with Italy, France, Finland and Switzerland; Japan remains a possibility.

### E. Summary

The prospect for very large amounts of gas in world trade, for the next several decades at least, depends crucially on whether the reserves of the Middle East and the U.S.S.R. are available. Even if they are, the security issues raised by NG imports, will continue to pose—or ought to—serious doubts as to whether energy import dependent nations should further compound their already complex situations by NG imports from these particular sources.

# CHAPTER V.—NUCLEAR ENERGY, 1976–2000 [1]

## A. Introduction

The nuclear fission era is the next great development in energy. The ushering in of the nuclear fission era, the more extensive use of nuclear energy (in quantities sufficient to displace oil), and the degree and speed with which nuclear energy spreads to all nations need not be limited for technological reasons associated with present generation reactors. Nuclear fission technology and fabrication capabilities are now widespread in the industrial states and are, therefore, available for sale to the rest of the world.

Instead, questions of comparative and absolute costs and problems associated with the fuel cycle—including safety—will determine the rate of growth (and hence, the contribution of nuclear energy in total energy supply) and the scope (in terms of the numbers of countries participating) of the nuclear era.

The nuclear fission era, with its own set of geopolitical factors, will overlap the declining use of oil as fuel, in the closing years of this century and for decades into the next. When technical advances allow the utilization of solar energy for generating larger amounts of electricity at competitive cost, the nuclear era will, in its turn, fade. But for the purposes of this analysis, energy derived from nuclear fission is to be of increasing importance in terms of its contribution to energy supply and its rapid global spread for the remainder of the century and for some period into the next.

All this is not meant to suggest that there are no unresolved issues affecting the further development of conventional nuclear energy. Clearly, there are such issues, and the initial great hopes for an early and accelerated use of nuclear energy are now being soberly reassessed. The most recent forecasts of nuclear power expansion have been scaled down (see table 1) from past estimates. For these reasons, it is now generally believed that conventional nuclear energy can only begin to make a substantial contribution to energy supply in the late 1980's and early 1990's.

TABLE I.—PROJECTED NUCLEAR POWER GROWTH

[In gigawatts electrical]

| Country/region | 1973 OECD forecast | | | 1980 | | 1985 | | 1990 | | 2000 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1980 | 1985 | 1990 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| United States | 132 | 280 | 580 | 77 | 82 | 185 | 205 | 339 | 385 | 805 | 1,000 |
| Canada | 7 | 15 | 31 | 7 | 7 | 18 | 18 | 41 | 41 | 115 | 115 |
| European Community | 57 | 134 | 283 | 59 | 56 | 146 | 159 | 285 | 292 | 633 | 623 |
| Japan | 32 | 60 | 100 | 16 | 17 | 50 | 49 | 90 | 84 | 190 | 157 |
| Others | 35 | 78 | 146 | 31 | 32 | 64 | 99 | 100 | 202 | 215 | 585 |
| Free world | 263 | 567 | 1,068 | 190 | 194 | 463 | 530 | 855 | 1,004 | 1,958 | 2,480 |

Note: 1. Edison Electric Institute; 2. OECD/IAEA, "Uranium—Resources, Production and Demand."

[1] This section draws on :
The Atlantic Council, "Nuclear Fuels Policy."
Federal Energy Administration, "National Energy Outlook, 1976."
OECE/IAEA, "Uranium, 1973," and "Uranium Resources, Production and Demand."



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The general economic slowdown in 1975 was undoubtedly responsible for some of the deceleration in planned nuclear energy programs. But this should not obscure the fact that there are still problems relating more directly to nuclear power itself, including public opposition, that will prevent the realization of the fullest, technologically possible contribution of conventional nuclear energy to total energy supply.

Any shortfall in available nuclear energy will have to be met from increased oil imports.

The greater utilization of conventional nuclear energy seemed to receive a major boost when, in 1973, the vulnerability of the industrialized countries to oil supply disruptions become apparent. Developed countries countered, in part, with threats to accelerate the development of nuclear energy. In this way, it was argued, Western technology, reflected in the development of nuclear power, could displace oil from some of its uses and reduce dependence on imported energy sources. Today, the magnitude and actual materialization of these benefits from nuclear energy, in the intermediate term at least, are in doubt. In the past 2 years, orders for nuclear reactors have been cancelled and orders for a great many others have been delayed for up to 5 years. Currently, the United States has 58 nuclear powerplants on line. Projected plants for 1985 are now 170 according to one source; in 1974 it was anticipated that there would be 209 in 1985.

Such postponements reinforce a point made repeatedly in this report: progress in energy matters depends upon the timely taking of closely interrelated steps and this, in turn, urgently requires Government involvement and coordination in the development of adequate energy supply. In no area is this need clearer than in the nuclear field, where costs are high, the industry is not integrated—with strong possibilities for leads and lags in the complex and interrelated aspects of the nuclear fuel cycle—and the security implications are enormous.

In addition, in the absence of Government involvement, a continuation of present trends suggest a strong possibility that a scarce and precious resource—uranium—may be utilized in a manner considerably less efficient than is prudent. This will be the case if present generation reactors based on enrichment technology continue to dominate nuclear energy worldwide. Any nation whose energy development entails an inefficient use of its uranium resources has no guarantee that adequate imports will be available to it in the future, a matter to be discussed later in this chapter.

Further into the future, the refinement and commercialization of the "breeder" reactor—which, over a 20-year period, creates more fuel than it uses—and the development of nuclear fusion—based on almost limitless supplies of deuterium—represent changes still to come in the nuclear era. Moreover, these developments could largely free countries from the constraints of the geopolitics of energy. The use of the breeder reactor would result in a profound reassessment of the requirement for enriched uranium and thus of the ore itself, substantially freeing nations from the contraints of resource scarcity and the tyranny of the location of energy resources beyond their borders.

## B. Nuclear Energy as a Substitute for Oil

As presently envisaged, nuclear energy will be used overwhelmingly in the generation of electricity, progressively displacing conventional fossil fuel electricity generation. In 1975, 79 percent of electricity produced both in the United States and Europe of the Nine and 83 percent of Japanese electricity was derived from the conventional thermal sources.

The potential magnitude of the nuclear contribution to total energy supply is dependent on the growth in electricity demand. While nuclear energy could produce process heat for various industrial purposes, nuclear energy—particularly nuclear energy produced by the current light water reactor—is primarily applicable to electrical generation, leaving fossil fuels dominant in other areas—transportation, petrochemical products, et cetera. The quantity of fossil fuels used for current and possible future generation of electrical energy represents the maximum amount that might be displaced by nuclear energy, at least for as long as nuclear power is derived from large units.

Historically, growth in electricity demand has been very rapid—approximately twice the rate of increased energy consumption as a whole. In spite of recent slowdowns, which will not alter historic patterns, it is anticipated that electricity will provide an increasing portion of free world total energy supply. Currently, electricity represents 15 percent of U.S. energy consumption and 9 percent of the gross inland energy consumption of Europe of the Nine. While nuclear power may contribute no more than 14 percent of free world energy supply in 1985 and some 24 percent in 1990, electricity may represent 30 percent of Free World energy supply in 1985, and a higher proportion thereafter.

The versatility of electrical energy is widely acknowledged and it can be produced from oil, gas, coal, nuclear, hydro, geothermal and solar energy sources. However, electricity cannot now be "stored" in the general sense, is expensive to generate and transport, and its production consumes a great deal of energy (but is more efficient in end use than conventional fuels). Electricity concentrates production of pollutants in one, highly visible plant (while electricity itself is a clean energy source). Siting, environmental problems, and the financial difficulties confronting the utility companies will affect the supply of electricity, but the upward trend of electricity in total energy supply is assured.

Nuclear power will be called upon to meet not only electricity demand growth but also to compensate and replace obsolete thermal generating plants. By 1985, 26 to 30 percent of U.S. electrical generating capacity may be derived from nuclear energy; currently nuclear energy represents only 5 percent of total electrical generating capacity. In Japan, a similar proportion of electricity will be generated from nuclear powerplants by 1985. The EC member countries estimate that 45 percent of the community's electrical energy will come from nuclear sources by 1985 (compared to 6 percent at present). In Germany, 40 percent of electrical requirements will derive from nu-

clear generated electricity in 1985, in Italy, 50 percent in 1985 reaching 80 percent in the 1990's, and the comparable 1985 figure for the United Kingdom is 25 percent. In light of the recent deceleration in nuclear programs, these forecasts are probably optimistic, but they are indicative of the general trend.

In terms of potential savings of conventional energy sources, a conservative forecast of nuclear energy possibilities, suggests that nuclear power could displace 1.6 billion barrels of oil equivalent in 1980, and 3.5 billion barrels in 1985. Divided among the industrial nations, in various proportions, these figures suggest that the amounts of oil used for electricity generation, and therefore susceptible to displacement by nuclear energy are not large. In the United States, only 554 million barrels of oil a year—or 9 percent of U.S. petroleum inputs to all sectors—are used for electricity generation.

However, given the likelihood of increasing electricity demand, savings of oil, which in the absence of nuclear power would have been required for electricity generation, may be substanital. Individual nations may decide that the development of nuclear energy is worth the very high cost involved. This is particularly true if domestic uranium resources and enrichment facilities can substitute for imported oil. Thus by concentrating only on the quantity of oil displaced, the point is missed that, to the extent that nuclear energy represents an alternative domestic energy source, its value in terms of national security and freedom of action far exceeds the value implied by the oil displacement numbers alone.

## C. Energy "Independence"

The role which nuclear energy may play in reducing supply uncertainties will be limited in large measure by current issues affecting the nuclear fuel cycle.

Current nuclear technology is based primarily on the uranium fuel cycle. Uranium ore is mined, milled, and refined to produce uranium concentrates, $U_3O_8$; converted to uranium hexaflouride ($UF_6$) to provide feed for uranium enrichment. $UF_6$ is enriched to provide reactor grade uranium fuel which is then fabricated into nuclear fuel. In fabrication, enriched uranium is pelletized, encapsulated in rods and assembled into fuel elements. The fuel is then loaded into reactors and the heat of the fission process is utilized in electricity generation. Spent nuclear fuel may be reprocessed to recover the remaining fissionable uranium and plutonium. Radioactive wastes produced in the process are then permanently stored.

All aspects of this nuclear fuel cycle are interdependent, that is, developments in any particular aspect of the fuel cycle will have implications for the rest. Because the different steps are interrelated and because a large proportion of the steps are under governmental control while other steps are in the hands of private enterprise, at least in the United States, the potential for leads and lags and the development of bottlenecks is unusually great. Reactor technology is proven and commercially available. But it is not certain that all the necessary supporting functions will be available for the optimum use of uranium or in a manner which encourages the maximum development of nuclear energy.

Given very long leadtimes involved in the development of nuclear energy, it is possible to be somewhat more confident about the nuclear situation in 1985 than is true for other energy sources:

| | *Years* |
|---|---|
| From exploration to production of uranium | 8–10 |
| To open mine | 3 |
| To build mill | 2 |
| To establish a conversion plant | 4 |
| To build a fabrication plant | 5 |
| To design, construct, license, test and put a new enrichment plant into production | 8 |
| To construct and begin generation from a nuclear reactor | 7–10 |
| To construct a reprocessing plant | 10 |

## I. URANIUM ORE

Uranium reserves are believed to be very largely concentrated in four countries: the United States, Canada, Australia and South Africa (where uranium is presently a byproduct of gold mining). The cyclical nature of uranium demand to date has resulted in sporadic exploration and incomplete delineation of reserves; therefore, the usual uncertainty regarding all raw material reserves plagues uranium estimates as well. However, these four countries will continue to account for a major portion of uranium reserves and production for the next 15 years at least, and probably even longer.

TABLE II.—FREE WORLD: ESTIMATED URANIUM RESOURCES AS OF JAN. 1, 1975

[Thousand metric tons]

| | Under $15/lb $U_3O_8$ production cost | | | | $15 to $30/lb $U_3O_8$ production cost | | | |
|---|---|---|---|---|---|---|---|---|
| | Reasonably assured | Percent | Additional | Percent | Reasonably assured | Percent | Additional | Percent |
| United States | 320 | 30 | 500 | 50 | 134 | 18 | 312 | 46 |
| Canada | 144 | 13 | 324 | 32 | 22 | 3 | 95 | 14 |
| Australia | 243 | 23 | 80 | 8 | | | | |
| South Africa | 186 | 17 | 6 | | 90 | 12 | 68 | 10 |
| Subtotal | 893 | 83 | 910 | 91 | 246 | 33 | 475 | 70 |
| Other | 187 | 17 | 90 | 9 | 484 | 66 | 205 | 30 |
| Total | 1,080 | | 1,000 | | 730 | | 680 | |

Source: OECD/IAEA, "Uranium—Resources, Production and Demand."

TABLE III.—WORLD URANIUM PRODUCING CAPACITIES

[Thousand metric tons]

| | 1974 | Percent | 1975 | Percent | 1980 | Percent | 1985 | Percent |
|---|---|---|---|---|---|---|---|---|
| United States | 14 | 56 | 12 | 46 | 25 | 42 | 40 | 46 |
| Canada | 5 | 20 | 7 | 27 | 10 | 17 | 12 | 14 |
| Australia | | | | | 3 | 5 | 5 | 6 |
| South Africa | 3 | 12 | 3 | 12 | 11 | 18 | 14 | 16 |
| Subtotal | 22 | 88 | 22 | 85 | 49 | 82 | 71 | 82 |
| Others | 3 | 12 | 4 | 15 | 11 | 18 | 16 | 18 |
| Total | 25 | | 26 | | 60 | | 87 | |

In the absence of intensive uranium exploration and development activities, constraints on nuclear energy developments caused by a scarcity of low-cost uranium reserves could emerge in the early 1980's.

Moreover, because of the heavy capital investment costs involved, reactors and nuclear power stations, for which an adequate and continuous supply of fuel for 20 years of operation is not guaranteed, may simply not be built.

TABLE IV.—WORLD DEMAND FOR $U_3O_8$

[Thousand metric tons]

| | Edison Electric | | OECD/IAEA | |
|---|---|---|---|---|
| | No recycle | Recycle | High* | Low† |
| 1975 | 23 | 23 | 18 | 18 |
| 1980 | 61 | 56 | 53 | 48 |
| 1985 | 115 | 99 | 101 | 82 |
| 1990 | 191 | 153 | 168 | 130 |
| 2000 | 336 | 281 | 313 | 326 |

*Assuming no plutonium recycle.
†Assuming some constraint in electricity demand growth and plutonium recycle as from 1981.

TABLE V.—WORLD CUMULATIVE DEMAND FOR $U_3O_8$ (URANIUM CONCENTRATE)*

[Thousand metric tons]

| | No recycle | Recycle |
|---|---|---|
| 1975 | 23 | 23 |
| 1980 | 232 | 218 |
| 1985 | 687 | 619 |
| 1990 | 1,487 | 1,281 |
| 2000 | 4,226 | 3,532 |

*Tails assay 0.3 pct.; 72 pct. equilibrium capacity factor.

Source: Edison Electric as quoted in the Atlantic Council.

Comparing uranium production to world demand for uranium thus confirms the prospect of shortages as early as 1980–85. Producing capacity, even if additional reserves are discovered, could fall short of demand some time after the early 1980's if no additions are initiated immediately. Moreover, note that 1985 cumulative demand represents 18–20 percent of total uranium resources ("reasonably assured" plus "additional" at under $15 per lb and $15–$30 per lb) ; by 1990, cumulative demand will have accounted for 37–43 percent of these same reserves.

Uranium demand however, is not determined solely by the demand for nuclear energy per se, or the demand for electrical energy, although clearly these are important determinants. Recycling, as indicated in the table, could reduce uranium requirements. (There are no commercial reprocessing facilities in the United States and a decision relating to the use of mixed-oxide fuels produced in recycling has been postponed.) Reactor type and size also have a bearing on natural uranium requirements. The light water reactor (LWR), which is technologically proven and the likely dominant reactor type for the remainder of the century, uses more uranium less efficiently than some of the other existing reactor types. The type and amount of enrichment also affects demand for natural uranium and the LWR requires highly enriched uranium.

TABLE VI.—FREE WORLD: ESTIMATED NUCLEAR CAPACITY BY REACTOR TYPE

[GWe]

| | 1980 | Percent | 1985 | Percent | 1990 | Percent | 2000 | Percent |
|---|---|---|---|---|---|---|---|---|
| Light water | 170 | 88.0 | 475 | 90 | 860 | 86 | 1,842 | 75 |
| Steam-generating heavy water | | | 5 | 1 | 21 | 2 | 77 | 3 |
| Advanced gas-cooled | 6 | 3 | 6 | 1 | 6 | | 5 | |
| Candu—heavy water | 10 | 5 | 27 | 5 | 68 | 7 | 183 | 7 |
| High temperature | 1 | .5 | 8 | 1 | 30 | 7 | 136 | 5 |
| Gas-cooled, graphite-moderated | 6 | 3 | 4 | 1 | 3 | | | |
| Fast breeder | 1 | .5 | 5 | 1 | 16 | 2 | 237 | 10 |
| Total | 194 | | 530 | | 1,004 | | 2,480 | |

Source: OECD/IAEA, "Uranium—Resource, Production ,and Demand."

Further uncertainty derives from the efforts to develop and commercialize the breeder reactor. Whether the "breeder" comes into use may be a highly significant determinent of the adequacy of uranium reserves and of planned enrichment facilities. If, as some assert, European "breeder" technology is ahead of the United States, some difference in comparative uranium-supply security, may emerge—but not to any appreciable extent before the nineties. Widespread use of a "breeder" could extend the life of uranium resources by 60 years or more.

The possibilities for world trade in uranium ore do not appear to be great. Producers can be expected to satisfy domestic requirements before considering export. In addition, the value of enriched uranium is about three times the value of natural uranium. Producers therefore, are likely to delay exports until a national enrichment capability is achieved. (In the United States, imports of uranium are banned until 1977 when an incremental lifting of the import prohibition takes place.) The implications of an emphasis on exporting not the ore but the enriched fuel itself raises the same security issues that would face countries dependent upon refineries located in oil exporting nations rather than upon the latters' crude alone.

No automatic assurance of supplemental supply comes from the fact that presently no OPEC or OAPEC state is a large provider. While this is of interest, obviously, it is possible that one or two or conceivable even the three (South Africa, Australia, and Canada) could wish to employ their resource position to attain some economic or political objective. While it seems nearly inconceivable to Americans that such a combination could be raised against them, the possibility exists. There is also no necessary identity between the interest of producers and consumers and it would not take a political objective for producers to deny access to consumers except on the formers' terms.

We do not yet know enough of the location of substantial uranium reserves elsewhere but it may be the case that outside North America, and the others mentioned on the previous page, Gabon, Niger, Algeria, Pakistan, Brazil, et cetera, indicate that some possibly large reserves will be located in the LDC's.

