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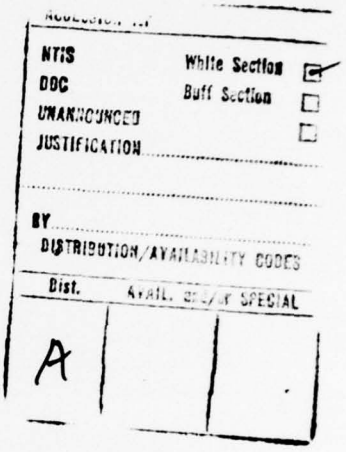

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This study highlights and interprets those aspects of energy supply which will engage the interests of states from now until the early decades of the 21st Century. The study traces and amplifies themes which will preoccupy the great industrial states until such time as solar power, nuclear fusion or some other relieves them of the challenge of securing access to adequate and continuous supplies of energy.

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This study also discusses amd makes recommendations on energy policy options which would give the United States and allies greater assurance of energy supply.

This report--"GEOPOLITICS OF ENERGY"--has been prepared for the U.S. Department of Defense by MELVIN A. CONANT, Director, and FERN RACINE GOLD, Associate; with advice from others including EDWARD N. KRAPELS, International Institute for Strategic Studies (London) and MASON WILLRICH, Professor of Law, University of Virginia and of The Rockefeller Foundation.

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"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, 9 January 1975)

"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 & 1st Deputy
Prince Minister, Saudi Arabia,
2 July 1976)

PART I: Introduction

It is the first objective of this study to highlight and interpret those aspects of energy supply which will engage the interests 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 souce relieves them of the challenge of securing access to adequate and continuous supplies of energy.

The second objective is to discuss and recommend energy policy options which would give the United States and allies greater assurance of energy supply.

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 type colonial relationships or power, defined in military terms.

In an earlier era the question of access would not have arisen in its current form and would have been resolved by the actions of great powers in any event. With a growing unwillingness to use direct military force, other factors, such as political control of energy resources, assume 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, in part, on those very geographic factors, and, in large part, 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.

As a key aspect of access to raw materials, energy 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. Geopolitics of Energy

1) Geopolitics as an approach to the study of international relations stresses the importance of locational factors in the relations among states. 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) The value of geopolitical analysis is enhanced by its dynamic nature. It is explicitly recognized that the importance of various geographic factors changes with developments in many areas, including the passage of time itself, advances in technology and the need for access to raw materials. Changes in political goals and judgments as to legitimate means will also have bearing on the conduct of states with regard to the geographic factors.

3) Finally, geopolitical analysis recognizes that the international system itself undergoes changes; there are new actors (new nations as well as multi-national corporations, international organizations, regional economic and military organizations, etc.); the legitimacy and adequacy of old 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 enlarged international environment that geopolitics and access to raw materials will evolve. In a circulatory manner, geopolitical factors and access to raw materials will, in turn, have their impact upon the international system.

4) Are there then geopolitical factors 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?

5) In addition, because all major primary energy resources depend on a host of additional actions necessary to: (a) transform them into useable 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 must be included.

6) Finally, there is a continuously changing relationship between factors influencing supply - reserves, processing, new discoveries, growing energy consumption, and energy research and technology - and the factors influencing demand - economic growth, resource requirements of a particular economic system, availability of substitutes - which eventually give different resources and their geographic factors different importance over time.

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 United States energy interests and scarcely one for other industrial states of the non-Communist world. With no clear conception of

energy interests, 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, in all frankness, 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 myraid 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 pre-industrial societies brings the issue of over-all "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 reduce the necessity for access to foreign supply; and, second, to pursue policies designed to secure access to that additional supply which is essential to their national requirements.

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, etc. 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 in terms of the location of energy resources.

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 dialogue, trade arrangements such as the Lome Convention, etc., 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.

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 short-falls 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 and at reasonable price constitute a triad of energy interests. They are inseparable; failing to obtain any one of the three could have disastrous consequences.

PART II: Highlights of The Contemporary Geopolitics of Energy (--1976)

Introduction

The 20th century has witnessed the greatest shift in energy sources the world may have experienced -- save only with 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, its transportation, and its conversion to meet a host of requirements.

What were the circumstances which produced the revolution in oil beginning in the mid-fifties, 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; ten years later, it was some 217 QBTU; five years later, in 1975 it is estimated to have 225 QBTU. Fifteen years from now -- in 1990 -- it could be 415 QBTU; an over three-fold increase in total world energy consumption in only thirty years.

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

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

The convenience of oil, therefore, its scant labor requirements; its extraordinary range of uses; 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.

Prior to World War II, French, German and American commercial interests sought access to that oil. In the German case, the desire for general strategic advantage vs. Britain may have outweighed considerations of oil; 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 predominated. Japan looked primarily to Southeast Asia.

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 U.S. 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 U.S. to continue explaining 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 sixties 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 to regain the requisite assurance of supply.

A. 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 United States economy rose from 20 to 35 trillion BTU; import dependence of the United States rose from 23% to 39%. It was in this period that the U.S. 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 U.S. nearly tripled from 1960-75.

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

TABLE I

	ENERGY CONSUMPTION (QBTu)				OIL AND GAS AS A % OF ENERGY CONSUMED				% OF OIL CONSUMED MET BY IMPORTS				MIDDLE EAST AND AFRICA SUPPLIED % OF OIL IMPORTS			
	1960	65	70	75	60	65	70	75	60	65	70	75	60	65	70	75
U.S.	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
USSR	26	34	45	60	38	50	58	59	0	0	0	0	0	0	0	0

B. 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% of oil in world trade.

Reserve figures, per se, mean only the existence of volumes of oil in a given field, country or region. Producing capacity informs as to how much can actually be extracted given present knowledge of the field, available technology, existing infrastructure, and some judgment as to profitability.

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 barrels. Communist nations have possibly 112 billion barrels and the rest of the world is judged to have about the same: 112 billion barrels.

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.