## II. ENRICHMENT

Enrichment capacity is now a potential bottleneck in the continued development of nuclear energy. In this case, and for a time, the U.S. Government provides about 95 percent of free world enrichment capacity at three plants located in the continental United States. It is anticipated that even with the expansion of these facilities, enrichment capacity could be fully saturated in the next 10 years, suggesting that for another decade it may be the United States, through its enrichment capacity, which should continue to be greatly influential in nuclear developments. However, it is also a "wasting" asset as the Europeans and others (i.e., South Africa) are working in this area of fuel supply.

TABLE VII.—PRESENT AND PROJECTED ENRICHMENT CAPACITY

[Thousand tonnes SW per year] [1]

| | 1980 | 1985 | 1988 |
|---|---|---|---|
| United Kingdom | 0.4 | 0.4 | (0.4) |
| United States [2] | 27.7 | 44.9 | 50.8 |
| URENCO [3] | 1.0 | 10.0 | 10.0 |
| EURODIF | 6.5 | 10.8 | 10.8 |
| EURODIF II [4] | | 6.0 | 9.0 |
| UCOR (South Africa) | | | 5.0 |
| Total capcity | 35.6 | 72.1 | 86.0 |

[1] SW (separative work)—effort involved in various enrichment techniques is expressed in terms of SW units.
[2] Includes new plant of 17,200,000, tons SW per year for 1985 and 23,000,000 tons SW per year in 1988.
[3] Capacity will be increased according to requirements.
[4] Under consideration.

Source: OECD—Note that adequate enrichment capacity for 1985 and beyond is dependent on projects currently only planned.

TABLE VIII.—SEPARATIVE WORK UNITS REQUIRED

[Thousand tonnes SW, 0.25 pct tails assay]

| | Annual demand | | | |
|---|---|---|---|---|
| | High estimate | | Low estimate | |
| | Pu recycle | No pu recycle | Pu recycle | No Pu recycle |
| 1980 | 31 | 31 | 28 | 28 |
| 1985 | 58 | 65 | 51 | 57 |
| 1990 | 98 | 112 | 84 | 95 |

Source: OECD.

Required enrichment capacity is also determined by factors beyond the demand for nuclear energy. Reactor type, the availability of recycling facilities, and the tails assay (the amount of $U^{235}$ left in the depleted portion of uranium feed) of the enrichment process itself will affect the level of need for enrichment capacity.

Most recently, the U.S.S.R. has begun supplying some natural and enriched uranium to Western Europe. The Europeans also have plans for building an independent enrichment capability; the Eurodif project, (France, Italy, Belgium, Spain, and Iran), envisions the construction of an enrichment facility in France to be operating at full capacity (10.8 million SWU) in 1981. The URENCO project (the Netherlands, Germany, and the United Kingdom), is expected to attain a capacity of 10 million SWU/year by 1985. In 1985, however, the United States may still retain over 60 percent of total world enrichment capacity.

## D. Safeguards

Adequate safeguards against possible accidents in the manufacture and use of nuclear energy are of extreme importance both because of the damage and contamination resulting from a nuclear accident and because of the implications of an accident for public attitudes. In the event of a major accident, it is likely that in many countries, public reaction would be such as to delay still further the fullest potential value to be derived from the application of nuclear energy.

In addition, the danger of even more rapid nuclear weapons proliferation, as a byproduct of the use of nuclear energy, requires that adequate safeguards against such an eventuality be developed. Weapons grade fuel can be produced in the recycling process. This largely explains U.S. resistance to reprocessing; on the other hand, Europeans, in a much less favorable uranium resource position, take for granted the necessity of reprocessing.

The enrichment process itself can produce weapons grade uranium. The regional enrichment/processing centers proposed by the United States can be seen as serving two ends: first, it is an attempt to prevent fuel services from becoming manipulable and tools for the pursuit of political objectives by the country selling such services; and, second, it represents an attempt to introduce a safeguard against the diversion of enriched uranium from peaceful uses to nuclear weapons.

It is difficult to escape the conclusion that the further development of nuclear power, particularly (but certainly not exclusively) in LDC's, not many of whom will be able and willing to bear the cost of nuclear development, and the export of nuclear reactors and fuel cycle technology (which the United States will remain powerless to stop) entails significant risk of accelerating the proliferation of nuclear weapons. It is highly doubtful that the Non-Proliferation Treaty will stop any nation from pursuing its own conceptions of its national interest in this extremely sensitive area. More recent developments in the Nuclear Suppliers Club, which consists of all the major, industrialized exporters of nuclear facilities and technology, suggest a greater possibility that additional international safeguards will be agreed.

## E. Conclusions

There is a strong possibility that: (1) uranium resources will not be utilized in the most efficient manner; and, (2) the future development of nuclear energy will be impeded by bottlenecks in several phases of the nuclear fuel process. There is no inherent or technological reason why these two events must occur but in the absence of government involvement and coordination there is little likelihood that they will be avoided.

Competion for natural and enriched uranium may parody developments in oil. Europe and Japan do not escape energy import dependence via the conventional nuclear energy route. However, if enrichment capacities permit, a prudent measure for the United States and certainly for the Europeans and Japanese, involves the stockpiling of enriched fuel in a fabricated state to protect against a power breakdown if supply were severed and a nation was deprived for a long period of time.

Moreover, in spite of its associated problems of wastes and plutonium, the emplacement of breeder reactors would be another long-range necessity to obviate reliance upon foreign ore and enrichment capacity until the coming of nuclear fusion and, even further in the future, solar power.

Thus, development of nuclear energy as currently envisaged may not result in energy independence. However, with recycling, the breeder, and additional technological processes which extend the life of uranium reserves, some greater degree of independence from energy imports will develop. Eventually, fusion (based on deuterium, an element found in water) may significantly reduce the energy import dependence of the industrialized states but not before the first or second decades of the next century.

## CHAPTER VI.—IMPORT DEPENDENCE OF INDUSTRIAL STATES

The continuing, general dependence upon the Middle East is evident. Stress has been placed in earlier discussion on the varying degrees of dependence upon oil and upon the Middle East among Europeans, Japanese and Americans; more precisely, there are significant differences in the degrees of dependence upon particular Middle East sources. Current import figures make this clear.

Before presenting these data, a warning is necessary. Degrees of dependence upon oil are all "one directional" in that oil continues to be an ever more important energy source for most nations. Similarly, for the next 15 to 25 years, it is not likely that the significance of imports to national energy budgets will be greatly diminished as a percent of those budgets. Even if that percentage represented by oil is smaller, volumetric requirements will increase. Some 50 million barrels a day were consumed in 1975; by 1990, even with efforts by governments to reduce the percentage represented by oil in their energy balance—some of which will be successful—we anticipate close to 80 million barrels of oil will be consumed.

In addition, there will be the usual shifts in reliance upon particular sources for the ordinary commercial, seasonal, marketing reasons, for competitive purposes, or because one source or another may seem more or less reliable. Therefore, one cannot do less than observe *annual* trends and not conclude too much from *quarterly* import figures, and never from monthly. Finally, shifts in sources cannot be made peremptorily, as it were; the management of world-wide crude slates and exchanges, the logistics and refinery functions must all be anticipated and interwoven.

ESTIMATED PERCENT OF IMPORTS (CRUDE AND PRODUCT) TRACED TO ORIGINAL SOURCE (1975)

| | Arab | | | | | |
|---|---|---|---|---|---|---|
| | Saudi Arabia | Kuwait | Libya | Iraq | UAE | Algeria |
| United States | 14 | 0.5 | 6 | ---------- | 3 | 5 |
| Canada | 21 | 3.0 | 1 | 3 | 4 | ---------- |
| Japan | 30 | 10.0 | 1 | 2 | 8 | ---------- |
| Western Europe | 28 | 6.0 | 6 | 8 | 6 | 4 |
| United Kingdom | 25 | 12.0 | 3 | 3 | 4 | 2 |
| Germany | 19 | 3.0 | 15 | 1 | 8 | 1 |
| Italy | 26 | 4.0 | 10 | 18 | 3 | 3 |
| France | 31 | 6.0 | 2 | 11 | 11 | 6 |
| Spain | 50 | 1.0 | 6 | 12 | ---------- | 1 |
| Netherlands | 22 | 11.0 | 1 | 3 | 9 | 1 |

| | Non-Arab | | | | |
|---|---|---|---|---|---|
| | Iran | Venezuela | Indonesia | Nigeria | Canada |
| United States | 8 | 18 | 8 | 14.0 | 13 |
| Canada | 23 | 32 | ---------- | 2.0 | ---------- |
| Japan | 24 | ---------- | 11 | 1.0 | ---------- |
| Western Europe | 16 | 2 | ---------- | 6.0 | ---------- |
| United Kingdom | 20 | 4 | ---------- | 7.0 | ---------- |
| Germany | 15 | 3 | ---------- | 10.0 | ---------- |
| Italy | 14 | 2 | ---------- | .5 | ---------- |
| France | 12 | 2 | ---------- | 8.0 | ---------- |
| Spain | 9 | 2 | ---------- | ---------- | ---------- |
| Netherlands | 30 | 1 | ---------- | 12.0 | ---------- |

From the above, note that for 1975, the United States received a lower percentage of its oil imports, by a substantial degree, from Saudi Arabia than is recorded for any other major importing, industrial state. While in 1976 they received nearly 24 percent of its imports from Saudi Arabia, this increase while of course significant does not change the greater importance of Saudi oil to Europe and Japan.

Note also that the United States received a lower percentage of its oil imports from Iran than is recorded for any other major importing, industrial state.

Note then, the United States received a higher percentage of its oil imports from Nigeria than did any other major importing industrial state; and that with the single exception of Canada, the United States received a far higher percentage of its imports from Venezuela than did any other of the listed states.

Finally, the United States received, in 1975, some 30 percent of its imports from Arab countries but Western Europe got nearly 60 percent, and Japan 51 percent of their imports from Arab countries.

Now look at exports from the producing nations' perspective:

ESTIMATED PERCENT OF OIL EXPORTS (1975) TO LISTED IMPORTING NATIONS

| | MB/D total | United States | Canada | Japan | Western Europe |
|---|---|---|---|---|---|
| From Arab countries: | | | | | |
| Saudi Arabia | 7,080 | 10 | 3 | 19 | 47 |
| Kuwait | 2,100 | ---------- | 2 | 20 | 37 |
| Libya | 1,520 | 14 | ---------- | 4 | 48 |
| Iraq | 2,250 | ---------- | 1 | 4 | 41 |
| UAE | 1,700 | 7 | 3 | 24 | 45 |
| Algeria | 930 | 28 | ---------- | ---------- | 54 |
| From non-Arab countries: | | | | | |
| Iran | 5,350 | 5 | 4 | 21 | 36 |
| Venezuela | 2,350 | 16 | 11 | ---------- | 11 |
| Indonesia | 1,310 | 28 | ---------- | 40 | ---------- |
| Nigeria | 1,790 | 41 | ---------- | 4 | 41 |
| Canada | 1,460 | 100 | ---------- | ---------- | ---------- |

From the above, we observe the exceptional importance to the oil exporting states of the European and Japanese markets; very considerably greater than that of the United States. Only in the case of Nigeria and Canada does the United States dominate a producing nations' export market. (Venezuelan exports to the United States have occupied a more important place in its trade; the lower percent reflects the recession's drop in fuel oil demand). For OAPEC as a whole, the United States receives 10 percent of members' exports while Western Europe gets 42 percent and Japan 15 percent; for OPEC as a whole the United States receives 18 percent of their exports while Western Europe receives 40 percent and Japan 16 percent. Put in millions of barrels a day, OAPEC exports some 1.8 to the United States, 7.5 to Western Europe and 2.7 to Japan; OPEC exports some 5.4 to the United States, 12 to Western Europe and 5 to Japan.

It is these data which emphasize the underlying oil market factors which help explain the caution with which Western Europe and Japan must consider U.S. "initiatives" vs. OPEC. There can scarcely be any meaningful comparison between the situations of Europe, Japan, and that of the United States from the particular aspect of their comparative importance to oil in world trade—OPEC oil or, of

greater significance, of oil from the particular region of the Persian Gulf.

We have seen, in the nuclear section of this report, how likely it is that the import dependence of the industrial nations will relate not only to oil but to uranium ore as well. Thus, the energy concerns of these states will be also for adequate and continuous supply of this other and newer energy source. The only significant difference to be noted at this time is that the present OPEC members do not possess substantial uranium reserves (with the possible exception of Nigeria). Equally important to note, however, is that with the exception of the known large possessers of uranium reserves—South Africa, Canada, United States of America, Australia—the sources of additional and probably needed uranium lie within the LDC's.

Moreover, we have noted also that imported natural gas is likely to be an important security factor to energy-deficient states, especially in Europe and Japan, as Soviet and Middle East supplies become more available.

# CHAPTER VII.—GOVERNMENTS AND ENTERPRISES IN INTERNATIONAL ENERGY

## A. Role of Governments in International Oil Supply

The success of the private international oil industry in making oil the primary source of fuel for the industrial world was the very factor which brought governments of all stripes and sizes into the act. Once oil had become a commodity vital to their economies, decisions affecting national interests would not be left to the commercial instincts of the private commercial or trading sector.

Similarly, when oil became crucial to the revenues of producing states, decisions as to volumes and prices could no longer be left to the judgment of oil companies alone.

This would be all the more the case when for most states the principal purveyors of oil in domestic and world trade have been foreign-owned and controlled companies whose overseas affiliates lack the power of independent decisionmaking in the handling of international supply.

Governments' role in oil accelerated with the collapse of Western empire, chiefly because the international oil majors were linked with the colonial/capitalist system. Moreover, while it can be said these companies lacked the foresight, imagination and initiative to forge timely new relationships with the recently independent and highly nationalistic governments with which they had to deal the point must also be made that for over a quarter century, in a number of cases, they had maintained a concession system as the basis for oil exploitation which was enormously beneficial to them and also to consumers. When the politics of oil in its domestic and international ramifications came to the fore, the concessions system was the first casualty.

It was really not a case of great changes coming at great speed for there had been many warnings in the quarter century after World War II: Iran, Libya, Iraq, Venezuela, Indonesia, Algeria, Saudi Arabia, et cetera. Adaptation might have been an impossible task for most of the companies in any case; the majors saw themselves beset by challenges and dangers, hoping that with time and fortitude all would be right again, or very nearly, or enough so. The attempts which were made to adjust came very largely from the nonmajors who sought an advantage for themselves in accommodating to change by altering traditional concession arrangements and the division of—or better—profits from the disposition of oil on terms increasingly more favorable to the producing governments.

Nevertheless, as indicated in the next section on the role of the international oil industry, the functions of the "majors" remain important, if diminished.

However, with that diminished role—particularly in determining the volumes and prices for crude absent any alternative—it was neces-

sary for consumer governments to undertake larger roles in oil partly to assure continuity of supply. As governments have done so, and the process is still very much under way, a very broad range of government responsibilities became engaged. Commercial considerations, which in the past determined the commitments of the oil indusrty, are no longer central. Oil has become enmeshed in a number of other national interests and objectives which complicate access. Of course, this is true for energy-deficient or importing states as well as for the oil exporting countries.

The elevation of oil to its current level of governmental concern may make for less difficulties in most industrial nations than it does in the United States. It has long been the case, for much of Europe and for Japan, that very major commercial enterprises function within a system in which government concerns and corporate undertakings are related. In fact, for much of Western history great commercial enterprises have often been conceived and sponsored by government. It is only in relatively recent times, and primarily in the United States, that government and commerce have been seen as separate and even adversary. With the politicization of oil an accomplished fact, European and Japanese societies may have an advantage over the United States which will be wrestling with the questions of government-and-industry or Government versus industry for many years to come.

In addition to Government attention to security of supply, the expense of developing alternative energy sources and the cost of certain energy research seems now to require government direction and funding, directly or through subsidization. There are differences of opinion over the extent to which Government involvement is needed but the general trend toward a larger role is unarguable as is the need for Government attention to legislative or bureaucratic impediments to energy development.

For all these reasons, some government presence is necessary and inevitable. Whether its involvement will improve upon the provision of energy is not so certain.

Basically, however, the justification for some forms of Government involvement is that international energy supply is, in the first instance, very largely under the control of states, not commercial enterprises, and therefore the supply available may be used for political purposes. Moreover, with the consequent vulnerability of energy-deficient states to shortages, contrived or otherwise, only Government can insure all possible measures are taken to limit the damage which can be caused by producing governments. Finally, energy objectives call for development and infrastructure on a larger scale and time is pressing. Commercial enterprises cannot be expected to deal alone with very large-scale national energy requirements, and they have themselves made this point.

In the United States, the central questions are how to define generally supported energy objectives, how to determine the need for incentives to the private sector to carry out national policy? How to reform the regulatory maze which is said to be a self-inflicted wound preventing us from reaching energy goals? Most difficult of all, how best to assure that energy companies perform in the furtherance of energy objectives? If a company has coal and oil assets, for example, how to make certain that either resource is exploited at a rate con-

sistent with national energy objectives? And yet preserve and encourage private enterprises in the undertaking? These questions reflect a minimal role for the U.S. Government; those who intend the government to be very much more deeply involved look to a national oil corporation, and to greater undertakings directly in exploration and development. Whichever course is adopted, the key issue is how best to improve upon one's access to energy in world trade while encouraging the exploitation of indigenous resources.

## B. The International Oil Industry

While it is inevitable that governments will increase their oversight and involvement in energy supply, the international majors—for as long as consumer and producer governments pursue policies which permit them to be important in the search for and supply of oil—can anticipate continuing to be essential. On the other hand, if governments give precedent to nonmajors, or discriminate in favor of government oil entities or otherwise give preference to national oil companies, then the diminished role for the international majors will have its unavoidable effects upon the companies' own interest in keeping in the game.

In judging whether or not preference should be given to companies other than the international majors, insufficient attention has been given by governments to the efficiency of supply which these large companies have come to symbolize and which is an essential ingredient in the provision of energy. Insufficient attention has also been given to the point that if governments can limit their attention to setting the appropriate framework for corporate risk taking and investment to insure that the necessary size and diversity of energy efforts are, in fact, undertaken, then the energy costs are not a direct charge upon the government's national budget—a not inconsiderable point.

Will there be sufficient incentive for the majors to be interested in remaining in energy? If there is, there can be little doubt that the assets which they possess and which are not readily duplicatable—managerial and otherwise—can be employed in their private and in the general interest. In the past, these companies were not buffers between producers and consumers, as they often like to say, but the critical link between the two, agents with great interests in both production and consumption, able to balance supply and demand with exceptional skill and efficiency. Under the appropriate government-established conditions there can be an identity of interest between private and public interest.

The international oil companies have seen their role diminished essentially by two forces: (1) the actions of producer governments which have very largely but not completely removed the companies from decisions affecting crude volumes and prices; and, (2) the rise in the numbers and the consequences of private and governmental oil companies, usually nonintegrated, but which have progressively obtained an increasing share of the market in world oil trade.

Prior to the swift assumption of control by producers over the terms on which they make their oil available, there had been a steady increase in the share of functions performed by "nonmajors." There have been plenty of signals that the process will probably accelerate.

In 1961, governments controlled about 8 percent of crude production as did the "nonmajors"; nearly 83 percent of the world's oil was handled by "majors." By 1972 (the year before producer governments took over), the share of governments had risen to some 10 percent, the role of "nonmajors" to about 18 percent and the share for the "majors" had declined to about 72 percent. The role of government today is at least 70 percent with the balance a nearly indefinable mix of "nonmajors" and "majors." In refining, the role of "majors" slipped from nearly 70 percent in 1961 to about 54 percent in 1972 (with "nonmajors" aquiring some 25 percent in 1972); in marketing, the "majors" went from about 64 percent in 1961 to nearly 52 percent in 1972 while "nonmajors" captured some 27 percent by 1972 and governments had acquired about 21 percent.

From the "majors" perspective, about the most to be hoped for is a holding of their present position out of which, in time, might evolve opportunities for greater investments. There may come other opportunities from countries determined now to explore for indigenous oil. There is also the possibility of roles for these companies, akin to Aramco's expanding activities, in producer states. Anything much less than that would surely find an increasing number diversifying their talents and assets into other endeavors.

From the viewpoint of producer governments, it is the ability of "majors" to move nearly 52 percent of oil in world trade to the consumers' markets which is presently so consequential. Moreover, in a period of general oversupply, the majors can make decisions as to supply from which sources which relieves the governments from having to do so in an OPEC forum. Over time, with the universal availability of communications and data processing, consumer or producer government oil companies could move these volumes; but very few, if any, governments possess today the requisite managerial resources to cope with the complex supply arrangements inherent in oil moving in world trade. As they acquire the necessary talents, a diminishing role for the international majors would seem to be a natural consequence.

The "majors" will continue to be better able to mount the kind of immense undertaking represented in the North Sea, on the North Slope of Alaska and generally offshore. Theirs is by no means a monopoly of such capabilities but it is still impressive enough to warrant consideration when their future role is discussed.

### C. Role of Governments and Enterprises in Nuclear Energy

The situation and prospects for nuclear energy differ significantly from that of oil. In the nuclear case, the role of government has been preeminent from the outset as the possessor of nuclear technology, the major sponsor of advanced research and the owner or licensor of the bulk of present enrichment processes. While the fabrication of equipment has been both a government and private enterprise activity, there seems little reason to doubt the continued predominance of government in all parts of the fuel cycle.

The international oil majors—especially Shell, Gulf and Exxon—have invested with varying success in parts of the fuel cycle and each has undertaken substantial research programs independently and in

concert with government. In no case has any U.S. private enterprise yet obtained a position in all of the fuel cycle. In other countries, such as Germany and France, there appears to be a far closer coordination of effort with private companies due in large measure to their governments' having adopted clearer guidelines for their support in overseas nuclear contracts. The United States has been inconsistent and uncertain in its own approach thus adding to the hesitation of U.S. nuclear enterprises to commit requisite talents and sums to overseas opportunities.

The astronomical rise in research and capital costs, public concern over safety and environmental aspects, fluctuations in market forecasts for electric power generation, excessive lead times and the unavoidable dependence upon government policies which are themselves evolving, all combine to limit the interest of private enterprises and to leave to government nearly everywhere the key roles in nuclear energy development. Initiatives such as the U.S. Government's Nuclear Assurance Fuel Act, which represents the single most important move to enlist private enterprise in the key enrichment processing function, has a very uncertain future. Its passage through the entire legislative process will be at least by amendments which may nullify its purposes—and be regarded a harbinger of the fate for comparable efforts.

Only in the design and fabrication of capital equipment, including reactors, will private enterprise in the free world be likely to have an important role.

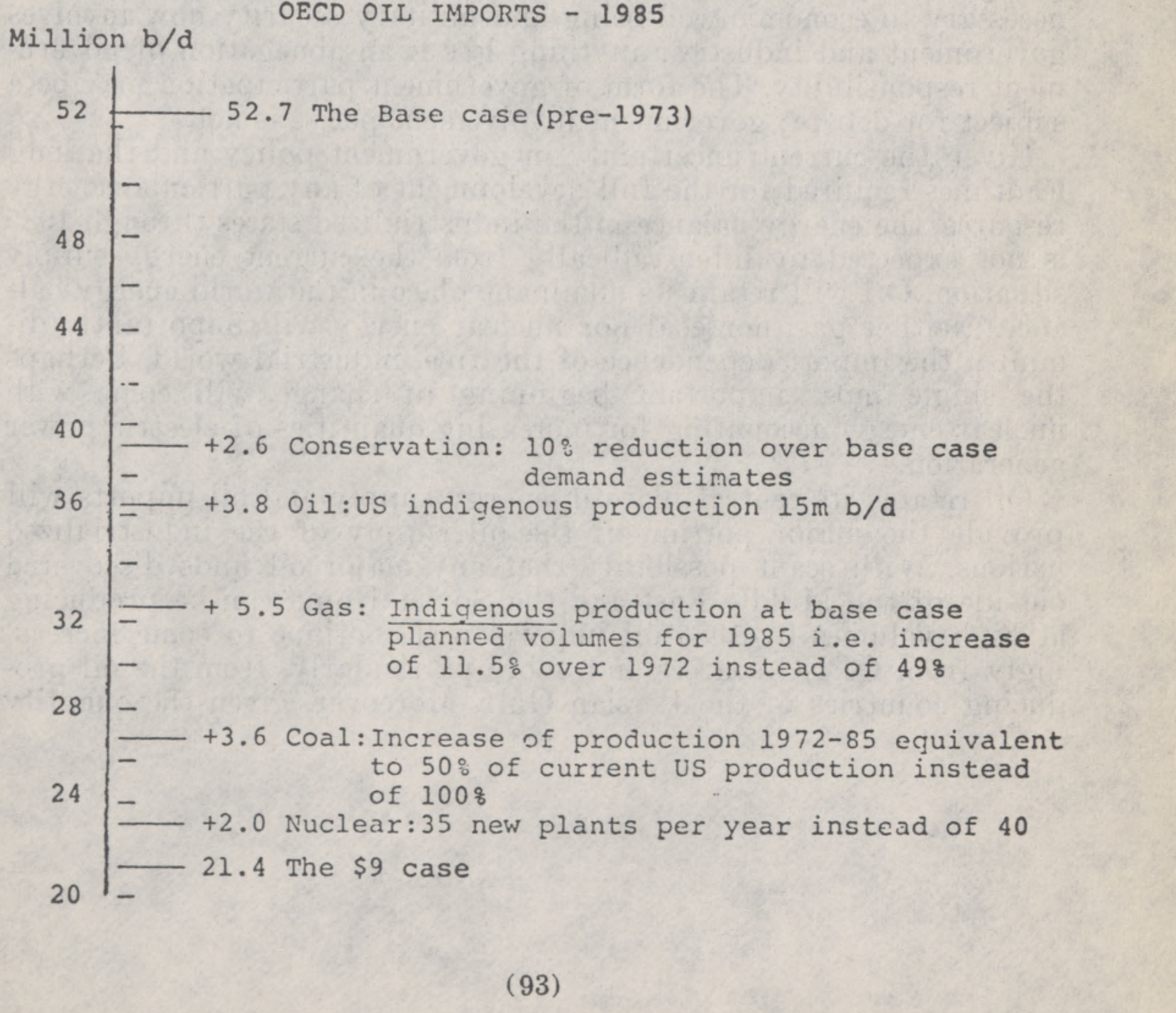
In view of the certainty that substantial uranium ore imports will be necessary for the industrial nations, governments' role in securing access to uranium ore, and the acquisition of enrichment and reprocessing facilities, insures the politicization of nuclear fuel supply in all its aspects.

## CHAPTER VIII.—SUMMARY AND OVERVIEW

Most forecasts of energy supply and demand are based on assumptions regarding: (1) a decline in oil demand resulting from higher oil prices; (2) a decline in energy demand arising from deliberate conservation schemes; (3) an expanded indigenous (non-OPEC) production stimulated by higher energy prices; and (4) the development of alternative energy sources, also encouraged by higher oil prices. It is further assumed that future GNP growth rates will fall below historical trend (in part, because of higher energy prices), suggesting some moderation in the growth of energy demand. In addition, the forecasts generally assume the requisite industry investments and positive expressions of Government support regarding conservation and the development of energy resources, through a variety of interrelated policies implemented in timely fashion.

The sensitivity of the forecasts to any change in their basic assumptions is illustrated dramatically in the 1973 OECD study, "Energy Prospects to 1985." In the OECD example, the projection based on a current dollar price of $9 per barrel of oil includes very optimistic assumptions regarding the ability to expand OECD indigenous oil production, the ability to develop alternative energy resources, the oil savings to be derived from conservation, and the decline in oil demand resulting from higher oil prices. Oil imports provide the balancing mechanism between OECD oil supply and OECD oil demand.

If the assumptions regarding alternatives, indigenous production and/or conservation prove wrong, the extreme sensitivity of the forecast to these errors is suggested in the following chart:



A failure to develop alternative energy sources (coal, gas, nuclear) in the assumed quantities adds 11 million B/D to OECD oil imports in 1985. All told, failure to develop alternatives, failure to find and develop adequate quantities of indigenous energy resources and failure of conservation efforts adds 18 million B/D to the OECD oil import bill for 1985. While it is unlikely that a total failure in all these directions will occur, a 50 percent shortfall would still be equal to today's total production of Saudi Arabia.

In addition to possible failures in achieving the quantitative requirements, there is the need for all developments to occur in a timely fashion. Energy supply and demand are determined by a complex and interdependent set of economic and political factors. Failure to complete any particular step in time, or partial but insufficient success in another phase, can trigger a set of consequences which could throw all forecasts off.

The critical importance to this total energy effort of some form of government coordination at least, and probably involvement is obvious, as is the role of industry. In the absence of an effective national energy policy and its implementation there is no inherent reason why market forces alone will call forth an industry response in either the necessary direction or with adequate scope and speed. The interrelatedness of all aspects of the energy equation also suggests that ad hoc and isolated government initiatives will not be sufficient to meet national energy objectives; the need is for a comprehensive energy policy. The provision of adequate and continuous energy supplies necessary to economic well-being and military security now involves government and industry; anything less is an abnegation of government responsibility. The form of government participation may be a subject for debate; government involvement per se is not.

Given the current uncertainty in government policy and the long leadtimes required for the full development of any particular energy resource, the energy balance in the industrialized states through 1985 is not expected to differ radically from the current energy supply situation. Oil will retain its dominant place in the world energy balance. Neither gas, nor coal nor nuclear energy will importantly diminish the import dependence of the free, industrial world. Perhaps the single most important beginning of change will come with nuclear energy accounting for increasing quantities of electric power generation.

Oil retains its central place in energy supply and oil imports will provide the major portion of the oil supply of the industrialized nations. With scant possibility that any major oil finds discovered outside of the Middle East and the Soviet Union can be producing at high volumes by 1985 oil imports will continue to come increasingly from OPEC sources and, more particularly, from the oil producing countries of the Persian Gulf. Moreover, given the quantity

of oil demanded, major finds would have to be huge even to begin to challenge the dominant position of the Persian Gulf. The prospect is thus for increasing competition for Middle East oil; U.S. competitors will include not only NATO allies and Japan but perhaps the U.S.S.R. as well.

This situation may well hold into the 1990's, when it is anticipated that nuclear energy, oil from tar sands, oil from shale and coal gasification and liquefaction may be making larger contributions to energy supply. But none of these developments, in this time frame, will eliminate oil's dominant role in total energy supply.

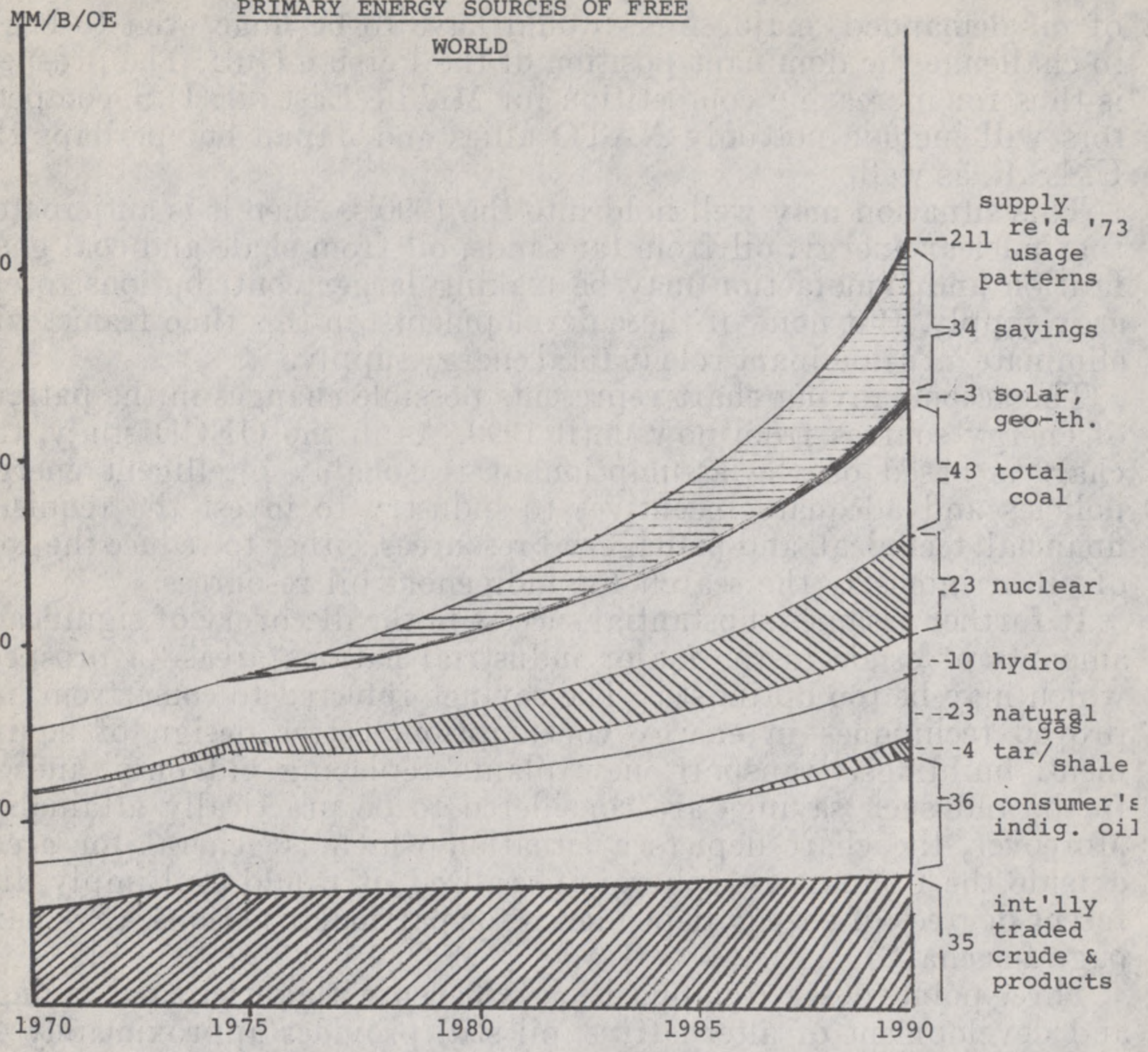
The accompanying chart represents possible changes in the pattern of energy sources from now until 1990. As in the OECD study, the chart is based on the assumption of reasonably intelligent energy policies and adequate incentives to industry to invest the requisite financial, technical, and managerial resources, either to reduce the role of oil or intensify the search for indigenous oil resources.

It further assumes substantial success in the discovery of significant amounts of crude in the major industrial nations/areas—a prospect which may be too optimistic. The savings referred to come from improved techniques in energy consumption, better design of equipment, buildings, transport, new plants replacing old ones, and so forth, and such savings are considered to be practically attainable. Moreover, the chart depicts a situation which is general for areas outside the Communist sphere; if realized, it would still imply different degrees of energy dependence for particular nations. (See next page for chart.)

Three points deserve emphasis. *First*, even with anticipated savings and development of alternatives, oil still provides approximately 40 percent of total free world primary energy supply in 1990. A more recent forecast from the same source agrees with the Exxon prediction that in 1990 oil may still account for 50 percent of total free world energy supply. Moreover, even if oil's share in total energy supply should decline, the absolute quantity of oil demanded will increase through 1990.

*Second*, it must be remembered that shortfalls in the development of alternative energy sources and failure to expand indigenous oil production can only be compensated for by increased oil imports.

*Third*, in spite of the expansion of nuclear energy, almost 75 percent of the 1990 free world primary energy supply still derives from conventional energy sources—coal, hydro, natural gas, and oil. Of these, oil will be far and away the most significant energy resource in international trade. Further use of conventional fuels also may not free Europe and Japan from energy import dependence. Additional reliance on gas imports would present the unattractive alternatives of becoming dependent on Soviet gas exports or multiplying dependence on the Middle East (now gas as well as oil).




In addition, developments in nuclear energy, tar sands and oil shale, do not necessarily reduce the energy import dependence of all the industrialized countries equally or at all.

Tar sand and oil shale deposits appear to be concentrated in the United States, Canada and Venezuela. Outside the United States, uranium deposits appear to be concentrated most prominently in Canada, Australia and South Africa, while enrichment capacity may still be dominated by the United States in the early 1990's. In terms of the ore, while these states are counted among the industrial and advanced developing countries rather than among the OPEC countries, it would be prudent to anticipate that the interests of these producers will not automatically coincide with those of consumers.

Generally, the European and Japanese resource position in energy is clearly less favorable than the United States position and the U.S.S.R. may be in the most favorable energy resource position of all (over the long term and considering only Soviet domestic requirements).

If little else is done, a continuation of present trends results in a situation through the 1990's that may be characterized by the continued dominance of oil in total energy supply, the demand for increasing absolute volumes of oil, the West's and Japan's increasing dependence on oil imports, the increasing importance of Persian Gulf oil and intensified competition for that foreign-source oil involving the United States, its NATO allies, Japan and possibly, the Soviet Union and

the People's Republic of China. The varying degrees of our respective dependence upon Persian Gulf exports, with Europe and Japan far more dependent than the United States, will serve to constrain the latter. From the Gulf producers' perspective, the greater importance to them of Europe and Japan has equal significance.

Throughout this century, and still further into the future, it is inconceivable that the great industrial areas of today will not still be the bulk of the energy consumers and also the energy importers of tomorrow. Both in the case of oil—for this century at least and for uranium ore for as long as present generation reactors constitute the principle source of nuclear power—the consumers will be in the North; the producers will be in the South.

A significant change will surely come in the geopolitics of energy as the producers begin evermore to process their raw materials, and probably to enlarge upon their involvement in the marine logistics of supply. But the "bottom line"—the ultimate markets will still be in the North and the trends generally will be to correlate the interests of consumers and producers. The potential exceptions—those cases in which great influence over supply is matched by no pressing need to meet demand levels in international trade—will be very few and even, perhaps, be limited to Saudi Arabia. Nevertheless, there will remain exceedingly important considerations affecting energy supply which warrant further and more specific mention—and these are embedded in location and control.

## A. Location and Control as Geopolitical Factors

Oil is indeed where one finds it but there are additional considerations which make location crucial. The new element in the international oil situation is the combination of location and control in one and the same group of underdeveloped countries. The concentration of oil reserves in a small group of less developed countries, increasingly more assertive in their international relations, combined with the real need of the industrialized nations for oil and the lack of immediate substitutes, gives the coincidence of location and control a compelling importance.