UNITED STATES
HAWAII
Honolulu
PACIFIC OCEAN
NORTH AMERICA
Vancouver I.
San Francisco
Los Angeles
Lower California
Revillagigedo Is.
Clipperton I.
MEXICO
Monterrey
GULF OF MEXICO
Havana
CENTRAL AMERICA
CARIBBEAN
PUERTO RICO
West Indies
Panama Can.
Galápagos Is.
ECUADOR
COLOMBIA
Caracas
Orinoco
Georgetown
Paramaribo
Cayenne
Manaus
Amazon
Madeira
BRAZIL
Belém
Fortaleza
Natal
Recife
Salvador
Brasília
Belo Horizonte
Rio de Janeiro
São Paulo
Santos
Porto Alegre
Montevideo
Buenos Aires
Córdoba
Bahia Blanca
ARGENTINA
PARAGUAY
BOLIVIA
La Paz
Titicaca
CHILE
Antofagasta
Valparaíso
Santiago
Tierra del Fuego
Falkland Is.
SCOTIA SEA
S. Georgia
S. Sandwich Is.
UNITED STATES
CANADA
Denver
Winnipeg
Hudson Bay
St. Louis
Great Lakes
Toronto
Ottawa
Montreal
Quebec
Edmonton
Calgary
Atlanta
Savannah
C. Kennedy
C. Hatteras
Washington
Philadelphia
New York
Boston
Halifax
Newfoundland
St. John's
Bermuda
ALASKA
Aleutian Is.
BERING SEA
Komandorskiye Is.
Kamchatka Pen.
SEA OF OKHOTSK
Sakhalin
Magadan
ARCTIC OCEAN
Banks I.
Queen Elizabeth Islands
Ellesmere I.
North Pole
Severnaya Zemlya
New Siberian Is.
Franz Josef Ld.
Baffin B.
Davis Str.
GREENLAND
C. Farewell
ICELAND
Reykjavik
Arctic Circle
Svalbard
Novaya Zemlya
Barents Sea
Murmansk
UNITED KINGDOM
IRELAND
North Sea
Baltic Sea
London
Paris
FRANCE
B. of Biscay
SPAIN
Madrid
Lisbon
Rome
Berlin
Warsaw
Minsk
Riga
Moscow
Gorkiy
Kuybyshev
Volgograd
Kharkov
Rostov
Black Sea
Caspian Sea
Tbilisi
Ankara
TURKEY
Aral Sea
Karaganda
Novosibirsk
Yenisei
Noril'sk
Verkhoyansk
Yakutsk
Khabarovsk
Nikolayevsk
SOCIALIST REPUBLICS
Str. of Gibraltar
Rabat
Casablanca
Algiers
Tunis
Tripoli
Cairo
Alexandria
MEDITERRANEAN SEA
Madeira
Canary Is.
Azores
NORTH ATLANTIC OCEAN
Tropic of Cancer
Cape Verde Is.
C. Blanc
Dakar
MAURITANIA
Nouakchott
GAMBIA
PORT. GUINEA
SIERRA LEONE
Monrovia
LIBERIA
Abidjan
SAHARA
ALGERIA
LIBYA
NIGER
Niamey
MALI
CHAD
SUDAN
Khartoum
White Nile
ETHIOPIA
Addis Ababa
SOMALI REP.
Mogadishu
NIGERIA
Ibadan
EQUAT. GUINEA
Libreville
C. AFR. REP.
DEM. REP. OF THE CONGO
Congo
KENYA
Nairobi
L. Victoria
TANZANIA
Zanzibar
Dar es Salaam
L. Tanganyika
L. Nyasa
ANGOLA
Luanda
Nova Lisboa
Lusaka
RHODESIA
MOZAMBIQUE
Mozambique Chan.
Lourenço Marques
Pretoria
Johannesburg
SWAZILAND
LESOTHO
Durban
Walvis Bay
SOUTH AFRICA
Capetown
Cape of Good Hope
Pt. Edward Is.
Red Sea
Mecca
Riyadh
SAUDI ARABIA
YEMEN
G. of Aden
UN. ARAB REP. (EGYPT)
Equator
SOUTH ATLANTIC OCEAN
Ascension
St. Helena
Tropic of Capricorn
Tristan da Cunha
Gough I.


NORTH PACIFIC OCEAN
INDIAN OCEAN
ARABIAN SEA
BERING SEA
SEA OF OKHOTSK
SEA OF JAPAN
SOUTH CHINA SEA
CORAL SEA
TASMAN SEA
INDIA
AUSTRALIA
NEW ZEALAND
JAPAN
PHILIPPINES
INDONESIA
MONGOLIA
SAUDI ARABIA
ETHIOPIA
SUDAN
ANGOLA
MOZAMBIQUE
SOUTH AFRICA
Equator
Tropic of Capricorn
Tropic of Cancer
Date Line
KEY OIL EXPORTERS: RED
KEY OIL IMPORTERS: GREEN

2

C. Logistic Requirements of the Industrial World (1975)

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 United States ports; the present general surplus of tonnage approximates 40%. 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% 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 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 only supply vulnerability in the present logistic system is that fractional contribution to West Europe's energy provided by the USSR. It is not in 1976 an important amount by any standard but is obviously something to watch, especially with regard to gas.

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 U.S., the key Caribbean refineries are considered "secure"). Oil producing governments' intentions to move "downstream" have, to date, been unfulfilled. Refineries are under the control of industrial nations. In product supply, only the Caribbean refineries raise questions of sea lane 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: 2 MMB/D. The vital, large volume markets for OPEC oil lie solely in the industrial nations.

In Summary, oil production for international

	OPEC states	Industrial Nations
Trade	X	
Logistics		X
Refining		X
Markets		X

D. 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 benefit.

From the outset, British and American domination of international oil has been a "constant". Between the British and American companies there is such domination that, in 1976, it is still possible to note there are no close "seconds". The erosion of their role in international oil has come from ENI, CFP, and scores of "independents" and other national companies of very diverse national origins. Of course, it has been the direct actions of producer governments which 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 increasingly successful in "sunshine" measures forcing disclosure of information on prices, profits and planning. The erosion of the role of the international majors has thus been from both the producers' and consumers' side.