The oil producers are less developed countries (LDC's) and to some extent they share the world view common to most LDC's. Location and control become elements of prestige and instruments of influence and power—bargaining levers to be used to reform or replace the prevailing international economic and political system, now dominated principally by the United States and its allies. The systems seem to be exploitative and designed, perhaps consciously, perhaps inadvertently, to secure the interest of the industrialized countries at the expense of the LDC's. From their perspective, control over their natural resources, vital to the industrial nations, holds out the possibility that economic independence, growth and development are now attainable.

While the LDC solidarity resulting from a common colonial or neocolonial experience and a common sense of aggrievement is real, it must not be overstated. It is opportune for the oil producers to champion LDC causes in the various conferences and international organizations involved in the "North-South" debate. OPEC can uphold the LDC cause at little cost to its members by linking the question of access

to adequate and continuous oil supplies at "reasonable" prices to areas of interest to other LDC's. Moreover, by increasing their links to other LDC's the cost of any precipitous action possibly being considered by external powers is increased.

Nonoil producing LDC's suffering enormously under the burden of higher oil prices, still find the OPEC/LDC relationship vital. Disunity would not get them less expensive oil and, separated from the oil link, the industrialized countries would be even more reluctant than they are now to make concessions to LDC demands for a new economic order.

The skewed location of oil reserves, the success of the oil producers in securing to themselves the largest share of the benefits from their natural resources, and the model which this suggests to other raw material producers, raises important questions of access to raw materials, the terms under which access is secured, and issues of North-South relations in general.

From the perspective of the industrialized countries, the location of oil reserves and the loss of control over them have compelled a recognition of an uncomfortably more symmetrical interdependence than was thought to exist. The acknowledgement of interdependence (indeed, dependence), the necessity for bargaining and the uncertainty associated with dependence and bargaining is unsettling to countries accustomed to assuming that power was their exclusive preserve, that the status quo was the right and natural order of things, and that they had a monopoly on wisdom (and power) which secured the peace.

If the initial U.S. response to the OPEC challenge was a call for solidarity among the industrialized states—a show of force of sorts when the use of force itself has been perhaps temporarily rejected—it is now clear that there are differences within the group of industrialized states as well. There are differences in terms of of resource dependence; Europe and Japan are in far less favorable resource endowment positions than is the United States. Essentially this means that the United States, with less at risk, has relatively greater freedom of action. The differences in resource endowment mean that the European and Japanese perceptions of an emerging world order may be significantly different from that of the United States.

Nations accustomed to declining power and cognizant of their continuing and inescapable dependence may be more willing to deal creatively with interdependence than a nation accustomed to greater independence of action. If the United States can, through its enormous economic and market power, prevent a deterioration in the terms and conditions of access to raw materials so much the better. But this does not preclude a European-LDC arrangement or new Japanese-LDC relations affecting raw materials—including energy—from which the United States may well be effectively excluded either as a result of its own attitude, or even intentionally by other industrial and/or developing states. Should such occur, the divisive effects upon NATO would be very considerable. Nor are we in a positon even to guess intelligently about the capabilities and intentions of the U.S.S.R. in this changing array of interests.

Location and control of oil reserves has seemingly drawn a line separating an emergent LDC bloc from the industrialized countries. Yet the reality of international politics is far more complex than the

superficial division of the world along North-South lines. Developments in North-South relations will certainly have an important bearing on the question of access to raw materials but the situation is malleable and the shape of new international relationships is still evolving.

We are in a curious position; the parameters of our energy position are clear, and they are unlikely to change absent national policies of a comprehensive, demanding character. Yet in no case has a commitment commensurate to the challenge been made—neither in the United States, Europe nor Japan. If our energy situation is left to drift, aimless, then our vulnerabilities can only increase, and the chances multiply of a grievous miscalculation on the part of either key producers or consumers.

### B. The Farther Prospect: Energy Beyond the 20th Century

It is difficult to speak of this time; not only are technical and quantitative factors only vaguely perceptible but, more importantly, the details of the energy situation in the 21st century depend heavily on the decisions nations take today and in the near future—or do not take. In addition, we do not know what society will look like so far into the future and surely the nature and structure of the society will have a bearing on energy requirements.

With these provisos in mind it is possible to suggest that in the years following the turn of the century, the geopolitics of energy may be far less important than it is today. Toward the very end of the current century, electricity will provide an ever-escalating share of energy supply. Nuclear energy and breeder reactors will supply a larger share of electrical generating capacity. Uranium scarcity may be as acute as the current oil situation but the breeder reactor may be functioning sufficiently to extend the life of uranium resources. Oil usage may be more restricted to its critical uses—transportation and petrochemicals. Contributions from oil shale, tar sands and solar energy will be more significant. However, it is only a decade or more into the 21st century that it is at all possible to talk about the possibilities of energy independence for a large number of countries.

Nuclear fusion would, of course, constitute a totally domestic energy source if it can be operationalized and commercialized. Solar energy also holds out the promise of energy independence as does—for the United States at least—the maximum utilization of coal. Fusion and solar energy would largely free nations from the constraints imposed by the geopolitics of energy but not much is expected of them before the first or second decade of the 21st century and could they have the desired effect before the middle years?

The challenge posed by the geopolitics of energy is how the world will meet its energy requirements for the remainder of the century, but particularly for the next 10, 15 or more years in which oil remains dominant and its location is so sharply restricted to one geographic region. Later, oil will be important as a feedstock and in uses in which alternatives simply are not available; nonfuel oil uses will exceed oil used for fuel. The question is how do we survive in the intervening years? How well will the industrial energy—consuming nations cope with the competition between them over access to energy resources? How well will relationships evolve with the energy raw material producers?

# PART II.—POLICY OPTIONS AND RECOMMENDATIONS

## CHAPTER IX.—CONSIDERATIONS AFFECTING U.S. ENERGY POLICY

1. The events of 1973 demonstrated that U.S. security and well-being were dependent on a continuous flow of imported oil in adequate quantities, the control of which had passed to the oil producing governments. Economic well-being and industrial production, domestic political stability and military capability are interrelated so that the shift in control of oil supplies to the oil producing states implied that the United States had become vulnerable to the actions of certain countries to an unprecedented extent. With the military requirement of adequate and continuous oil supplies, the importance of the control of oil resources by foreign countries, whose interests may differ from those of the United States, is even more compelling.

2. At the same time, "foreign policy" has two aspects: (a) the protection of U.S. domestic interests and objectives from adverse developments overseas; and, (b) the promotion of U.S. interests abroad. In reality, the two are closely intertwined, not necessarily in harmony and sometimes actually conflicting.

3. Post-1973, U.S. freedom of maneuver in international affairs has been and is likely to continue to be unduly constrained by our dependence on oil imports and the necessity to consider the interests and demands of the oil producing states. While access to overseas energy is only one of our key interests, it cannot be relegated to low priority but must stand among our most important. How well we secure our energy interests will help determine our success in meeting other goals.

4. Without minimizing the essential importance of oil, we should keep in mind that a nation's freedom of maneuver in international affairs is limited by domestic considerations and this is as true of energy as with any overseas interests. This becomes increasingly true as the implications of worldwide economic interdependence become clearer.

5. In addition, while oil has peculiar characteristics (e.g., its vital importance to industrial economies and the unavailability of immediate substitutes), the United States does have power to affect developments. The United States has considerable market power by dint of its large size and wealth and the United States still occupies a commanding position in international economic relations (which gives the U.S. veto power at least). The U.S. energy resource position is more favorable than that of most other industrial states. Finally, the United States retains a military capability which some oil producers see as a guarantee of their own security or, perhaps, a U.S. asset which could be employed in last resort to obtain supply, a capability not presently possessed by another oil importing country.

6. In effect, the post-1973 world offers both constraints and possibilities for international action; our oil dependency creates problems as well as opportunities.

7. The need to insulate the domestic economy from forces beyond U.S. control, the need to free military operations from the potential constraints imposed by foreign powers and the desire to free foreign policy to some greater extent from the constraints of domestic considerations (which should follow naturally from success in the first two areas) constitute a general U.S. objective which may be described as the need to limit U.S. economic, political and strategic vulnerability resulting from dependence on energy imports.

8. From this follows a host of additional issues full consideration of which must go into the determination of objectives. These issues deeply involve the interests and vulnerabilities of allies. U.S. energy interests and initiatives cannot—or must not—be considered in isolation.

9. To the extent that U.S. allies in Western Europe and Japan remain vulnerable to the actions of energy exporters, efforts to limit U.S. vulnerability must include consideration of the effects upon Western Europe and Japan.

10. Pressure can be brought to bear on the United States through the continuing and inescapable import dependence of its allies. At the very least, the U.S. economy could not remain unscathed by adverse economic and political developments in Western Europe and Japan resulting from inadequate or sporadic oil supplies.

11. We have already argued that competition between governments for Middle East oil will intensify over the next 10 to 15 years.

(*a*) Within this competition, the United States will be concerned with the divisive effects of competition for oil within the Western alliance.

(*b*) The United States will also be concerned with its own competitive economic position vis-a-vis its allies and vis-a-vis the Communist nations as it may be affected by this competition.

(*c*) The United States will be concerned with the relative competitive position of the Western alliance vis-a-vis the Warsaw Pact.

12. In addition, oil exports will increasingly originate in the Persian Gulf thus engaging U.S. interest in:

(*a*) The stability or direction of political and economic change in the region;

(*b*) Limiting or countering the extension of Soviet influence in the area;

(*c*) The relative positions of Saudi Arabia and Iran; and,

(*d*) The security of the Straits of Hormuz.

13. Within the Gulf area, Saudi Arabia will be pivotal and thus an area of profound concern to all energy-deficient states.

14. Recognizing that access to oil, and raw materials in general, may no longer be determined as automatically as it had been in the past, the United States must be concerned with those new avenues and mechanisms for securing access which may evolve, with or without U.S. participation, and which will create precedents for energy in world trade.

15. More broadly, the issue of access to raw materials, including energy, is linked to developments in "North-South" relations generally.

16. Adequacy of OPEC production will be an area of concern to the United States, with adequacy in terms of U.S. interests still to be defined.

17. It should be noted again that energy import dependence is not limited to oil, but includes West European and Japanese potential dependence on Middle Eastern or Soviet gas exports, and a possible U.S., West European, and Japanese dependence on imports of natural or enriched uranium.

(*a*) The United States must be concerned with areas where it appears likely that new uranium resources will be located.

(*b*) For many reasons, the United States must be concerned with the potential for nuclear weapons proliferation resulting from the increasing spread of nuclear energy worldwide; to some extent public interest in limiting proliferation can affect the use of nuclear power for peaceful purposes and even the investment in next-generation nuclear technology.

18. In the area of natural gas, the United States must be concerned lest its own increased imports of LNG, as well as Europe's and Japan's, increases energy dependence on the Soviet Union, or multiplies dependence on the Middle East.

19. Part I of this study postulates free world dependence on energy imports at least through the end of the century. The central issue is how to navigate through the interim period during which dependence on imported energy sources persists, and before the constraints imposed by the geopolitics of present forms of energy may be lifted. Domestic politics and foreign policy objectives beyond access to energy will sharply affect our passage.

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## CHAPTER X.—THE NATURE OF THE THREAT: EMERGENCY SITUATIONS

### A. Introduction

Before an energy policy dealing with long term energy considerations can be formulated, it is necessary to assure that there is, in fact, going to be a long term. In effect, only after the capacity exists to overcome short term, occasional shocks, is the environment conducive to the careful, time-consuming, complex analysis which is necessary for the elaboration of long term objectives and policies. The so-called emergency situations must be attended and in order to accomplish this the nature, extent and scope of the potential threats must be defined.

Policy can be devised to serve two interrelated goals. First, policy can be designed to deter the actualization of a threat. Second, policy can be designed to negate the effects of a threat which has already been implemented. Clearly, the second is an important element of the first, but it does not exhaust the possibilities for deterrence.

### B. Embargo

From 1973, the most obvious threat takes the form of deprivation via a deliberate embargo on oil shipments to the industrialized countries, either collectively or selectively, by the oil producers acting in pursuit of some political objective.

Given the disparate nature and interests of the OPEC countries, we doubt they share sufficiently a common political purpose which all members would be willing to support to the extent of halting all oil exports to the industrialized world. The collapse of "North-South" discussions might be such an issue but a more likely response to Western intransigence appears to involve higher oil prices and/or some cutback in production rather than a total generalized embargo. In fact, a total generalized embargo in support of LDC objectives has never been proposed, would probably involve much higher costs than OPEC is prepared to pay for LDC diplomatic support and would depend on a greater, united commitment to general LDC goals than probably exists within OPEC. However, higher oil prices and curtailed production are quite serious enough.

In addition, an OPEC-wide embargo clearly involves heavier costs for some OPEC members than for others. Given their internal political, economic, and social systems, some OPEC members are better able to sustain periods of lost revenue than others. Saudi Arabia, Kuwait, the United Arab Emirates, and Qatar—all countries whose income exceeds their present revenue needs—may be able and willing to sustain an embargo with little negative domestic repercussions. Iran, Venezuela, Indonesia and Nigeria are countries with large populations and ambitious development plans making oil revenues more than a

convenience; the likelihood of their participation in an embargo for any but their own pressing interests is debatable. Longer term, they may be better able to sustain a loss of revenue with economic development and the development of new revenue sources. The position of other OPEC members is still more uncertain but they are not large enough producers, perhaps even in combination, to make or break an embargo: Algeria, Iraq, Libya, Ecuador, and Gabon.

The narrower, all-Arab OAPEC however, includes those countries capable of sustaining a loss in revenue and may, in fact, include those countries sharing a sense of common political purpose derived from the Arab-Israeli conflict or from Arab nationalism. It should be recalled that in 1973, it was OAPEC which instituted that embargo and the associated production cutbacks. For domestic political reasons, an embargo in support of an Arab cause might be attractive to these countries. (Even here, however, the extent of unity can be questioned; Iraq, an anti-Israeli militant, did not participate fully in the 1973 embargo.)

In an embargo of short duration the wealthier OAPEC states could probably subsidize the poorer oil producers for their participation if it were necesary to include them. However, as OAPEC will be increasingly the most important source of oil supplies (and Saudi Arabia the most important single source), even an embargo which excluded Nigeria, Gabon, Venezuela, Ecuador, Indonesia, and Iran might produce a situation in which oil supplies from the nonparticipatory states could not compensate completely for oil lost in the action.

### C. "Conservation"

There is another category of possible producer state actions which could have effects similar to those of an embargo. Different objectives of different states might coalesce in conservation measures. A major producer, or a combination of them, could institute "conservation" measures and thereby reduce supply, perhaps in graduated steps. Conservation measures may be entirely legitimate, for example, based on objective facts regarding field characteristics or surplus revenue accumulation. Such measures may also be used to tighten the oil market to sustain prices. Other producers may simply want to dampen the rise in excess revenues. For others, conservation measures might be used to put escalating political pressure on consumers. Elements of all four might serve among disparate producers as one or more reasons sufficient to institute measures to restrict production.

### D. Conflicts in the Middle East

Beyond the threat of a deliberate oil embargo of varying proportions and the threat posed by conservation policies, an additional threat to secure, and adequate oil supplies might originate in conflicts within the Gulf in which sudden oil shutdown in one nation or another could be expected. A long anticipated variation is one in which animosities among the Arab states, or between some of them and the Iranians (complicated by U.S. relations with both Iran and Saudi Arabia), could shut off very large volumes of oil, even if only sporadically.

The pivotal actor in all these possibilities is Saudi Arabia. The Saudis alone might not be able to completely offset the effects of any

of these developments but their participation could guarantee success. Their nonparticipation might be sufficient to avoid catastrophe in the industrialized countries. Under any circumstances, the Saudis would be under intense political pressure emanating from both sides. The political future of this sparsely populated nation, possessing a resource vital to others, accumulating substantial financial resources, and located in a highly unstable region will continue to be of utmost concern to all energy import-dependent countries. The other potential actor is, of course, Iran whose ambitions, military power, and insatiable need for revenue could find access to other's oil irresistable.

## E. Responding to Emergency Situations

International energy cooperation to date has been geared largely to meeting emergency situations posed by producers against consumers. International cooperation has revolved around efforts to: (1) deter the actualization of threats; (2) negate the effects of a threat already implemented; (3) demonstrate the seriousness with which threats are viewed by the industrialized countries; and, (4) avoid debilitating competition among consumers.

Very much an American initiative, encouraging energy cooperation among the industrialized countries has generated less than full enthusiasm in either consuming or producing states. In arguments reminiscent of developed country objections to OPEC, most producers assert that cooperation among the industrialized nations encourages a policy of producer—consumer confrontation, which, it is argued, benefits no one.

Consuming states which are more dependent on imported oil than is the United States are seriously ambivalent toward the cooperative effort. International energy cooperation is beneficial to the extent that it avoids implementation of threats and higher costs. At the same time, to the extent that the producers denounce "confrontation," heavily dependent consumers become increasingly nervous. Moreover, to the degree that consumer states judge that their link with the United States multiplies their risks, international energy cooperation in the framework of the International Energy Agency could become too expensive.

We continue to believe in the necessity for having in hand responses adequate to meeting emergency situations. We have the elements of the requisite program in the International Energy Agency. The near-automaticity of the sharing agreement must not obscure the differing risks members believe they run from their association in the IEA or the high probability that the overly complex and nearly incomprehensible formula for sharing can scarcely be implemented. We shall turn, again, to the companies to share available oil as equitably as possible, under the aegis of governments. The fact that the vulnerability of the industrialized countries appeals to OPEC members does not suggest the desirabiilty of such a policy for the Western nations and Japan.

Assuming that another embargo is initiated, which nations are likely to be the targets? Increased U.S. dependence on Middle East oil could make the United States a direct target—particularly if the provocation for the embargo was again the Arab-Israeli conflict.

However, we realize now that the targets might be Western Europe and Japan with the intention of bringing indirect pressure to bear on the United States. The very possibility that Europe and Japan may be compelled to bear the brunt of Arab displeasure with United States Middle East policy could have intensely divisive repercussions within the Western alliance which would become evident at the moment of crisis unless the United States has foreseen the possibility and shapes its response intelligently.

The fact that Europe and Japan are now linked to the United States in the emergency sharing formula almost guarantees their involvement in an embargo. Even if the oil producers should permit oil exports to Europe and Japan on levels not exceeding preambargo shipments, the necessity for sharing would reduce oil supplies available for domestic use. The linkage can be seen to multiply the risks incurred by Europe and Japan.

The emergency sharing program should serve to negate the effects of an actualized threat. However, if the United States is the target, the Europeans and Japanese must run the risk of incurring the displeasure of the oil exporters by sharing available supplies with the embargoed country. If Western Europe and Japan are the targets, the burdens will be spread among those countries more than the United States will be able to contribute to their supply, offsetting the embargo. It seems most likely that the emergency-sharing formula serves as something of a deterrent; once deterrence fails, all bets may well be off.

The emergency-sharing component of the International Energy Program is divisive and unlikely to survive the test of embargo. However, since it does introduce an element of uncertainty in producing government calculations, it probably can not now be abandoned without suggesting to the producing countries that the industrialized countries are as divided and weak as the former believe them to be. Still the United States must be prepared for a European and/or Japanese extreme reluctance to invoke the emergency-sharing formula—and the United States should be quite ready and willing not to ask for invocation in the first place.

The essential operational characteristic of an embargo is that it must accomplish its objectives in a short period of time. The longer the embargo, the more drastic the economic consequences to the industrialized countries (which will have negative economic repercussions in the oil-producing countries and other LDC's as well) and the greater the chances that, in desperation, military action will be taken against an unspecified producing state ("unspecified" so as to encourage the embargo participants to break ranks).

Stockpiling or strategic reserves are the mechanisms now accepted not merely to tide a country over a period of embargo but also to meet the possibilities of conservation policies limiting available oil, or supply disruptions caused by upheavals in the Middle East.

The indeterminate effects of stockpiling must be recognized; stockpiles and reserves provide some protection against supply disruption but may also provoke a longer, more geographically widespread, and quantitatively larger cut in oil supply, with a sense of greater commitment by the producers, once an embargo is decided upon and implemented.

At the same time, efforts enabling the industrialized countries to weather an embargo imply that the producers must be prepared to

sustain greater and longer-lived financial and other costs. Thus a national strategic reserve provides an essential tool not for embargoes alone but for supply situations short of an embargo as well. It serves both a deterrent and an after-deterrence-fails function. As stocks are drawn down, the pressures on producers and consumers for some form of political settlement increases.

In addition, we must give consideration to the point that a very large consumer-importer, possessed of a strategic reserve, could itself decide to apply pressure against a major supplier by suspending imports for a time. Depending upon the world oil market, such an initiative could severely damage an oil exporter.

## F. Petroleum Stocks [1]

In normal circumstances, stocks, or inventories, are a vital part of the oil industry's distribution system. When the normal flow of oil is disrupted, stored oil can "fill the gap" for a limited period of time. The 1973–74 Arab embargo and subsequent Government activities have made this second role of oil stocks very important indeed. At present, and through the 1980's, oil stored in each importing nation will be a key factor in its vulnerability to accidental or deliberate disruptions in world oil supplies.

### I. STOCK INFORMATION

To discuss the protection current and prospective levels of stocks provide for the major importing countries, the United States, Europe, and Japan, it is necessary to clearly distinguish between commercial stocks and "emergency reserves."

Commercial stocks or inventory are held by the oil companies, and sometimes also by major consumers such as utilities. An integrated oil company will hold stocks of crude oil and products emerging from its refinery. Oil in pipelines, tankers, barges, trucks, and rail tank cars are all part of the commercial stocks oil companies report to national governments, and which are included in the stock figures published in statistical surveys. The statistics, when reported weekly or monthly, will show large variations in particular product stocks on account of seasonal fluctuation in demand.

These commercial realities are reflected in stock statistics, and make it extremely difficult to distinguish in those data between commercial stocks and emergency reserves. This is particularly the case in countries where governments do not require that industry maintain an emergency reserve, for example, the United States, or where they have only recently done so, as in West Germany. No one can yet estimate precisely how much stored oil in the industrial states could be used in an emergency before the reduction in stock levels begins to cause spot shortages and even runouts.

The most thorough assessment in this area has been conducted by the United States National Petroleum Council, September 1974. For the American oil market as of September 1973, 170 million barrels of primary crude, and 140 million barrels of primary product stocks were

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[1] This section contributed by Edward N. Krapels, Research Fellow, International Institute for Strategic Studies, London.

simply "unavailable"; that is, when inventories are drawn down to that number of barrels the "U.S. logistics system simply would not operate." This is oil held in pipelines, tank bottoms, and in retail delivery vehicles. An additional 70 million barrels of primary crude stocks and 360 million barrels of primary product stocks are needed by the industry to maintain "continuity" of operations. Thus, the "minimum operating level" of stocks, which is the sum of unavailable oil and stocks needed to maintain the continuity of operations, amounted to 240 million barrels of crude and 500 million barrels of product.

In September 1973, by these definitions, 99 percent of reported crude stocks and 97 percent of reported product stocks were needed to support the distribution processes of the industry. None of these can be considered, according to the NPC, to constitute true emergency stocks or reserves.

The NPC's high estimate of minimum operating levels implies that the American oil industry is very efficient indeed, or that the NPC is very cautious. There is strong evidence, however, to support the claim that the nation's oil distribution system is efficient. The NPC notes that, although demand for oil products increased by 28 percent from 1968 through 1973, and refining capacity expanded as well, total inventories did not rise. Furthermore, stocks are a significant drain on an oil company's cash flow, especially at today's oil and money prices, and in the absence of government requirements, the oil companies have no incentive to hold more stock than is absolutely necessary.

In a subsequent report—August 1975—the NPC made a somewhat more generous estimate of what it called the "U.S. emergency reserve base": as of December 1974, about 140 million barrels, or roughly 23 days of American oil imports.

## II. EUROPE AND JAPAN

There is no equivalent to the NPC assessment for Europe and Japan. In fact, statistics on the stock levels of these countries are generally not reported to the public. Currently, a listing of "stock" levels for all OECD countries can only be found in the "Statistical Survey: International Oil Developments," the biweekly survey of the U.S. Central Intelligence Agency. The most recent listing of stocks is shown below:

| Country | Stocks (thousands of barrels) | Days consumption[1] | Notes |
|---|---|---|---|
| Japan | 324,000 | 68 | Average monthend for 1975. |
| Britain | 140,000 | 74 | June through December 1975 only. |
| France | 214,000 | 97 | Average monthend for 1975. |
| Germany | 169,000 | 63 | Excluding January and April 1975. |
| Italy | 157,000 | 83 | February, June, July, August 1975 only. |

[1] Utilizing final inland consumption data found in "BP Statistical Review of the World Oil Industry."

The CIA does not define stocks into its crude and product categories. Needless to say, it is impossible to conduct even a rough country-by-country assessment of the level of commercial stocks versus emergency reserves from such data.

Nevertheless, it is certain that a large part of European and Japanese stocks fall into the "unavailable" and "minimum operating level" categories to which the NPC refers. But since European markets are more compact, have much less pipeline mileage, and more central refinery operations, and the oil companies are required to maintain a certain level of inventories by law in some countries, it is likely that the share of inventories that are readily available is larger than in the United States.

EEC country governments have been under pressure from the Commission to require by law that the equivalent of 90 days of consumption be held in stock at all times. It has recently been reported—Petroleum Intelligence Weekly, January 5, 1976—that the Commission is taking Belgium, West Germany, Ireland, Italy, and the Netherlands to the European Court for failure to establish this legislation. Nevertheless the Commission has also stated—PIW, June 7, 1976—that the community as a whole has 108 days of consumption in stock. The Netherlands was reported to have 236 days—probably includes stocks held by export refineries—Denmark 141, France 118, Belgium 116, Germany 93, Britain 89, Luxembourg 79, and Ireland 76.

These estimates are meaningless without knowledge of the consumption statistics against which they are drawn. The Commission, however, is not releasing more specific information. Energy specialists in the Commission regard the analysis of the real level of emergency reserves important community and national government intelligence, and are unwilling to disclose further information.

The OECD and its energy branch, the International Energy Agency, similarly have not made public the members' stock positions. The OECD at this time is in the process of issuing nonrestricted data on crude and product stocks to member governments.

Therefore, we continue to be limited in our ability to assess the extent to which Europe and Japan may be protected from oil import disruptions. Oil industry sources have provided us estimates that European countries, on average, must maintain 30 days of crude and 30 days of product, measured against daily consumption, to maintain the continuity of their oil distribution systems. Using this estimate, we can infer that selected European countries' emergency reserve base, as measured against the data given earlier on country stocks and consumption, is 14 days for Britain, 27 for France, 3 for Germany, and 23 for Italy. Measured in terms of the number of days of imports, the situation in France and Italy is roughly comparable to the United States, in the neighborhhod of 20 to 30 days of imports.

### III. STOCKS, IMPORTS, AND THE INTERNATIONAL ENERGY PROGRAM

The number of days of imports a country has in emergency reserves has become a more confusing question since the formation of the International Energy Agency. In the negotiations leading to the agreement on the emergency program (the IEP) a common definition of emergency reserves was sought because they play a crucial role in the manner in which the IEP's designers hoped to manage a future crisis. The negotiators settled for an interim agreement which adopted the OECD definition of stock levels (never intended for anything but

reporting purposes), deducts the oil held in pipelines plus an additional and arbitrary 10 percent as unavailable, and labeled the rest "emergency reserves." This interim definition still stands, in spite of constant attempts by the Secretariat to come up with a more realistic one. It must be noted that yet another proposal is about to be submitted to the Agency's governing board.

Although the Agency has not released estimates of the amount of emergency reserves each member has under this definition, it is possible in the case of the United States to work back from the definition to arrive at the IEA's estimate of the emergency reserve. The NPC did this and the resulting figure is about 950 million barrels. The difference between this and the NPC's own estimate of 140 million barrels is striking. The NPC commented that the IEA estimate "does not recognize the need to keep the oil logistic system operating efficiently." A similar judgment can be made in regard to the other IEA members, although it is not possible to be as precise.

We can, however, give a rough indication of how long stocks could protect the IEA members against several kinds of disruptions:

| Selected countries | Normal consumption 1975 (thousands of barrels per day) | Estimated emergency reserves (millions of barrels) [1] | Number of days emergency reserves would last if drawdown equals following percent of normal consumption | | |
|---|---|---|---|---|---|
| | | | 10 | 20 | 30 |
| United States | 15,845 | 140 | 87 | 44 | 22 |
| Japan | 4,905 | 39 | 80 | 40 | 20 |
| Britain | 1,875 | 27 | 142 | 71 | 36 |
| Germany | 2,665 | 8 | 30 | 15 | 8 |
| France | 2,240 | 81 | 370 | 135 | 68 |
| Italy | 1,925 | 43 | 226 | 113 | 57 |

[1] Assuming the "minimum operating level" is equivalent to 60 days of normal consumption, excepting the United States, for whom the NPC estimate is used.

In spite of the inadequacy of the data, these estimates are of interest because they show how wrong the data would have to be before the estimates would show that countries could rely on current stocks for a significant period of time.

## IV. FUTURE PROSPECTS

While conventional stocks have not been appreciably built up since 1974, great plans are being considered by some governments. The United States appears committed to creating a separate "strategic petroleum reserve" of 500 to 1,000 million barrels by the early 1980's. The Government of Japan recently declared its intent not only to achieve 90 days of consumption in conventional storage, but also to create an additional 90 days' reserve under government control.

European countries, except France, have more modest goals. The EEC standard of 90 days of consumption may be met by all countries, but this represents only an incremental gain by some of the members, while others already exceed the standard. The IEA may be influential in prompting further increases, but we must await the outcome of the negotiations on a final definition to get a meaningful indication. Various individual countries have embarked on programs of their own. On record are Germany, with a modest objective of increasing Federal

Government stocks from the current 20 million barrels to about 60 million barrels; and France, where the government has decreed that all crude importers and refiners, not just distributors of finished products, are now required to continuously maintain 45 days of stock.

The American and Japanese reserves will make a substantial difference in the length of time a given oil import loss can be maintained. Roughly speaking, if the United States opts for a 500 million barrel reserve, it can quadruple the number of days the shortages can be sustained. However, if the U.S. imports and dependence on the Middle East are significantly higher than they were in 1975, the length of time is shortened. The same point can be made for Japan. Europe's vulnerability will not be significantly reduced with the current stock plans.

Finally, an assessment of the role of stocks would not be complete without considering the adversaries against whom they are to be used. The Arab States currently provide about 60 percent of the imports of the United States, Japan, and Europe, or, about 12 million barrels per day. Should they decide to curtail production, they must take the increase (if any) in emergency reserves into account in their assessment of how to put pressure on the importers. If they want to confront the importers with an irreplaceable loss of oil supplies quickly, they must curtail production significantly to force the importers to draw down their stocks. Our estimates show that if the Arab exporters cut back by 50 percent, resulting in an import loss of roughly 25 percent, and a supply loss of roughly 18 percent, stocks would be able to maintain a consumption level of 90 percent for only a few months in many countries. Some will face the loss more quickly than others, which further complicates the attempts of the IEA to create a united consumers' response.

In sum, current stocks can "buy time," but not much, and they do not provide absolute security against determined adversaries. Even when the level of emergency reserves for the United States reaches 500 million barrels, our own higher import dependence and the continued vulnerability of the European countries will still be cause for grave concern. Meanwhile, the incongruity of industrial states not yet being able or willing to confront their energy vulnerability in terms of their commercial stocks versus true emergency reserves—a situation which has now been with us for several decades—is inexplicable.

## G. Conclusion

Energy cooperation among the industrialized states involves relations between consumer states, and between them severally and collectively with producers. With regard to the importing countries, cutthroat competition between consumers may have been forestalled. Nothing in the IEP precludes closer relationships between individual consumers and producers but it does make the search for such relationships less frantic. Moreover, at the insistence of Europe and Japan, the United States was compelled to moderate the confrontational impression of IEA by calling for discussions with producers.

The variety of responses to possible emergency situations are necessary but they are only palliatives. Real amelioration depends on other actions taken elsewhere.

# CHAPTER XI.—LONGER TERM SUPPLY SECURITY MEASURES

## A. Introduction

Emergency stocks, conservation/rationing and standby agreements to share available oil may suffice to permit the energy deficient industrial nations to withstand embargoes and sudden supply disruptions. They are clearly not answers to the situation created by the geopolitics of energy—the location of energy resources in countries other than the major consumers and the need of the industrialized nations to obtain reliable access to them. There are, in addition, another set of concerns which are peripheral to long-term solutions but which nevertheless reflect concerns arising from the geopolitics of energy. Secure energy supply will have to include policies relating to critical segments of supply logistics.

Three aspects of this longer-term situation have been identified in Part I and include the need for a careful and continuing watch over: refining capacity, tanker control and the security of "superport" facilities and offshore terminals.

## B. Refining

With regard to refining, it appears that there is presently a very considerable spare (unused) capacity worldwide in the bulk of the consuming regions. Generally, the United States shares in this situation if the Caribbean refineries are included as "secure." The prospect, however, is that with anticipated economic recovery, idle capacity which plagues the industry today could disappear over the next 5 years. In the case of the United States, its "idle capacity" (based upon the Caribbean refineries) will fade considerably sooner and the United States may be increasing its product imports (from European refineries). When this occurs, and absent a carefully timed introduction of new refineries, the vulnerability of the United States to supply cutbacks from abroad could be considerably increased.

The same vulnerability (generalized to include Europe and Japan), could result from a situation in which refineries in the consuming countries were rendered "uneconomic" by the expansion of refining capacity in the producing countries with the producers insisting upon their supply of increasing volumes of product not crude—a longstanding OPEC objective.

As indicated earlier in this report, *crude* imports have a flexibility in sources which permits—within limits—substitution of geographic source; *product* imports cannot be replaced so readily—especially when there is no idle refining capacity. Currently, the spare capacity to meet U.S. needs exists in Europe. If and when the producer nations move to refine greater quantities of their own crude the potential for damage to oil importing nations will again be increased.

The requirement is for government-industry anticipation of such developments, and actions taken to assure a U.S. domestic capability to meet all our product needs. Some form of public subsidization of refining capacity may be necessary much as stocks of key materials are created.

### C. Tankers and Port Facilities

With regard to tankers, until the United States has deepened its harbors and completed its superport facilities offshore, it will not be able to take full advantage of the economies of scale provided by the giant tankers (VLCC). Presently the largest size tanker which can enter U.S. harbors is still limited to about 85,000 dwt (although lightening of larger vessels is often accomplished). This size tanker no longer dominates dwt in world oil trade; in fact, it has become an anachronism so far as major supply to a giant industrial nation is concerned. The number of tankers in this category is diminishing and there are few orders for replacement. Yet it is precisely this size tanker on which U.S. supply will be forced to rely for at least the next 5 to 10 years.

Maintaining an adequate fleet of such vessels is not only a commercial requirement but a charge on the national security as well.

In addition, Governments may have to encourage greater investment in product tankers as increasing quantities of world oil trade will take this form. The possibilities for further conversion of some surplus crude oil tanker capacity should also be assessed.

The problem of defending critical offshore terminals, the concentration points for immense volumes of oil, can only be noted. As an example of the importance of these facilities, the single Shetland Islands' installation, Sullom Voe, projected to receive Shell/Esso and BP North Sea production, could become the reception facility for over 50 percent of Britain's oil. Similarly, terminals in the producing countries which process large volumes of oil for export, such as Saudi Arabia's Ras Tanura and Iran's Kharg Island must be kept secure.

## CHAPTER XII.—LIMITING VULNERABILITY: THE DOMESTIC COMPONENT

Means to limit U.S. vulnerability to sudden, short-term supply disruptions and threats to the logistics system are clearly essential. However, in an important sense these are exceptional occurrences, responses to which buy time, permitting more fundamental actions limiting our continuing, daily vulnerability derived from dependence on oil and oil imports and the control of oil supplies and prices by the producing governments. By concentrating on the United States, we do not imply that many of our options are irrelevant to our allies; indeed, with some variations to reflect individual cases, comparable opportunities exist for others, acting singly in some options, and acting together when useful to do so.

### A. Comprehensive Energy Policy

Obvious as it may be, the first prerequisite for limiting U.S. vulnerability is the adoption, by the United States, of a comprehensive energy policy; this is far from being the case today.

The absence of an overall energy policy, by projecting confusion and continued vulnerability, may suggest to producing governments that military action may be the only possible response to an action of theirs which runs afoul of U.S. interests. In this instance, it has been held that deliberate vulnerability can serve as a kind of deterrent moderating the behavior of producing countries. The element of uncertainty is allegedly made to work for the United States.

We believe this argument serves more as an excuse for a failure to formulate energy policy and make difficult but necessary commitments than it offers a prospect for relief.

A comprehensive energy policy on the other hand, demonstrates the seriousness with which the United States views energy matters and the sincerity of its intention to be freed from the constraints imposed by the geopolitics of raw materials. Internationally, a comprehensive energy policy reveals the seriousness of America's commitment to adequate and secure energy supplies: "energy" is unambiguously and profoundly a matter receiving U.S. attention and commitment, a matter not to be left to the whims of foreign nations blessed by a geographical accident with a disproportionate share of the world's oil resources.

A comprehensive energy policy holds out the possibility that the dominance of the producing states may well be temporary, possibly inducing caution among producers. While not suggesting a dilution of effort, we recognize that by making the position of the producing states less secure in the long term, some could be induced to exploit their temporary advantage more vigorously. Against such possibilities, the "defensive" measures of reserve, adequate tanker control and refining capacity make good sense—if done by all.

The aforementioned requirements, if met, would allow the United States then to proceed on its energy initiatives. Domestically, they are: (1) to proceed with the intensive development of coal, (2) the search for additional indigenous and hemispheric supplies of oil and gas and uranium ore; (3) the maximization of efforts to bring nuclear energy into our economy on widely accepted terms; (4) energy research; and, (5) conservation of all fuels and their highly selective use.