Nevertheless, certain of the funtions previously exercised by the majors continue to be irreplaceable: the management of world-wide movements of varieties of crude; access to tankers, refineries and markets on the commanding 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.

E. 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 inter-related: (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; the other 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 acting directly or indirectly as instruments of policies reflecting a broader range of concerns and less consequential in helping set 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 United States 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. Yet 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 inter-related issues of energy, other commodities economic development, and financial questions. The CIEC approach was opposed initially and, according to some consistantly by the United States, but generally desired by others who saw in it, at least, a step away from "confrontation", and possibly a step towards 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.

F. Energy & The Soviet Union

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

The principal current energy problem confronting the USSR 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 1.8MMB/D; the USSR supplies 90% 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 a great development strain.

To date, Soviet efforts have been unavailing to acquire the technology (drilling, offshore designs and recovery techniques) presently possessed very largely by Western and Japanese oil companies, which are thought to be essential to further development of Soviet energy resources. The Soviets persist. The oil industry seems generally still 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.

The question about Soviet policy and energy which has long haunted observers is whether the Kremlin could succeed in aligning "radical" producing governments to its side in an action 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 1973-4. Moreover, it would seem that in all three instances 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 USSR'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 producing countries that in any disruption of oil supply to the West caused by the dismemberment of oil industry operations in the Middle East, there could be an immediate replacement of their functions from some other sources, notably the talents of the producing states, assisted by Soviet contributions. Finally, there was never any prospect that the Communist world's purchases of oil from the Middle East would even remotely replace, even for a short time, the revenues to these states earned from present and foreseen Western and Japanese markets.

There is a possible, fourth, explanation: the USSR 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?

G. 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 assumption 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 is long: Mexico, Venezuela, Algeria, Libya, Iran, Iraq, and Kuwait.

Producers intend to "right the wrongs of history" and 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 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; its policies, therefore, are indistinguishable from the others.

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 unaware 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% 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.

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 forty years ago. Yet there is scarcely a more volatile political issue today than the one that Mexico will determine its 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 United States company participation, which was to function under very different circumstances. The eventual acquiring by Iran of control over its oil was seen to be inevitable. Why would the example not be incendiary?

Indonesia was also a pace-setter. 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.

Some regard Saudi Arabia as the truly significant exception to the colonial experience of other producers. Originally, Saudis preferred United States oil interests over the British largely because the United States was "different" and could be a counter-weight 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 United States oil companies have, from

the outset, monopolized the exploitation and disposition of the immense Saudi resource; 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 of the area.

Earlier, we asserted the opinion it would be hard to substantiate a view that the record of oil exploitation and the imperial interests of the West show that a consistent geopolitical assessment of oil guided the actions of leading industrial and energy-deficient states.

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 or 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.

H. Significant Aspects of the Contemporary Geopolitics 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 MM 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 Nigeria North Sea and Alaska, and possibly Mexico. A conservative estimate of the time required to explore, prove, develop and produce a truly significant amount for world trade is from five to ten 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 USSR (and PRC) are not now major contenders for Mid East oil out of a need to supplement their own domestic supply. Competition for Mid East 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's production is about 8.6 MMB/D; its production capacity is estimated at 11.5 and its potential at 20 MMB/D 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 suggest the Saudi and Iranian connection could prove troublesome.

7) OPEC member states - all counted as LDC's - control the production of most oil in world trade.

8) Producing countries control a significant portion of the sea-lanes 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 lie with the industrial world as do the great oil markets. Only some 3% of the world's tanker fleet of 320 million tons is regarded as presently under "OPEC" states' control. 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 super-port facilities commensurate to their present needs. The United States cannot take full advantage of the economics of VLCCs. The United States is crucially dependent upon smaller vessels whose replacement has lagged behind the construction of VLCCs.

11) Member states of the International Energy Agency, through their agreed plan for the sharing of available oil, have the possibility of withstanding supply interruptions or cutbacks better than at any previous time.

12) International oil companies remain essential to consuming and producing nations alike, largely because of their logistic systems and access to processing facilities which permit them to handle very large volumes of oil. At least 80% of world oil trade is handled by these international oil companies, or 24 MMb/D. 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, "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 isn't even agreement on a process for doing so.

14) It is still the case 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. If that is to occur, very substantial efforts, persisting over a great many years, is the inescapable condition for eventual success.

Part III

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 life-blood of the industrialized economies; and, (2) oil reserves and production tend to be geographically concentrated in particular less-developed countries (ldcs). In effect, oil reserves and production are most abundant in a small number of developing countries, while the need for adequate and continuous supply of oil is most urgent in the developed, industrial states.

II. Sources and Data

For the purposes of this analysis, 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 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 Company, Inc., "A Long-Range Outlook for Energy, OPEC, and World Oil Prices," New York, April 1976.

Exxon Corporation, "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 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 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.

III. 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% 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 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 alternative or additional energy sources are long. The following estimated leadtimes (years from decision to start up) -- probably optimistic -- are indicative:

Development of proved, but non-producing field, Middle East	1-2 yrs.
Production from extensions of oil fields, U.S.	1-3 yrs.
Offshore (US) from lease to peak production	9-14 yrs.

Surface coal mine	2-4 yrs.
Underground coal mine	3-6 yrs.
Oil, geothermal, synthetic power plants	5 yrs.
Coal-fired power plant	5-8 yrs.
Hydroelectric dam	5-8 yrs.
Production of oil and gas from new fields, U.S.	3-12 yrs.
Uranium exploration and mining	8-10 yrs.
Nuclear power plants	7-10 yrs.
Coal gasification	10-15 yrs.
Tar sands and oil shale	5-10 yrs.

Add to these figures the delays in decision-making 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 lead-times 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% 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.