There has been and continues to be some action on these fronts; the essential point is that actions taken to date have been ad hoc, with little recognition of the need for an energy policy and commitment which acknowledges the interdependence of all aspects of the energy picture. Moreover, actions to date, emerging from fierce battles between the administration and Congress and within the administration itself, have done little to reduce the vast areas of uncertainty which continue to inhibit the private sector.

With regard to the search for additional oil supplies, for the longer term, Part I offered a number of observations concerning potential, highly prospective oil regions. The United States can embark on an unprecedented effort to expand supply sources outside the Persian Gulf, to three highly prospective areas within this hemisphere, and also in the sub-Arctic regions where control over discovered oil would be within the grasp of the industrial world.

The three areas referred to consist of Canada, Mexico (and the Caribbean basins) and the Orinocco Belt of Venezuela. Success in developing oil resources in these three, with the strategic crude and product reserve, should give solid assurance that the United States can withstand contrived supply shortages. The political interests of these three are not related to the regional political interests of the Gulf (nor are they likely to be participants in embargo actions taken against the United States over Israel).

Moreover, the United States should consciously reduce its imported crude and products whose origins are in the Persian Gulf. While we have argued the security implications of the Gulf Straits and the African and South Atlantic routes, we do not ascribe to the view that oil shipments from the Gulf are inherently and continually a source of danger. The interests of all key producers—except possibly Saudi Arabia and Kuwait—are embedded in supply continuity, but prudence, reinforced by the desirability of keeping the United States flexible, indicates that preferential import selection away from the Gulf is desirable.

Attainment of a billion barrel emergency stock, coupled to a capability for quick introduction of a stringent, accelerated conservation effort and/or rationing, is still the most important step which the United States can take to limit its immediate vulnerability to supply shortage. A reserve of this magnitude is probably more than ample (except in the aftermath of a general nuclear war).

However, some assert that creation of such a reserve may be all that is necessary to render us all but immune to any plausible scenario. This is nonsense. The reserve is sufficient only to buy time to permit a state to engage all its applicable powers to resume the flow of oil. The reserve does not, of course, affect the level of imports,

encourage indigenous energy resource development, or meet other requirements.

We have also called attention to the need for adequate domestic refining capacity. Within the context of a comprehensive energy policy we would be in a position to examine how to maintain what level of refining capacity needed under U.S. control or influence. Similarly, we could look again at the perennial question of effective U.S. control over crude and product tankers of the required sizes.

In the area of nuclear energy, we still require completion of a massive survey of the United States in terms of tonnage, not so much of the "economics" of uranium ore, in order to determine realistically available indigenous sources of uranium ore and the implied level of necessary uranium ore imports. We require a realistic definition of the additional enrichment or other processing facilities adequate, with some spare, to meet national and international needs.

Finally, among the elements of a comprehensive national energy policy must be the beginning of a process to define the roles of industry and government as we move into an energy era of unprecedented complexity. As in so many aspects, our dealing with the really new and important set of relationships, implied throughout this study, has been ad hoc and inadequate, satisfying no branch of government, industry or the public. Yet we must have a clarification of this evolving relationship if we are to engage fully the greater economic, technical and managerial assets of the private sector.[1]

## B. Role of Government

Over the past several years we have been assailed by an unending stream of recommendations as to what must be done, by whom and how quickly. Many of these do deal with real and vital interests and objectives; most assert an unprecedented role for Government in assuring that the Nation's needs are met.

Few of these proposals emphasize, as we have repeatedly, the complex, interrelated and interdependent actions which must occur in a timely manner if present, conventional and future indigenous energy sources are to be available. We have cited the case of coal and nuclear energy as excellent examples of the need for a government role to facilitate those undertakings whose scope puts them beyond the means of private companies. Moreover, until the government takes actions in these areas, private activity will be inhibited by uncertainty.

We have also in mind that the U.S. Government must possess the means to assure performance, i.e., guaranteeing that an oil company which is also heavily in coal can not negate a national energy policy objective which seeks to limit the use of oil and to expand the use of the other. This calls for an unprecedented kind of peacetime relationship which must be thought through with exceptional care; it does illuminate the hard fact that the provision of energy is no longer only a commercial undertaking. (We must anticipate also the possibility that producer governments, each having its "national oil company" may prefer to deal directly with the U.S. Government on supply; it

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[1] The authors have been invited to undertake such a study—on an urgent basis—under the auspices of Yale University.

is a likely outcome of any "special relationship" in which imports are agreed upon. There are other mechanisms, obviously, which can be employed and we do not recommend the United States choose the route of an official oil entity.)

It will seem anticlimatic, but we choose to place our greater emphasis on the absolute, fundamental requirement of a proper and effective national government oversight of energy, and even involvement in its supply when necessary.

No matter how pressing energy priorities may be, no matter what level of investments and technology are available, without a sensible, disciplined and competent energy grasp by the Federal Government we cannot possibly accomplish the goal of significantly reducing our present and foreseen vulnerability to shortfalls in supply.

Lacking such government oversight, the most we will do is pursue on an ad hoc basis certain aspects of our energy needs in an haphazard, contradictory and inadequate manner; "energy" could then truly become the nation's "Achilles' heel."

If we can be confident in the definition of our energy position—and confident in the intelligent selection of directions, priorities and incentives, and of the durability of national policies, public support for commitments will be forthcoming and the private commercial and research interests of our country can respond.

### C. Government Organization

There are four aspects of Government machinery which need specific attention; if there is nothing much which is new in this list, and the administration (and others) have generally agreed upon it, we choose to refer to "organization" to add our emphasis to its important place in a national energy program:

(*a*) In the executive branch, creation of a Department of Energy whose Secretary should be a statutory member of the National Security Council.

(*b*) Presidential appointment of the Chairman of the Council of Economic Advisers, or the President's Assistant for Economic Affairs, as the Chairman of the Energy Resources Council.

(*c*) Organization of the legislative branch's oversight into a Joint Committee on Energy subsuming all other jurisdictions.

(*d*) Reformation of the regulatory processes of our Government which, if left to their present devices and delays, could alone defeat the private commercial interests in an expanded energy effort and, in so doing, propel the U.S. Government into unfamiliar and undesirable energy roles.

(*e*) Reexamining, still once more, the question of energy competence in government; how to attract into public service experts who can apply their knowledge to the national task. We must greatly improve the quality of our effort.

We require mobilization of public support for energy priorities. As long as all energy initiatives fall on the desire to refrain from granting advantages to "big business" as exemplified by the oil companies, this emotionalism will make positive energy action difficult: only when the public understands the issues will the pressure be on Congress to take positive action. We have never had this, and cannot obtain it,

without private leadership and an educational effort, sponsored not by government or industry, but as exemplified in the Citizens' Committee for the Marshall plan in the summer of 1947. (We had what appeared to be a comparable energy undertaking in the winter of 1973–74 which was totally ignored by government and is now forgotten.)

If these six steps are taken, national energy objectives can be attained; if any one of them is not accomplished, we will fail, perhaps not absolutely or totally, but in the sense of incomplete and inadequate responses. Moreover, as we have suggested, if the United States sets this energy tone, it's very accomplishment will moderate the attitudes and actions of producer (and consumer) nations who might otherwise downgrade our national resolve.

## CHAPTER XIII.—LIMITING VULNERABILITY: INTERNATIONAL IMPLICATIONS AND OPTIONS

### A. Between Autarky and Vulnerability

In adopting a comprehensive energy policy certain international repercussions of policy must be considered. At one extreme, policy tends toward autarky; at the other, toward deepening dependence and both these choices involve important international ramifications.

Autarky may be neither possible domestically (in terms of timing, or at reasonable cost, i.e., costs which allow the simultaneous pursuit of other societal goals) nor desirable internationally. Should the United States deliberately minimize its direct involvement in international energy, generally, the United States may appear to be lacking in interest and commitment to developments in international energy of possibly vital interest to allies (and to the U.S.S.R.).

However, commitment can be demonstrated in many ways and it is unlikely that anyone would doubt U.S. concern in an area so vital to its major allies. The point here is not to discredit U.S. movement toward greater energy self-sufficiency but rather to note that every policy involves costs and implications which must be considered if they are to be offset or amplified, as the case may be.

At the same time, greater U.S. energy self-sufficiency could free considerable quantities of oil for use by consumers with fewer energy options than the United States. It was largely U.S. entry into the international oil market in a big way, post–1970, which changed a buyers' market into the sellers' market which provided such a major contribution to OPEC's "success".

At the other extreme, the United States could attempt to multiply its own dependence on particular producing states as clear evidence of an enduring U.S. interest in them as suppliers. In this way, all the world would be warned that threats to (or from) them would so seriously and directly affect the United States that they would be considered to be provocative and likely to elicit a serious American response—including military action.

Between these two extremes the United States must find a way to demonstrate its sustained vital interest in the producing states without backing itself into a corner from which only a military escape is possible. On balance, the risks associated with greater U.S. energy self-sufficiency appear to be less momentous and more easily negated than the risks associated with deliberate U.S. energy vulnerability.

There are those who argue that the U.S. capability to influence the actions of Europeans and Japanese depends upon many forces, an important one being expressed through our collective energy vulnerability which necessitates collective responses. Without knowing precisely what interests and objectives are served by such an argument, we confine our thoughts to what seems prudent and attainable in greatly

limiting our energy vulnerability and to the extent possible, aiding allies to do likewise.

## B. Energy and the Western Alliance

### I. DISCUSSION

With regard to these allies, a comprehensive U.S. energy policy will have important implications for Western Europe and Japan. In fact, the continued lack of a comprehensive U.S. energy policy is at least one major reason for the inability of other countries to develop their own energy policies; the uncertainty derived from both the United States and the oil producers makes planning nearly impossible. To some, divisiveness within the Western alliance looks increasingly like European pique at its dependence on the United States, but strains within the alliance are nevertheless real.

This uneasy situation might be somewhat ameliorated if the various elements of U.S. energy policy could be submitted, at least for consideration to allies perhaps within the IEA forum, however tricky it might be for domestic political reasons. We are aware of current plans to discuss within the IEA broad energy policy goals with provisions for periodic reporting by member states on their progress in reducing their dependence on Middle East oil. The initiative represents a move in the right direction and should be broadened to include objectives beyond reduced dependence on Middle East oil. If done with tact and with the recognition that allies have something useful to say, it would seem, on balance, that international discussion could be useful both to the formulation of policy and to alliance politics, and might prevent situations in which the policies of different nations conflict and possibly negate each other; competition among alliance countries might be reduced.

Moreover, the United States clearly has an interest in evolving European and Japanese energy policies. Since the United States itself may be susceptible to pressure put upon its allies, the United States must be concerned with the energy policies of these countries—a rather ticklish proposition given the sensibilities of sovereign States, perhaps partially offset by U.S. discussion in the IEA forum of its own energy policy options.

### II. NEW SOURCES

There are additional areas for intra-alliance cooperation and lessened vulnerability through the development of new sources of oil.

Current longer term estimates of highly prospective oil bearing regions are limited very largely to the offshore. Prominent among them is a nearly continuous belt lying along the U.S.S.R., Arctic, Alaska, the Western Canadian Arctic, Greenland, Spitsbergen. It is never possible to estimate productability absent the most extensive of surveys and then actual drilling; the most that can be said is that based upon present knowledge and assumptions there ought to be important oil (and gas) resources in these latitudes. It is an environment which has been perhaps the most difficult to work in the history of petroleum. The technology for doing so is in the possession of the private oil industry predominantly and is therefore an asset of possibly incomparable value.

The United States should take the lead in organizing an international setting of the free governments directly involved in these regions whose single purpose is to encourage and facilitate an immense undertaking by the international oil industry perhaps as consortia, or companies acting singly, to determine what is available and to develop discoveries with utmost speed. It would be an unprecedented endeavor of immense cost but it would be a clear signal of our resolve to remove at least some of the bonds created by a geopolitics of energy which has so sharply focused our attention and bound our energy interests to the Middle East.

### III. STRATEGIC RESERVES

The United States should extend particular efforts to insure that IEA members implement rapidly the creation of truly effective, in-place strategic crude and product reserves. Creation of such a reserve is far more effective when many leading importing states take similar actions. We have warned in this report that stock figures supplied by all member states of the International Energy Agency continue to be suspect, partly because the very IEA definition of stocks permits member states—including the United States—to describe their situations in more optimistic terms than the facts probably justify. It is essential that this highly defensive and necessary creation of reserves proceed rapidly and convincingly.

### IV. ALLIES IN THE MIDDLE EAST

Reduced U.S. dependence on Persian Gulf oil, which has been identified as one aspect of a comprehensive U.S. Energy Policy would also serve to withdraw the United States from some of the implications of the anticipated intense competition between Europe, Japan, and U.S.S.R. for access to Middle East oil.

If we have alternatives, or can help create them, we could avoid some of the risks we run in the significant complications certain to rise from the difference in the high degree of dependence upon the Gulf of Europe and Japan, and the relatively low dependence of the United States. Similarly, as we have stressed also in this report, there are risks to our alliance cohesiveness from a situation in which the United States would continue to try to play a lead role in the oil policies of key Gulf producers when, from their interests, the oil markets of Europe and Japan are so much more consequential.

It is arguable that conditions for a more enduring peace in the Middle East may depend to a greater extent than the United States admits on a consciously abetted renaissance of European (and a strengthening of Japanese) economic and political interests in the region and a consequent diminishment of the seemingly overwhelming U.S. presence. It need not imply any lesser concern of the United States for the security of the region.

Such a course does, however, imply a major shift in U.S. policy vis-a-vis Saudi Arabia. Caught up in the euphoria of a spate of opportunistic U.S. energy overtures post 1973–74, not one of which appears to have been dispassionately argued then or since, the United States is viewed from Europe and Japan as having succeeded in substituting itself in the monopolistic role in Saudi oil previously held by Aramco and its shareholders. This is probably an exaggerated ap-

preciation of what the United States has really accomplished, and not an estimate liked by some Saudis, but it carries a baggage of political implications.

Is the United States acting in a kind of trust capacity for Europe's and Japan's supply? Or as the mainstay of a still very potent set of U.S. private oil interests? Or is the United States keeping a position of great influence over Saudi Arabia to help keep Europe and Japan in line? Or to be in a position to counter a Soviet move southward? Or does the U.S. Government now have so prominent a presence in Saudi Arabia in order to buttress the present regime? Or to help (whom?) maintain peace and stability in the region. Against whose moves to alter conditions? Iran's? Or, by being in Saudi Arabia, does the U.S. Government have an additional fulcrum against which it might be able to exert pressures—in the Middle East—on Europe—on Japan—in behalf of Israel? Or is the U.S. Government in Saudi Arabia for any or all of these reasons which could be supportable but have not been carefully weighed through a process of disciplined inquiry?

Such an inquiry should have highest priority. The ramifications of the above questions extend deep into our key alliance relationships; their exploration is bound to bring us up against the portentous fact of our varying degrees of reliance upon the Gulf for a commodity which is generally vital to us severally and collectively. And the starting point of such an inquiry should be a definition of the U.S. purpose in having so large a presence in oil from the Gulf. If the answer is that we intend to use our presence to influence European and Japanese conduct, then such an undertaking should, first, be based upon the conclusion that such a role is supported by the American public and, second, that the defense and other commitments to support the role will be made.

We do not believe that such a conclusion is correct; rather, that the temper of our times warns against such a course. Generally, we argue that where the United States does not itself possess a direct and vital interest, or where there are alternatives, it is risky to contemplate a role for the purpose of influencing allies in a matter in which their interests are very substantially greater than our own.

In short, we ask that the United States should find ways of making plain to our allies what is now not clear: That it is not our intention to have an exclusive relationship with Saudi Arabia and that, in actuality, we reaffirm our belief in the general beneficial effect of an "open door" doctrine among these industrialized countries.

## V. CONCLUSION

None of these initiatives will result in a total identity of views or the establishment of complete harmony within the Western alliance; nor are these the objectives (which is to decrease U.S. vulnerability to the geopolitics of energy). The different resource positions of Europe and Japan versus the United States will continue to make for divergent interests and differing world views. Moreover countries will retain the right to go outside the alliance directly to producing states. But the United States will retain this option as well. There is too the possibility that U.S. allies will move cautiously in moving beyond the realms of the alliance because bilateral arrangements might prove very costly.

## C. Access to Energy and the North-South Dialogs

In the aftermath of the 1973 OAPEC oil embargo, it became increasingly clear that access to raw materials would be influenced less by the physical demands of the industrialized countries and more by the economic, political, and social objectives of the less-developed countries wherein these resources are located. It is not that the needs of either consumers or producers would be neglected (it is in no one's interest that this be the case), but rather that the balance had tilted in favor of producers as the vulnerability of the industrialized countries became manifest and the example of OPEC's success inspired hopes among the LDC's. The terms of access, questions of local processing, and the distribution of benefits from raw materials exploitation are open and evolving.

The LDC's, including, of course, all OPEC members, saw in OPEC's accomplishments a chance for inducing broad ranging changes in the prevailing international economic order which increasingly appeared to these countries to be weighted against their interests. The LDC demands are not new—stabilization of export earnings, trade liberalization for LDC manufactured goods, greater transfers of more relevant technology, debt relief, and so forth; what was new was the perceived enhanced position of the LDC's vis-a-vis the developed countries derived from the "oil link."

For the OPEC states the oil link appeared to be a relatively inexpensive way to demonstrate LDC solidarity borne of a commonsense of historical aggrievement, a means of securing LDC diplomatic support on the Arab-Israeli issue, a means of increasing the costs to the developed countries of any precipitores military action under consideration and/or a way to increase the role and leadership of individual OPEC members in a united LDC bloc and in more general international affairs. From the perspective of the non-oil LDC's the oil link, to the extent that it could wrest concessions from the industrialized countries, was vital as higher oil prices wiped out the chances for economic growth and progress. Breaking with OPEC would not secure them less expensive oil; concessions from the West and Japan were, under the circumstances, urgent and it was perhaps only the oil link which brought renewed attention, at least, to these longstanding LDC demands. Today, issues between the developed and developing countries are being discussed in almost every international forum and collectively these are the North-South dialogs.

The oil producers, by repeatedly linking the issue of access to oil to the broader demands of the LDC's, guaranteed that developments in more general North-South relations will have important implications for access to energy resources:

1. On the most general level, the oil producers have repeatedly warned that lack of progress in the "North-South" dialogs and a continued unwillingness of the industrialized countries to make concessions to LDC demands, will result in higher oil prices and possibly, production limitations.
2. Actual trade, aid and investment policies emerging from the "North-South" dialogs may affect access to energy raw materials.
3. On a less formal level, the changing relations among nations, occasioned by the "North-South" dialogs, may also have important implications for access to energy.

## I. THE "NORTH-SOUTH" DIALOGS AND OIL PRICES

In the immediate term, the oil producers have repeatedly warned that the continued unwillingness of the industrialized countries to accede to LDC demands, will result in higher oil prices. Sheik Yamani, the Saudi Oil Minister, also suggested that in the absence of any progress in the "North-South" dialog, particularly in the Conference for International Economic Cooperation (CIEC), oil production might be cut back. Regardless of the sincerity of the OPEC commitment to the LDC cause, (and it varies from OPEC member to OPEC member), having made the commitment it would be politically inopportune for OPEC to renege on it now.

It cost OPEC little to champion the LDC cause in this way and provided an additional rationale and justification for higher oil prices which would probably have accompanied economic recovery in the West and Japan and escalating prices for OPEC imports originating in the industrialized countries in any event. Until recently the happy possibility of raising prices to punish the developed world did not seem onerous. However, the costs to OPEC of the oil link are rising; aid commitments by the OPEC countries continue to increase so that OPEC's resolve to get Western and Japanese concessions for the LDC's is probably additionally motivated by a desire to avoid escalating direct LDC demands on OPEC finances.

In addition, the threat of higher prices is now partially revealed as a bluff. In the absence of a two-tier oil price, to use higher oil prices to induce the developed countries to make concessions is probably at least equally harmful if not more destructive, to the non-oil LDC's as to the industrialized countries. Just as the cost of the link to OPEC is increasing, its power has been revealed as a double-edged sword.

This is not to downgrade the oil link to the point of zero utility or impact. Rather, it seems likely that the unwillingness of the oil producers to blatantly betray the LDC cause does complicate oil relations and puts pressure on OPEC to accomplish something for the LDCs. Within OPEC, the position of moderates who seek price restraint and production adequate to meet free world demand, may be strengthened by Western and Japanese concessions while continued unwillingness to make any adjustments in the international economic system may enhance the position of OPEC "radicals". It is debatable whether the industrialized countries should continue to allow OPEC to use the "North-South" dialogs as an excuse to raise prices. At the same time, the link is a double-edged sword in another respect; the resolve of the industrialized countries may have been reinforced by an unwillingness on the part of the developed countries to appear to be succumbing to OPEC pressure.

## II. LONGER-TERM IMPLICATIONS FOR ACCESS TO ENERGY

With the convocation of the Conference for International Economic Cooperation in Paris in December 1975, it was anticipated that these North-South discussions would result in a long term agreement, stabilizing oil prices and supply. The oil link was to establish a three-way relationship in which Western concessions to the less developed

countries would be reciprocated by a formal agreement with the oil producers guaranteeing secure access to oil in adequate quantities and at reasonable prices.

A year into the CIEC meetings, it is increasingly clear that such a formal agreement is not likely to materialize from these deliberations. OPEC members seized the power to determine prices and production levels only in 1973; it is difficult to visualize their relinquishing or sharing it with the industrialized countries now. Moreover, to the extent that one expects a tightening of the oil supply/demand situation and the further shifting of the balance of power towards producers inherent in such an eventuality, there is little reason for producers to relinquish that power in advance or to get locked into an international agreement.

Moreover, OPEC's demands for its own members (security of financial assets from the effects of inflation and/or currency depreciation, investment guarantees against political risk, a greater voice in international monetary affairs and greater Western and Japanese assistance in industrialization and economic diversification) coincide with the interests of the industrialized states and could be agreed to by the West and Japan out of their own self-interest and without reference to a formal oil agreement.

Thus it is in the interests of the industrialized countries to provide within their borders and internationally, investment, opportunities and instruments, hedged against inflation, currency depreciation and political risk. Only in this way can the industrialized countries encourage: The petro-dollar recycling on which relative balance of payments stability depends; the higher oil production levels needed in producing countries with little need or ability to utilize even greater oil revenues; and the greater stake for producing governments in the health and stability of the international economic system which might induce moderation in their activities.

Not only will the industrialized countries offer such mechanisms in their own self-interest, but they are competing with one another to do so. And strangely, it is surprising how really little has been done in these regards although the United States and United Kingdom Governments have apparently offered special investment options to attract OPEC funds.

Considering that the relationship was meant to be more complex, i.e., if the West and Japan had little beyond that which they would offer OPEC members regardless of an oil agreement, they could make concessions to broader, linked LDC goals, the industrialized countries had little incentive to do so. With concessions, the industrialized countries could find themselves paying higher prices for a wide range of internationally traded commodities without coming any closer to an international agreement on oil simply because OPEC had little interest in an agreement of that sort.

It is possible that some different arrangements for commodity trade might be agreed at CIEC or the upcoming meeting on the LDC—proposed common fund for stabilizing international commodity prices and these could have some impact on oil; it may be more likely that oil remains a special case dependent on a tight demand/supply situation, the essential need for the commodity and the unavailability of immediate substitutes.

## III. "NORTH-SOUTH" RELATIONS

In the absence of international agreement, access to energy and raw materials generally will be influenced by the tenor of relations among states and blocs of states. These relationships are currently evolving, and will, in turn, be influenced by what transpires in the various forums in which the "North-South" dialogs are being held. From this perspective, apparent U.S. leadership of a movement to destroy LDC solidarity and to prevent any substantial agreement in any of the various pieces of the "North-South" dialogs may not be in the U.S. interest.

U.S. intransigence saves U.S. allies from agreements which may prove costly to these resource-deficient countries but it does not preclude them from making their own agreements with the LDC's. To the extent that delay, apparent confusion and U.S. policy make it unnecessary for these countries to pay higher prices for a broad range of goods, the Europeans and Japanese remain free of the stigma of acting as "spoiler" and free to attempt a more accommodating approach in other ways, even to the exclusion of the United States.

For example, the Lomé Convention (1975), between the EC and the 46 African, Caribbean, and Pacific countries (ACP), certainly suggests a greater willingness on the part of the EC countries to meet the LDC's at least halfway. Generalized, nonreciprocal trade preferences, greater multilateral financial assistance and the innovative STABEX scheme for compensatory financing to stabilize LDC export earnings are symbolic of a more accommodating attitude on the part of the West Europeans.

More recently, the West Germans have apparently dropped their opposition to the LDC-proposed common fund for stabilizing the prices of a number of commodities. The hope is that the good will resulting from this European and/or Japanese willingness to meet the LDC's halfway will spill over into the oil and energy areas. If bilateral arrangements and special relationships play a greater role in determining access to energy, the United States may be handicapped by the LDC conviction that the United States is considerably less than an honest and committed participant in the "North-South" dialogs.

This is not to suggest that the industrialized countries should succumb to OPEC pressure and resign themselves to LDC demands. But the demands predate 1973. Hard bargaining in many international forums and the arrangements finally agreed will contribute to the kind of international environment in which future questions of access to raw materials and energy resources will be determined.

Moreover, the current environment is conducive to internationally agreed change. The LDC's are currently less ideologically militant, more pragmatic and nationalism has lost some of its negativism and anti-Westernism while searching for a more positive content. They have implicitly recognized the West as being more essential to their own economic well-being than the Soviet bloc—a point which could not have escaped Soviet notice, although it is not easy to suggest the form the eventual Soviet response will take. The developed countries continue to bargain from a position of strength. The United States has a wide range of options and the evolving international environ-

ment is fraught with challenges and opportunities. In the event that the opportunity is allowed to pass, intentionally or through lack of leadership, a return to acrimony and confrontation is likely.

What then of the institutional arrangements of the "North-South" dialog? The dialog continues in many international forums. The CIEC is due to wind-up in mid-1977. CIEC is important to the United States because it is the sole international forum, in which the United States is a member, dealing with energy issues and including both producing and consuming countries.

Because of its scope and composition the CIEC Energy Commission constitutes a forum for increasing mutual understanding and appreciation of the respective interests of the producing and consuming countries.

Such a forum is both important and necessary. It may prove impossible to convince OPEC or the non-oil LDC's that such a limited initiative should go on regardless of developments in the wider CIEC undertaking. An organization separate from CIEC but similar in composition to the CIEC Energy Commission will be difficult to create because it would look like OPEC's abandonment of the oil link and the LDC's.

The United States should make an effort to convince other countries of the continued importance of the Energy Commission or the need for an organization like it. Some moderate U.S. cost might be incurred to keep this important initiative underway.

In a future in which the tone of the international environment and new international relationships will strongly influence access to raw materials—including energy resources—oil and uranium—it is prudent to ask if current U.S. policy may put the United States at a competitive disadvantage?

We have stressed the "North-South" dialogs, and emphasized below the urgent need to engage all the economic interests of producers into the world trading system because such purposeful efforts on our part may be the only way of diminishing the effects of the geopolitics of energy for as long as we are so dependent on oil.

### D. Balanced Interdependence

Some greater protection against the vulnerability derived from the geopolitics of energy can be found in deliberate efforts to redress the imbalance of interdependence occasioned by the unilateral power of producers over production and prices. The United States is not without assets and options in this regard.

With specific regard to oil, producers could be encouraged to participate in all phases of the industry. By multiplying their stakes, producer countries may develop interests closer to those of consumers, even if their greater involvement in oil operations also enhances their ability to manipulate supply and price for other than commercial reasons. Downstream investments in consuming countries might give producers an additional incentive to supply such projects.

We know that there are alternative means for tying producers' interests to consumers' interests and policies should be devised with this end in mind. Others have stressed that increased producer country direct and other investments in the developed countries might provide

one route—with appropriate industrial sectors previously determined to be closed to any but national investors, that is, the key sector approach which is employed by almost every country to insure national control of sensitive industries. In this way the general economic health and well-being of the industrialized countries becomes of more than passing interest to the producing governments. Some of them have already quite explicitly recognized that their own economic well-being is intimately associated with developments in the Western economies. Efforts to make this increasingly clear and valid should be intensified.

We should continue to reinforce trade ties with an expansion in U.S. exports of goods essential to the producing countries—including food. As development plans are implemented and expectations rise, it will be increasingly difficult for the producing countries to do without imports from the industrialized countries; that is, Colonel Qaddafi's threat to simply return to the desert will be increasingly difficult and unpalatable.

These suggestions embrace the traditional means whereby the interests of societies become mutual and, therefore, durable. We do not emphatically regard arms sales as having these results. At the most, they may for a brief period bind some of the interests of one nation to some of those of the other. They can complicate relations between the states rather than create common denominators of national interest. An effort aimed at "buying oil" by arms sales is the near antithesis of what we recommend.

In addition, there are still exporting country demands which may not be unreasonable and which still have not been addressed by the industrialized countries.

Indexation however, should not be considered among them. Saudi Arabia probably does not want to see the introduction of any automatic mechanism for price determination as this would detract from Saudi ability to influence OPEC. Moreover, from our viewpoint, the onus for price increases should remain with OPEC and not be transferred to inflation in the industralized countries.

Demands for investment guarantees seem more reasonable and if some could be generalized to protect all foreign investors, U.S. foreign investors might benefit as well. Desires for investment instruments hedged against inflation and currency devaluations do not seem out of line but the banking community would be better able to judge the effects of a more widespread use of such instruments. To date, there is little to indicate movement in these directions, although there are new U.S. Treasury instruments, or even serious study of what is a frequently expressed producers' objective.

Joint investment opportunities should also be explored. The question of whether countries with government energy companies have an advantage vis-a-vis the U.S. industry should also be studied with care taken to differentiate efficiency of supply from the issue of political advantage.

In addition to meeting some of the demands of some OPEC countries, such actions as those suggested above do not tie the United States to developments in the oil demand/supply situation. that is, should the U.S. situation turn out to be temporary nothing suggested here binds the United States to oil prices which do not reflect the changed circumstances.

The industrialized countries do have assets and opportunities to redress their energy imbalance without necessarily increasing the vulnerability derived from dependence on imported energy resources. Nothing precludes the producers from taking what appears to the outsider as irrational actions; but the costs of such action clearly would be higher.

## E. Special Relationships

### I. INTRODUCTION

If secure, adequate, continuous and reasonably priced oil supplies can not be obtained by international agreement, consuming countries may fall back on bilateral arrangements and "special relationships." The questions to be addressed include; (1) to what extent does a special relationship enhance security of supply? (2) at what cost? (3) under what circumstances do such relationships endure? (4) realistically, what opportunities for forming special relationships does the United States possess? (5) what are the problems, perhaps special to the United States, which our governmental-private sector system raises with special relationships? and, (6) what are the consequences of a special relationship for the particular producing governments and are those consequences consistent with the U.S. objective of attaining greater security of supply?

Historically, special relationships have taken various forms and served various purposes. Colonialism was a form of special relationship which secured for the colonial country any number or combination of objectives including: (a) areas for settlement; (b) access to raw materials; (c) potential export markets; (d) investment opportunities; (e) sources of labor; and (f) the trappings of power in a world in which competition for colonies was intense and colonial possessions symbolized strength. Relations between the colonial country and the colony undoubtedly would have been far different in the absence of colonialism, if such relations existed at all. By and large, colonialism represented an almost exclusive relationship between the metropolitan country and the colonies. Such relationships were not without cost to the colonial countries nor completely without benefit to the colonies.

With the increasing assertion of the colonies and the weakening of the colonial countries in two world wars, the interests of each side became sufficiently different to make a continuation of the relationship on the same terms unlikely. With the rise of the United States and the U.S.S.R. on the world scene, the colonies had alternatives to the mother country and the ascending powers were eager to break the exclusivity of the colonial relationship.

Colonialism was an artificial creation dependent on the overwhelming power of one side to maintain it and the weakness of the other side to resist. Colonialism could not survive the changes that occurred in its foundation.

Alternatively, special relationships may emerge for naturally occurring reasons, for reasons of a real coincidence of national interests or for reasons of deliberate government policy or some combination of these.

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Geographic location naturally influences relations among states. For example, the Soviet Union has special relationships with the countries of Eastern Europe. While there are many reasons for this, at least an important one among those reasons must have been the Soviet desire to protect its Western flank from a resurgent Germany. Moreover, geography has given all these states a mutual interest in seeing to it that Germany would not threaten them again and providing for the collective defense which could deter and/or defeat a resurgent Germany. (The latter point, of course, binds NATO allies together in their special relationship to West Germany).

It is these special relationships, based on the foundation of common interests which prove most durable. The Atlantic alliance is an example of a special relationship based on shared common interests which endures because, regardless of differences in relative power, world views, and judgments as to appropriate means, both the United States and Western Europe believe that their fates are inextricably tied one to the other.

With regard to access to oil the central question relates to the capacity of the United States and hemispheric oil producers to create by government agreement a special relationship which will reflect the mutual interests of the participants. Under normal circumstances our system would look naturally to the private sector to accomplish this purpose. The history of foreign oil in all the areas under discussion virtually precludes our ordinary approach for political reasons embedded in their national experiences.

We believe the United States may have opportunities to fashion such relations with its geographically close neighbors, shortening the oil supply lines and reducing U.S. dependence on Persian Gulf oil.

A balanced consideration of the value of special relationships will also consider the costs of such relationships and the issue of increasing dependence on single sources, even if those sources are not Arab. An important element in cost considerations is the degree to which the special relationship commits the United States in terms of price. If the oil demand/supply situation should change, the United States will not want to be bound by prices which no longer reflect prevailing market conditions.

In the context of this report we have limited ourselves to defining the questions which must be addressed if a policy of cultivating "special relationships" and preferential sources is to be intelligently evaluated as we believe it must be. We can suggest broad outlines of possible special relationships between the United States and its hemispheric neighbors. We can suggest that the opportunity for developing such relationships may actually be at hand and that special relationships with close neighbors offers the United States one major avenue for reducing its dependence on Persian Gulf oil, a goal quite as consequential for U.S. allies as for the United States itself. We can identify questions which should be addressed if such relationships are to be mutually beneficial and therefore, enduring.

Further study could probably address all these issues in far greater detail, including the question of costs and increasing U.S. dependence on hemispheric sources of supply. It may well be that oil and energy are so very consequential that cost is a less relevant consideration than security of supply, but the cost should be known.

## II. VENEZUELA

During the decade of the 1960's Venezuela repeatedly indicated its interest in preferential access to the U.S. oil market. That is, in return for preferential access to the restricted U.S. oil import market, Venezuela would guarantee quantities of oil supply. At the time, U.S. Government officials ignored the Venezuela proposal. Private oil companies, involved in negotiations with the Venezuela Government regarding their concessions, cautioned the U.S. Government against any overtures to Venezuela which might jeopardize the negotiations and their interests. In the event Venezuela became a founding member and staunch supporter of OPEC, the concessions were eventually lost in any event and the United States may have missed an opportunity to guarantee supply.

The old concessions are securely under Venezuelan control and there is little the United States can offer in this area; the Venezuelans, in new relationships with the private oil companies, need no additional assistance in this area of oil production.

The same cannot be said of the Orinoco petroleum belt. Here United States financial and technological assistance could enable the Venezuelans to tap this potentially huge source of oil (and oil revenue). Having only recently nationalized the concessions of the major international oil companies, it may prove politically embarrassing to the Venezuelan Government to invite these same companies back into an important position in the Venezuelan oil industry by giving them development responsibilities in Orinocco.

A United States Government initiative designed to assist the Venezuelans in developing the petroleum belt may be less objectionable in terms of Venezuelan politics. However, because the United States is hardly more palatable than the major international oil companies, which were viewed as agents of the United States Government in any event, the terms of such United States-Venezuelan cooperation must be firmly rooted in Venezuelan interests and must scrupulously avoid the appearance of exploitation.

In spite of advances in transportation, the United States remains a natural market for Venezuelan oil and oil products. The United States could then assist in the development of Orinocco with reasonable assurance that any product from this area would naturally find its way into the U.S. market. The United States therefore, could refrain from demanding such a guarantee but could encourage the eventuality by offering preferential treatment to oil from the Venezuelan petroleum belt. As Venezuela's natural market, however, a preferential agreement may not be necessary.

Consideration should also go to two additional questions: (1) how does the Venezuelan commitment to OPEC solidarity affect the possibility for such a United States-Venezuelan relationship?; (2) given that the United States is a natural market for Venezuelan oil and the fact that United States withdrawal from the Middle East oil market is as beneficial to the Europeans and Japanese as it is to the United States, might not United States allies be encouraged to assist in the development of Orinocco making the initiative more acceptable politically?

### III. MEXICO

The Mexican Government nationalized the operations of the private international oil companies in 1938. In spite of the fact that the event is now almost 40 years old, it is still viewed with nationalist pride as marking the real beginning of Mexican independence. In addition, the Mexican Government established a state oil company, PEMEX, which by now has accumulated considerable experience and skill.

The possibility that offshore Mexico may hold large oil reserves and that the Reforma field might represent a major oil field discovery and the consequent possibility that Mexico will become a more significant oil exporter makes a definition of United States-Mexican relations important.

PEMEX may be capable of developing Reforma alone, in which case preferential access to the U.S. market might be agreed but here too the issue of preferential treatment must be weighed in light of the fact that the United States may be a natural market for Mexican oil. Of course, nothing really prohibits the Mexicans (or the Venezuelans for that matter) from incurring the transportation cost of shipping Mexican oil to Europe and the issue of preferential treatment must be carefully evaluated.