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 energy 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 towards the end of the century, oil as a petrochemical feedstock will remain important with ever increasing volumetric demands.

IV. 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.

1) Oil will constitute the bulk (70-75% in 1980, and 65-70% in 1985), of Japan's primary energy consumption. Moreover, virtually 100% of Japan's oil supply will still be imported in 1985. The longer-term outlook is

not favorable and there is no possibliity for the discovery of sizeable domestic reserves. In the short-term, Japan can only hope to diversify its sources of oil imports and create a very substantial strategic reserve of crude to reduce its current overwhelming dependence on Middle East suppliers (75% of Japan's crude oil imports in 1975). 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.

2) Europe too, will remain heavily dependent on imports of oil. Oil will account for 50% 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 70-85% 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% range in 1985, and perhaps for the remainder of the century.

3) 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% of U.S. energy consumption, the U.S. may still derive 50% 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 U.S. 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.

4) 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 befoe 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 slow-down in the conversion to oil may be anticipated. Alternatively, the Soviets could prefer to seek additional oil from the Mid 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% of East European oil needs, a decline from the recent 90% 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 Comecom countries including the USSR 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 (340 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 USSR 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.

V. 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%. The Middle East and North Africa represent 43-54% 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 USSR, may join the competition.

VI. Summary

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

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

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.

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.

Most countries, world-wide, 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.

Particular stress must be given to the complexity of and inter-relationship 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.

The period 1977-1985 may seem to offer an improved supply/demand situation as North Slope oil comes on stream, 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, shortage could develop even in this early period.

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.

The tight oil supply/demand situation and the inevitable lags in the development of alternatives 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% of total world proved crude oil reserves (77% of Free World proved reserves); Middle East and African consumption however, represented only 5% of world consumption. OPEC reserves constituted 68% of total world proved reserves (76% of Free World), while the narrower, all-Arab OAPEC held 54% (60% Free World). At the same time, North America, Western Europe (and Japan without any) held only 12% of world reserves but all three areas accounted for 65% 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 resevoirs under existing economic and technical operating conditions."

Typically the rate of recovery from a functioning field is low - perhaps 30-40% on average*- 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 extension 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% provides a figure for ultimately recoverable reserves.

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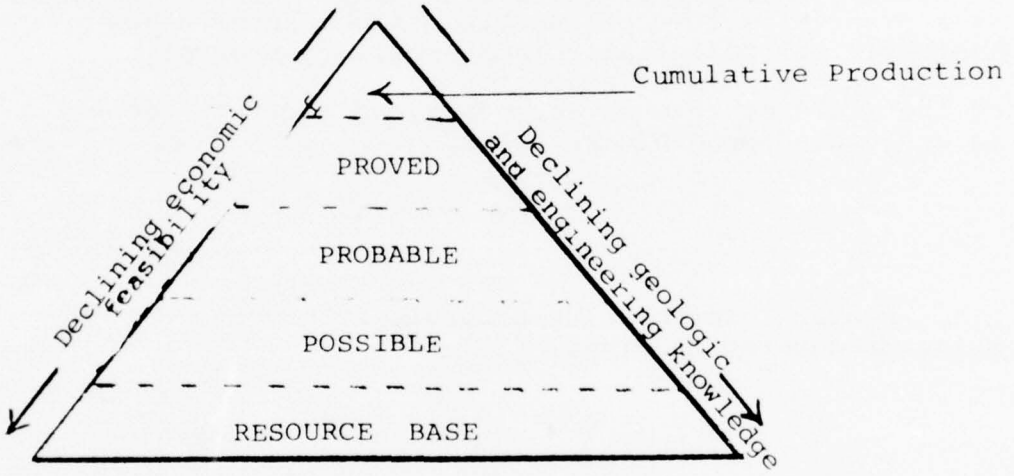
*with 20% as a minimum

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:



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 higher price will have to be high enough and increased price will have to be reflected in the market (i.e. 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% 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%) are located in the Middle East.

Even the inclusion of undiscovered reserves leaves oil reserves concentrated in areas outside the industrial countries. Of the 930 billion barrels thought still to be discovered, 33% may be located in the Communist countries - principally the USSR and China. Seventeen percent may be found in the Middle East. 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 667 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 475 billion barrels of recoverable reserves

only about 175 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
January 1, 1975
(billions of barrels)

Region	Discovered Ultimate Recovery	Expected Undiscovered Recovery	Total Recovery
Russia, China, et. al.	178	300	478
North America	173	155	328
United States	(157)	(85)	(242)
Western Europe	27	57	84
Middle East	613	150	663
Africa	89	71	160
South America	84	82	166
Far East	41	90	131
Antarctic	-	20	20
	1,105	925	2,030

Source: "World Oil," September 1975, p.49 (based on article by John D. Moody and Robert 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 U.S. 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% of total world production; Africa, 9%; Latin America (including the Caribbean), 8%; the Far East, 4%; and, the Communist world, 22% (all 1975). Only 20% 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% in 1965, to 20% in 1975. By contrast, Soviet-bloc production increased from 18% of the world total in 1965, to 22% in 1975. The comparable figures for the Middle East and Africa are 35% in 1965, and 46% 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 & 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% 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 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.* 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% to a range of 37 to 47%; future discoveries may be exploited to some 32%, 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.

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.

*The company's forecast includes offshore to 2000 meters' depths - farther out and in deeper waters than is usually assessed.

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

A. 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 U.S., 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.

B. Oil From Shale

With regard to oil shale, the U.S. Geological Survey estimates that total world wide 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 1100 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 USSR. In the U.S., 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 on stream in 1977 and 1979, respectively. Seventy-two percent of U.S. oil shale lands, containing nearly 80% 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 - 500,000 b/d, or 1-2% of total oil consumption at that time.

Given the sheer quantity of oil potentially available from oil shale deposits and their concentration in the U.S., 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 3-5 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.