Should the Mexicans reject assistance in oil development there are a whole host of additional Mexican interests which could be addressed in a special relationship—trade, investment, labor issues, et cetera. A special relationship of this sort must necessarily cover areas other than energy raw materials and the cost to the United States may therefore be higher than a straight oil arrangement. Making such a relationship politically acceptable to Mexico may prove even more difficult than in Venezuela which is not to suggest that an effort in this direction, requiring more skill than the U.S. Government has previously evidenced in its dealings with LDC's, should not be forthcoming.

Also we emphasize that as far as the United States is concerned the choice is not an either-or one, that is, selecting Venezuela for a special relationship does not preclude a similar relationship with Mexico. In fact, if a special relationship materializes vis-a-vis Venezuela (or Mexico) the other country may be more willing to negotiate a similar arrangement. If both countries participate, the special relationships might be more politically acceptable.

### IV. CANADA

The United States has long had a de facto special relationship with Canada in the energy area. At the same time that Venezuela was requesting a special relationship with the United States, the Canadians received special consideration in U.S. energy policies. The relationship evolved from the close intermeshing of the economies of the two countries and the special situation of Canada often required special Canadian exemption from U.S. laws. It is understatement to note that, while recognizing the benefits of the U.S. tie, the Canadians were hardly pleased with their dependence on the United States. Particularly in the area of natural resources—including oil—the control of these resources by foreigners (largely the United States) is an irritant in Canadian-American relations.

In the aftermath of the 1973 embargo, the Canadians took the opportunity to claim Canadian oil for Canadians. The oil export tax was raised and exports to the United States are to be progressively reduced as the Canadian logistics system is extended to allow greater interprovincial flows of oil.

The United States and Canada might develop joint projects of interest to both countries—including exploration and development in the Canadian Arctic, U.S. assistance in developing Canada's extensive tar sands deposits, and perhaps some greater degree of cooperation in the nuclear energy area. We may seek with Canada joint efforts in gas transmission; we have agreed upon the terms of a general pipeline treaty. Moreover, the Canadian Government now accepts the certainty of its becoming an energy importer as its current sources of oil become depleted. As the full import of this assessment sinks in, we expect fresh efforts by Canadian private and public companies (PETROCAN) to explore on a wide scale. The United States—privately and publicly—may find fresh opportunities to assist.

### V. CONCLUSION

All these areas provide opportunities and challenges to U.S. policy. The opportunity is available to substantially shorten U.S. oil supply lines and to reverse the trend of increasing U.S. dependence on Persian Gulf oil. The challenge resides in identifying areas of fundamental common interest on which to build durable and mutually rewarding relations.

## F. Saudi Arabia

We have returned repeatedly to the pivotal role of Saudi Arabia and the continuing need to adjust United States-Saudi relations in light of Saudi Arabia's increasing importance as the major oil producer with spare capacity in a tight oil demand/supply situation, Saudi influence in OPEC, and the essential importance of Saudi oil supplies to U.S. allies.

Decisions taken by the Saudi regime as to production levels and price will be of exceptional importance. A recent study has received widespread notice for it emphasizes the necessity of an early Saudi choice, between one of three alternatives, as world demand rises to meet presently available supply, the limit now placed by Saudis on its production (8.5 M bbl/d) is some 3 M bbl/d below present capacity. The margin is the crucial factor; according to the study, the practical, available Saudi capacity surplus may be 1.5 M bbl/d.

The three alternatives discussed in the report are to: (1) maintain the production limit against the increasing demand; (2) lift the limit, and (3) lift the limit and raise prices. Exercise of any one of these alternatives would be a signal demonstration of Saudi oil power.

There is a fourth alternative which may be equally attractive at least. The fourth alternative is to *lower* production on the grounds that Saudi oil revenue is wildly excessive to its needs, that there has been no progress on its insistence that excess revenue invested abroad be protected against loss in the value of the dollar (or other currencies) and that there is no durable, reasonable rate of return for Saudi Arabia's diminishing resource.

Such a decision, which we would argue is as likely as any of the others, would have several immediate effects on the revenue earned

by all OPEC states as a price increase would be inevitable (it would also, of course, bring an increase to Saudi Arabia but the effect on all other OPEC states would be great and could, indeed, be one of the reasons in support of such a Saudi move). The other effect would be ominous in that a lowering of the production level would bring producers and consumers closer to the crunch—where demand bumps sooner against supply and the pressures to get oil would build with danger of "miscalculations."

Against these possibilities, it is extraordinary that neither the United States (nor anyone else) is thought to be knowledgeable enough about the Saudi elite to have a more convincing appreciation of the probable directions of its oil policy. For all of the U.S. vaunted "special relationship," others are uneasy over the signals one Saudi or another flies which suggest that the United States has either misled itself into thinking that it knows the Saudi directions, or the Saudis may have misled the United States. Perhaps it is a case of both. Perhaps there is no unity amongst the Saudi elites on these positions or that the intricacies of the Saudi role in world oil are only now being understood by influential cliques within the royal family. The blunt fact is that we do not seem to know, which makes judgments as to the directions and durability of the regime more like guesswork.

This is the place, then, in this report to be reminded of the principal observations usually made of the Saudi government:

(1) The royal family is closely linked and there is little prospect of a serious division of interest which would be an opportunity for a coup;

(2) Even if there were a coup, the Saudi interest in oil revenue would compel them to maintain the flow (and it would be a good idea immediately to assure the United States, Europe, and Japan that this is to be the case);

(3) There is no possibility the Saudis can generate amongst themselves the skilled (and unskilled) labor force in sufficient number to realize even a scaled-down version of their development program; imported labor on a very substantial scale will continue to be needed;

(4) Similarly with "management" skill;

(5) There is little prospect that the Saudis could defend themselves against an attack from outside (Iran or, conceivably, Iraq); Saudi dependence upon U.S. support of all kinds is thought to be an essential ingredient in Saudi thinking;

(6) Saudis prefer to deal with Americans for a variety of reasons including their experience with Aramco;

(7) It seems likely the Saudis will not be able to meet their principal development goals in time and that the frustrations attendant to this anticipated failure will be a serious factor in internal clique alignments; and,

(8) As long as the golden eggs are distributed generously and with a sensitive hand, the chance of disaffection or envy "getting out of hand" is remote.

What is curious about this list is that it does not seem to be read as containing serious warnings but *in toto* to be read as "assuring" of stability. Applied to another country, the list would be regarded as almost a prediction of trouble: a vast country of an untold energy wealth which is vital to the needs of great, industrial powers; a regime

based upon an extended, near tribal system held together to some degree by loyalty but even more by its access to Croesus-like wealth and its "fair" distribution; unable to defend itself without dependence on a very major, external power; a country moving into modern times at break-neck speed with all the superficialities one would expect, dependent to an inordinate extent on large numbers of imported laborers and managers; located in a region where historic issues and relationships seem to tend more to divisiveness and suspicion.

These observations constitute necessary reminders of the weak underpinnings of a group to which the United States is so deeply committed, for whose conduct in oil matters the United States will be held to have been so very influential. This is the situation—an extremely difficult one—in which the United States and Saudi Arabia find themselves, or have put themselves. Whether the relationship is durable, or subject to swift change, is, of course, a key question. Whether the United States, anticiapting difficulties in Saudi Arabia, in the Gulf, and with European allies and Japan over its near exclusive position in this oil giant should modify its relationship has already been discussed (see section on U.S. allies in the Middle East).

## G. The Soviet Union and the People's Republic of China

As for the Soviet Union, barring its easy access to the capital and technology and management skills of the oil industry, we do not anticipate its being able to be a major oil exporter to the industrial world within the foreseeable future. Instead, we think it more likely to be the case that the U.S.S.R. will be forced to import oil—probably from the Middle East—to meet its domestic needs until such time as it is able to draw upon the prolific fields said to be in Siberia. As such, the U.S.S.R. may not be a serious factor directly complicating Western and Japanese oil supply. As a competitor for relatively small amounts of Middle East production it is not likely the U.S.S.R. could use "oil" as a source of disturbing influence in the region. Under the circumstances U.S. policy will have to carefully reassess the desirability of providing technical and/or financial assistance to Soviet energy development.

We have warned repeatedly, however, that this situation, prevailing for oil, may not hold for natural gas where the potentially leading suppliers in world trade are likely to be the U.S.S.R. and the Middle East. It is not so much a case of their gas becoming a major source of energy in Europe or Japan as it is a danger that its selective end-use in the industrial economies could give crucial leverage to the suppliers.

In the case of Communist China, its energy potential is impossible to discuss intelligently in any detail. No one knows, although some claim to do so. Based on the fragmentary evidence accumulated, we think it is more likely than not that China will have its hands full with the priorities and requirements of an economy moving into the petroleum age. Such oil as may be made available for export would not be large enough in volume to diminish significantly Japanese dependence upon the Middle East, for example. One estimate is that China would be fortunate if it could export as much as 800,000 barrels a day by 1985. In short, we have not considered China to be in itself an important factor in energy world trade.

## CHAPTER XIV.—NUCLEAR

On the nuclear fuels supply issue, the United States must move on several points; given assumptions accepted in this report, of the likelihood of a shortage of ore and of enrichment facilities, and the probability that the present lead of U.S. technology will be progressively diminished, the time within which the United States can exercise nuclear "muscle" is confined to no more than the next decade or two. Other countries will not wait for the ore shortage to exist or the closing of the technology gap to undertake their own initiatives to assure supply; anticipating these developments and recognizing the long lead-time needed directions will be charted in nuclear energy acquisition. We have seen evidence of this in many places.

Nevertheless, the intimate relationship between nuclear energy for war and peaceful purposes compels the United States to move with great firmness toward the adoption of its concept of international, regionally located fuel enrichment and other processing facilities. The difficulties lie in three directions: (1) the interest of Germany, France, the United Kingdom, Japan and the United States Governments and industries to develop major stakes in the provision of commercial nuclear plants; (2) the interest of nuclear-to-be industrial and developing states who see in their capture of the whole fuel cycle both the symbol of modernity and the means to be in weaponry; and, (3) the potential uranium ore exporting nations—such as South Africa, Australia, Canada, Gabon, et cetera—who have every reason not to export the ore itself, but as fuel. For all these varied interests, the otherwise obvious attractions of regional processing centers begin to fail.

The convening of the "Suppliers Club" of the leading nuclear—advanced countries has been, presumably, to define the terms on which nuclear energy for peaceful purposes is to be made available to LDCs (and other industrial states). There are those, of course, who ask if this is not another OPEC in-the-making; and, of the apparent attempt of uranium ore producers to conspire, another comparable undertaking. These assertions raise many complications. The one we single out is both a warning—and an alert for the seizing of a possible opportunity: it seems likely that nuclear energy will become a topic in energy discussions previously limited to oil; the demand for one will be linked to the other. Carefully and imaginatively handled, there could, for some nations, be a constructive link forged which would put energy generally, and not specifically one source or another, into a more general world economic setting.

Surely it should be possible to create a process whereby the equipping of a number of regional fuel centers could be allocated to suppliers leaving them to compete on the reactor level. If it is not possible to attract ore-exporting nations to the regional centers then it may be necessary to examine the potentialities for "special relationships" between the United States and exporters to assure the United States

of adequate uranium ore. We know that other states are actively considering such commitments. Most recently, the Japanese Government has undertaken an effort to explore and develop Indonesian uranium supply potentials. Japan has similar intentions with Canadian uranium resources. The examples will multiply. If so, most of the observations pertinent to such special relationships for oil are as valid for uranium (see section on special relationships).

Finally, the creation of national banks of uranium ore, most advantageously after some degree of processing, is as fundamental a security need as is an oil strategic reserve. The difficulty of each nuclear power attempting such is comparable also to the problems raised by major oil importers who wish to create, all at the same time, a strategic reserve when available supply may not permit it.

# CHAPTER XV.—EPILOG—POLICY RECOMMENDATIONS

With regard to reducing U.S. vulnerability to possible emergency situations, the United States should:

1. Maintain the International Energy Program as a symbol of the unity and commitment of the industrialized countries. Continuing and necessary efforts to strengthen the International Energy Agency by defining its functions and possibilities in more realistic ways than has been the case to date are essential.

2. Establish with the utmost urgency the Strategic Reserve which has already received congressional authorization and requires now intensified effort. In order to enhance the value of such a reserve. U.S. allies should be encouraged to establish their own Strategic Reserves. Additional work is still needed on defining and measuring adequate Strategic Reserves.

3. Establish a watch over tankers, including particularly the future availability of the smaller tankers which continue to play the major role in transporting U.S. supplies and products tankers, which may be in short supply or under producing state control as increasing quantities of oil flowing in world trade will take the form of products rather than crude.

4. Establish a watch over refining capacity given the possibility that U.S. excess capacity—when Caribbean refineries are included—will vanish in the near future and U.S. products demand will have to be met from European refineries. In addition, if the OPEC countries do enter the refining phase in a big way, the European refineries themselves may be "uneconomic."

In addition to these "defensive" measures more fundamental, long-term actions should be taken to reduce U.S. vulnerability deriving from the geopolitics of energy. Actions designed to limit the need for imported energy supplies and actions designed to secure access to those supplies which are vital must be developed.

1. Of primary importance is the need for a comprehensive national energy policy which implies the need for a greater government role in coordinating, overseeing, and encouraging energy developments in directions consistent with the U.S. national interest while reducing the prevailing uncertainty which discourages private initiative. Given the interrelationship between all aspects of the energy equation and the need for actions to occur in a timely manner, a comprehensive national energy policy is the first priority.

2. In order to arrive at a national energy policy changes in Government organization may be required; the implementation of such a policy however, is dependent on the centralization of governmental energy functions and responsibilities. We recognize that work has been done with regard to the changes in government organization necessary to an effective energy effort; to date this consideration has

been limited to the study phase. The need now is for action. We recommend:

(*a*) Creation of a Department of Energy within the executive branch whose Secretary should be a statutory member of the National Security Council;

(*b*) Presidential appointment of the Chairman of the Council of Economic Advisers or the President's Assistant for Economic Affairs, as the Chairman of the Energy Resources Council;

(*c*) Organization of the legislative branch's oversight into a Joint Committee on Energy subsuming all other jurisdictions;

(*d*) Reformation of the regulatory processes;

(*e*) Reexamining the question of energy competence in government; and,

(*f*) A related effort, but on the part of private, nonenergy-industry interests, to mobilize public support for necessary energy policies.

3. In terms of the specific elements of a national energy policy, we support actions which have been identified in the past by others but which clearly require greater commitment and action than they have received to date, including:

(*a*) The intensive development of coal;

(*b*) The search for indigenous and hemispheric supplies of oil and gas and uranium ore;

(*c*) The maximization of efforts to bring nuclear energy into the economy on widely-accepted terms;

(*d*) The intensification of energy research; and,

(*e*) The conservation of all fuels and their highly selective use.

4. Possible relationships between government and the international oil companies must be thoroughly explored. In some areas, where the necessary developments are beyond the capabilities of the private sector the role of government may be essential. The American Government-business relationship must be compared to the relationship existing in other countries to assess the United States competitive position. There are other questions as well. Merely to suggest a greater government role, says little about the role, capabilities and opportunities of the private sector.

U.S. security interests extend to include the continuing and inescapable dependence of U.S. allies on energy imports. The United States must be cognizant of the greater dependence and fewer options facing the other industrialized countries which makes them extremely sensitive to U.S. actions in areas where their interests are so much more heavily at stake. This situation makes for divisiveness in the Western alliance and calls for greater U.S. responsiveness to the needs of its allies.

1. We believe that the United States has energy options it should maximize and to this end we recommend that the United States should:

(*a*) Reduce its involvement in the Persian Gulf oil market;

(*b*) Develop possible oil and energy sources closer to home, particularly with regard to assessing the potential for "special relationships" with Canada, Mexico and/or Venezuela: and

(*c*) Take the lead in proposing multilateral public/private development of potential Arctic sources of oil.

2. The United States should reassess its relationship with Saudi Arabia and, while making clear beyond any doubt that U.S. interests are heavily involved in the country, the United States should make equally clear to its allies its intention of maintaining an "Open Door" policy in a country of such consequence to them. The Saudis, of course, retain the real ability to establish or break relations with any and all nations as it judges to be in Saudi Arabia's national interest and this is as it should be. We are speaking here only from the U.S. perspective.

We believe that the issue of access to oil is closely related to developments in "North-South" relations in general and the new international relationships evolving from the "North-South" dialogs.

1. It is therefore, necessary to reassess the U.S. position in this area. It seems unlikely that the continued conviction of the LDC's that the United States is the major stumbling block in the way of a new international economic order is in the U.S. interest in a world where access to raw materials and energy raw materials will be determined by new relationships now evolving.

U.S. allies may not be opposed to the United States self-styled spoiler role (although this may be moderating) since it spares them the need to make costly concessions to the LDC's while it does not preclude European and Japanese agreements with the LDC's from which the United States may be excluded.

2. We do not propose resignation to LDC demands but rather continued hard bargaining based on changed circumstances in which access to raw materials will nevermore be determined automatically by the needs of the industrialized world.

Finally, with regard to the Soviet Union, which probably enjoys the most favorable energy resource endowment of any of the major powers, including the United States, we propose that:

1. The U.S. Government and private interests refrain from extending technical and/or financial assistance to the U.S.S.R. for the development of Soviet energy resources.

2. The United States should monitor closely the trends in Soviet gas exports to Western Europe and Japan and the export of Middle East gas to these same areas through the Soviet pipeline network. In addition, U.S. gas imports probably are quite justifiably limited. The security implications of the dependence of important segments of the industrialized countries' economies on Soviet gas or Middle East gas subject to potential Soviet control are obvious.

# Appendix

## SOURCES AND DATA

For the purposes of this report, it seemed most appropriate to draw on the plethora of energy supply/demand forecasts currently available. These selected forecasts were prepared by organizations whose expertise is acknowledged. Moreover, it seemed unlikely that the generation of still another forecast would add substantially enough to knowledge in the field to justify the time involved in such an effort. Specifically, we have used mainly the following sources:

Commission of the European Communities, "Report on the Achievement of the Community Energy Policy Objectives for 1985," Brussels, January 1976.

Congressional Research Service, "Towards Project Interdependence: Energy in the Coming Decade," Washington, D.C., December 1975.

F. Eberstadt and Co., Inc., "A Long-Range Outlook for Energy, OPEC, and World Oil Prices," New York, April 1976.

Exxon Corp., "World Energy Outlook," New York, December 1975.

Federal Energy Administration, "National Energy Outlook," Washington, D.C., February 1976.

The Organization for Economic Cooperation and Development. "Energy Prospects to 1985," Paris, 1974.

The Atlantic Council, "Nuclear Fuels Policy," 1976.

The very number of forecasts available should not obscure the fact that there is a substantial amount of agreement regarding the future energy supply/demand situation; a remarkably similar picture emerges from all the forecasts.

Having said this it cannot be emphasized too strongly that in no case can forecasts of years ahead be regarded as more than reasonably intelligent estimates which suggest trends or general orders of magnitude and can claim no greater precision.

Finally, in the section (oil, gas, coal, nuclear) 1976–2000, the energy prospects described are "normal" or "reasonable" forecasts which assume no large, intensively-conducted, high-priority Government commitments to alter fundamentally a nation's energy posture.



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