C. 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 Company (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 b/d 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 cancelled 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 characteristics 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% a year, and a 4% 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 15-20 billion barrels a year since the 1940's; a figure which includes the enormous fields of the Middle East and USSR. If one excludes those reserves for reasons of security considerations, and looks only at the rate of discovery outside the M.E. 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. United States reserves represent 13 years of production at current levels of production. It is not anticipated that the U.S. 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, it is important 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 twenty-five years. United States 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 14-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% a year in the period 1965-73, oil supply, in the same period, grew at a rate of 7.4% 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 (MMB/D)					
	Demand		Production[1]		Implied Imports to Balance	
Source	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	34-40
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 pick-up, spare capacity is already declining.

Producing Capacity, Middle East and
Other OPEC Nations
(MMB/D)

	Estimated Current Production Capacity	Spare Capacity Jan.- May 1975	Spare Capacity July 76
Saudi Arabia	11.5	4.2	2.5
Kuwait	3.5	1.0	1.6
Iraq	3.0	.4	1.2
UAE	2.4	.5	.4
Qatar	.7	-	.2
Iran	6.5	1.4	.9
Persian Gulf	27.6	7.5	6.8
Libya	2.5	1.1	.5
Algeria	1.0	-	-
OAPEC: Iran subtracted	24.6	6.1	5.9
Indonesia	1.7	.7	.2
Nigeria	2.5	.9	.4
Gabon	.3	-	-
Venezuela	2.9	.5	.3
Ecuador	.2	-	-
OPEC	38.7	11.1	8.2

Source: Modified from Congressional Research Service, "Towards Project Interdependence", P. 55, Central Intelligence Agency, "International Oil Developments", Statistical Survey, July, 1976.

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 of some 12 MMB/D.

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 six to twelve months actually reach the 12 MMB/D level. It is strange that we cannot be specific but expert appraisals differ widely. At the least optimistic, one could argue that available space capacity today for all of OPEC may not exceed 1.5 MMB/D. 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 have to be made. If the choice is for the former, the world demand could be met.

Given forecasts of Free World import demand ranging from 27-44 MMB/D in 1985, adequate producing capacity may exist in OPEC to meet 1985 import demand. The Persian Gulf represents well over 50% of total OPEC productive capacity in 1985, and OAPEC capacity accounts for over 60% of 1985 OPEC productive capacity. Also note the dominant position of Saudi Arabia; Saudi capacity alone represents 30-40% of OPEC 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, i.e. Kuwait has determined to restrict production levels to 2.5 million b/d for conservation reasons. Venezuela has also limited production for conservation reasons. Iran and Iraq are committed to expanding production to 8 million b/d and 5 million b/d, respectively, by 1985. Other figures also reflect anticipated production figures.

Possible Production Levels
Middle East and Other OPEC
Nations, 1980 and 1985
(MMB/D)

	1980	1985
Saudi Arabia	7.9	9.11
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	24.5-265	28-30)
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	39-41

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

Other forecasts of actual OPEC production are similar:

	1980	1985
	(MMB/D)	
Exxon	31-36	34-40
OECD[1]	28	30
Other	-	27-35

[1]Includes production for OPEC internal use and Comecon market

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.

Taking some liberties with the forecasts however, it is possible to demonstrate the development of an increasingly tight oil demand/supply situation beginning as early as 1980 and certainly by 1985.

Possible Production Level Congressional Research Service		Free World OPEC Oil Import Requirements		
1980	1985	1980		1985
34-36	39-41	37	Exxon	40
Less OPEC Internal Demand 2.0	4.0		Eberstart	
32-34	35-37	30	Base	37
Less Comecon needs .5	1.0	34	High	44
31.5-33.5	34-36	33-35	Cong.RS	34-40
		-	Other	34-36

The suggestion is that the oil demand/supply situation is increasingly tight and moreover there is no inherent reason why OPEC production should attain the forecast levels. Competition for available supplies will be intense. In the case suggested above, 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 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. Saudi Arabia, however, may have sufficient spare capacity to ease but not necessarily resolve the oil supply/demand situation.

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:

(1) 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.

(2) 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 % of government revenue and oil as a % of exports will give some indication of the importance of oil in any given economy.

(3) Development Plans - Government development plans, even with the recognition that, for many of the OPEC countries planned allocations are rarely actually spent,

give 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.

(4) 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.

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.

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.

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 statemen. Additional income itself will broaden these horizons. Increased international influence will be accompanied by more 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 ldcs, 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.

However, the asymmetry of interdependence is not such that a one-way street of Free World dependence emerges. Rather, to the extent that oil must be sold, it is the Western nations which provide the great bulk of the oil market and this will remain true throughout this century.

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% of total oil trade. Today, oil products account for 30% of U.S. oil imports, originating largely in the Caribbean, and the U.S. accounts for over 40% of world oil products trade; other industrialized states have elected a far greater degree of products' self-sufficience. The last full year of data make this point:

Imports & Exports 1975*
(thousands of barrels daily)

	Imports		Exports	
Country/Area	Crude	Products	Crude	Products
USA	4,105	1,920	5	205
Canada	815	35	600	200
Latin America	2,040	300	1,135	2,040
W. 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
E & S Africa	340	145	-	35
S. Asia	295	95	-	5
SE Asia	1,155	410	1,175	280
Japan	4,565	380	-	5
Australasia	225	120	-	50
USSR, E.E. China	235	70	720	750
Total	25,685	4,650	25,685	4,650

*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% of total Free World demand for refined petroleum products in 1975 (a total of 36,025 thousand 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%. Questions regarding refined products have less to do with the level or growth in demand and rather more as to how that demand will be satisfied and from where. It does not appear that products trade will prove any more difficult to coordinate and arrange than the current trade in numerous varities of crude oil - which, it must be noted, is itself a complex process although local refining provides a valued flexibility in meeting unanticipated changes in market demand.

III. Refining Capacity

Current refining capacity is concentrated in the developed countries.

Refining Capacity, 1975

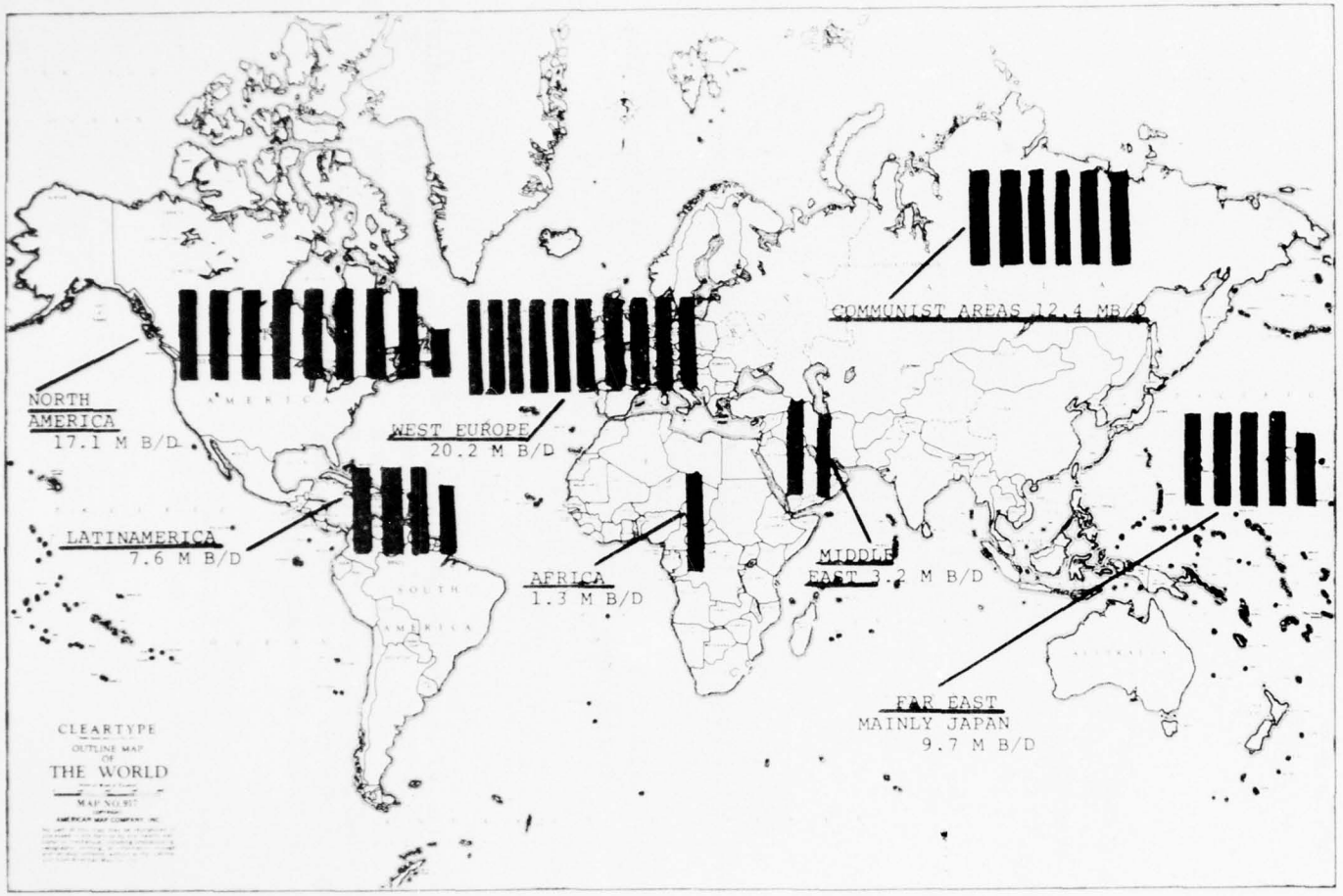
	Thousand Barrels Daily	% of Total
North America[1]	17,560	24
Western Europe	20,920	29
Japan	5,345	7
Total	43,825	60
Middle East	2,800	4
South America[2]	7,630	11
Far East	4,375	6
Africa	1,240	2
Sino-Soviet bloc	12,250	17
Total	72,120	100

[1]U.S. 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 U.S. has been the market tributary, the United States has virtual refining self-sufficiency and capacity to spare. Moreover, there is considerable spare capacity in every area.



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

1975	Refining Capacity	Average Spare* Capacity
	(thousand barrels daily)	
United States	15,345	20
Caribbean	1,360	15
W. Europe	20,920	40
Japan	5,345	23
Middle East	2,800	26
USSR, E.E. & China	12,250	10
World Total	72,120	-

Source: based upon BP, Statistical Review of the Oil Industry, 1975

* Approximate only

It is extremely difficult to predict for more than a few years what degree of spare capacity may still exist. A recent attempt to do so (PIW 7/26/76) has the 1973 surplus capacity at 4.1 MMB/D; for 1975 it has been at 11.6 MMB/D and in 1980 it may be 8.1 MMB/D (out of a total usable capacity of 61.4 MMB/D). If the total usable in 1980 is 61.4 MMB/D, it represents a 7.6 MMB/D increase over 1975 with nearly half that amount taking place outside the industrial world. How much of that anticipated increase will reflect OPEC construction is not indicated, but given the existance of spare capacity it is without much enthusiasm that the developed states approach the prospect of expansion of refining facilities among OPEC countries. Moreover, given control over their oil resources, the OPEC countries can easily enforce a policy of primary emphasis on refined products exports.

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 MB/D in 1974. Of this amount 900 thousand B/D 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 B/D, 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% 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% of total Free World demand; 2.8 million barrels a day also represents only 4% of 1975 total world refining capacity. However, it represents 60% 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%; OPEC capacity of 2.8 million B/D would have accounted for over 80% of that growth. Excess capacity in a West will become increasingly burdensome and 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 sources. 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

A. 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% of Free World oil consumption), approximately 95% 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 to ownership of the tanker fleet to the oil exporting countries relates to the importance Western governments traditionally have placed on maintaining national shipping and ship-building capabilities. Because oil trade represents such a commanding position in world maritime trade (49% 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, i.e., 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.

B. 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% of available capacity. By the end of 1976, it is estimated* 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 b/d in 1985 is assumed (see Oil, 1976-2000) and assuming further that 60% of Free World consumption flows in world trade, the tanker fleet would have to move between 43 and 48 million b/d, requiring a capacity of 172-192 million DWT. Under the worst possible conditions (which are extremely unlikely), i.e., no new buildings beyond 1977 and the retirement of all tonnage built prior to 1971,

*John I. Jacobs and Co., Ltd. World Tanker Fleet Review, 1975

(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 over-supply phase will prove persistent. Post--1985, if a tanker shortage develops, increasing freight rates would exacerbate the tighter oil supply situation anticipated.

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 by 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, i.e., even if spare refining capacity is available, the logistical element may be missing to take advantage of it.

Natural gas remains very much a "local" energy source tied closely to the location of production, in the absence of currently available logistic systems (pipelines, LNG tankers and processing facilities.) Given declining U.S., 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.

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*Drewry

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% of the world tanker fleet consisted of ships of 125,000 DWT and over. Indeed ships of 205,000 DWT and over constituted 50% of the tanker fleet and 76% 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 some strategic implications for 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, California, with Cherry Pt., Seattle and Los Angeles limited to 125,000 DWT. Not until the early 80's, at present planning levels and commitments, will the U.S. be considered able to take economic advantage of the VLCC. The LOOP and SEADOCK projects would then give the U.S. 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.

C 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.

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Table I

World Tanker Fleet at End-1975*
(Million DWT)
(Vessels 10,000 DWT and over)

Flag	Oil Company	Private	Government and other	Total	Share of Total
Liberia	26	64	.3	90	31%
Norway	--	25	.2	25	9
U.K.	22	11	.2	33	11
Japan	4	27	--	31	11
USA	4	5	1	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
USSR, E. Europe and China	--	--	8	8	3
Other Eastern Hemisphere	5	7	.2	13	4
Total	95	185	1.1	291	100%

*Excluding 43.6 million 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	No.	Million DWT	1974 Total World's (DWT) Fleet	USasa% of Total
U.S.	306	10		
U.K.	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 ship fleet with a capacity for transporting some 18 million b/d of oil.

The Soviet fleet constitutes some 3% of the world total and has the capacity to transport 2 million b/d 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 DWT of the ships envisioned in the Soviet plan (300,000DWT) 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 can not be said of the Western fleet. In 1975, 33% 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% of the fleet). Only about 4% of the world tanker fleet was owned by governments; excluding the Communist countries, less than 1% 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% ownership figure.

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

	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 Company, Ltd., "World Tanker Fleet Review"

The total OPEC fleet represents 3% of the total 1975 world tank ship fleet. The OAPEC fleet constitutes 88% of the OPEC fleet. The OAPEC-sponsored Arab Maritime Petroleum Transport Company, (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 DWT 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, i.e., 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% of the world LNG fleet capacity. Saudi Arabia has indicated its interest in product tankers. Concentration on products tankers would also enhance 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. Perference 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.

D. 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 ship buildings 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.

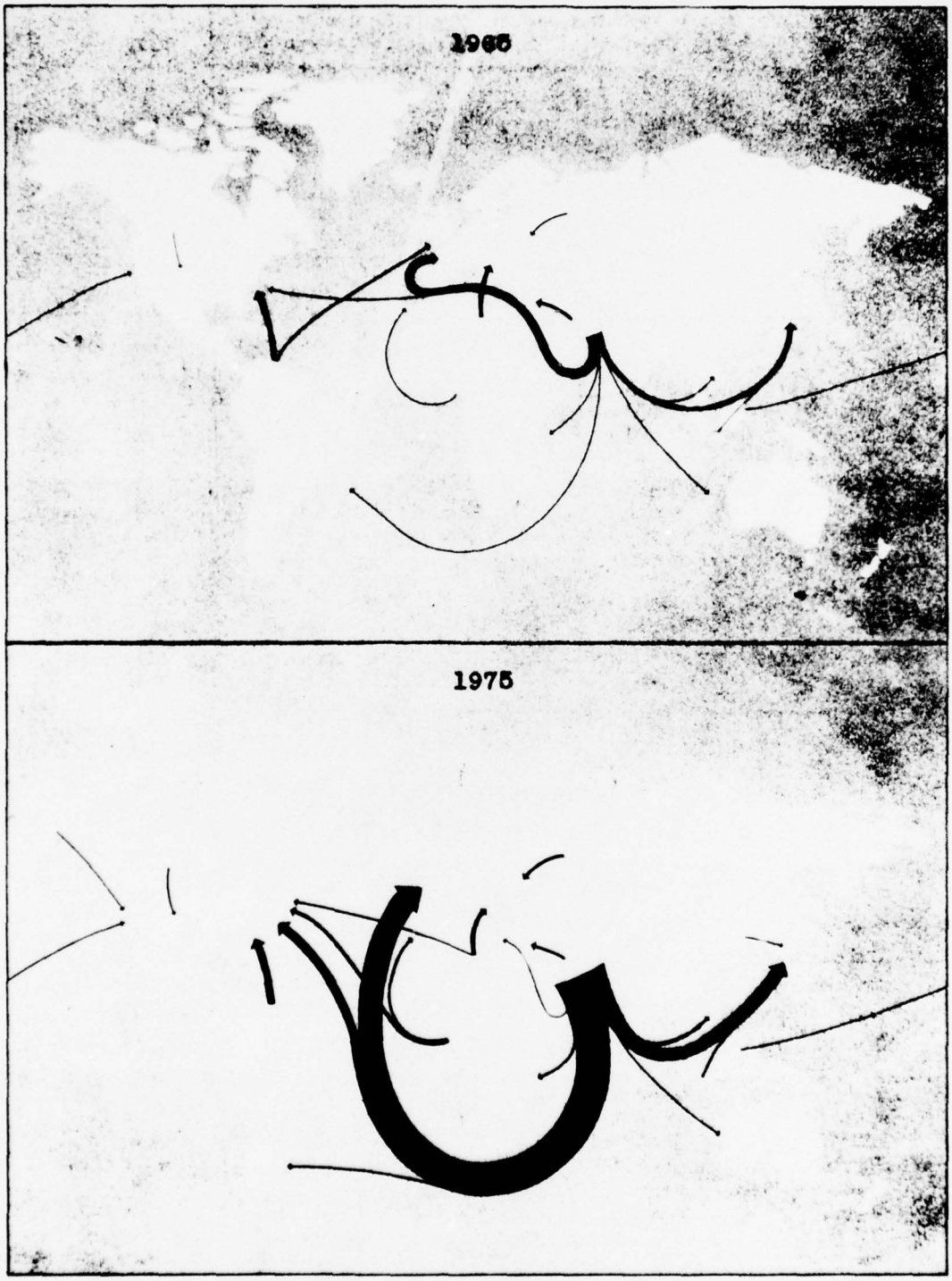
E. Security of the Sea Lanes

Employment of Tankers, 1975
(% of world's active ocean-going fleet on main voyage)

	Voyages From					
Voyages to	USA	Carib-bean	Middle East	North Africa	Others	Total
USA	3.0%	3.0%	6.0%	1.0%	3.5%	16.5%
Canada	---	0.5	3.0	---	---	3.5
Other Western Hemisphere	---	---	6.5	0.5	2.0	9.0
Western Europe, N.and W. Africa	---	1.0	42.0	1.5	3.5	48.0
E. & S. Africa and S. Asia	---	---	1.5	---	---	1.5
Japan	---	---	11.5	0.5	2.5	14.5
Other Eastern Hemisphere	---	0.5	4.5	---	0.5	5.5
USSR, E. Europe and China	---	---	1.5	---	---	1.5
Total	3.0%	5.0%	76.5%	3.5%	12.0%	100%

Source: BP, 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.


UNITED STATES
HAWAII
Honolulu
PACIFIC OCEAN
NORTH
Palmyra I. (U.S.)
NORTH AMERICA
Vancouver I.
San Francisco
Los Angeles
Lower California
UNITED STATES
CANADA
Hudson Bay
Baffin B.
GREENLAND (Den.)
Davis Str.
Revillagigedo Is. (Mex.)
C. Falso
MEXICO
Clipperton I. (Fr.)
GULF OF MEXICO
CENTRAL AMERICA
Galapagos Is. (Ec.)
CARIBBEAN SEA
Panama
ECUADOR
COLOMBIA
VENEZUELA
BAHAMA IS. (Br.)
PUERTO RICO (U.S.)
West Indies
BARBADOS
TRIN. & TOB.
Georgetown
Paramaribo
Cayenne
Bermuda (Br.)
Tropic of Cancer
NORTH ATLANTIC OCEAN
Azores (Port.)
Madeira (Port.)
Canary Is. (Sp.)
Cape Verde Is. (Port.)
Equator
SOUTH ATLANTIC OCEAN
Ascension (St. Hel.)
St. Helena (Br.)
Tropic of Capricorn
Tristan da Cunha (Br.)
Gough I. (Br.)
S. Georgia (Br.)
S. Sandwich Is. (Br.)
SCOTIA SEA
Falkland Is.
Tierra del Fuego
BRAZIL
Amazon
Madeira
Belém
Fortaleza
Natal
Recife
Salvador
Brasília
Belo Horizonte
Rio de Janeiro
São Paulo
Santos
Porto Alegre
Montevideo
URUGUAY
Buenos Aires
ARGENTINA
Córdoba
Bahia Blanca
CHILE
Valparaíso
Santiago
Antofagasta
BOLIVIA
La Paz
PARAGUAY
Asunción
PERU
SOUTH AMERICA
Newfoundland
St. John's
Halifax
Boston
New York
Montréal
Ottawa
Toronto
Detroit
Chicago
St. Louis
Dallas
Houston
New Orleans
Atlanta
Savannah
C. Kennedy
C. Hatteras
Miami
Havana
Denver
El Paso
Winnipeg
Calgary
Edmonton
Vancouver
Seattle
Mackenzie
Banks I.
Queen Elizabeth Islands
North Pole
Thule
Godthaab
Julianehaab
Arctic Circle
ICELAND
Reykjavik
ALASKA
Yukon
Pt. Barrow
Nome
Aleutian Is.
BERING SEA
Komandorskiye Is.
Kamchatka Pen.
Petropavlovsk-Kamchatskiy
SEA OF OKHOTSK
Magadan
Sakhalin
Nikolayevsk
Kuril Is.
Khabarovsk
Verkhoyansk
Yakutsk
Lena
New Siberian Is.
ARCTIC OCEAN
Severnaya Zemlya
Franz Josef Ld.
Svalbard (Nor.)
Barents Sea
Novaya Zemlya
Murmansk
Archangel
Noril'sk
Yenisey
Ob'
UNION OF SOVIET SOCIALIST REPUBLICS
SIBERIA
L. Baykal
Irkutsk
Novosibirsk
Omsk
Sverdlovsk
Perm'
Chelyabinsk
Karaganda
L. Balkhash
Alma-Ata
Tashkent
Aral Sea
Caspian Sea
Moscow
Gor'kiy
Kuybyshev
Volgograd
Rostov
Kharkov
Kiev
Odessa
Tbilisi
Baku
Leningrad
Riga
Minsk
Warsaw
Berlin
UNITED KINGDOM
IRELAND
London
B. of Biscay
North Sea
Baltic Sea
Black Sea
SPAIN
PORT.
Lisbon
Madrid
Gibraltar
Rome
Athens
Tunis
Algiers
Casablanca
MOROCCO
IFNI
SPAN. SAHARA
ALGERIA
LIBYA
Tripoli
Benghazi
Alexandria
Cairo
U.A.R. (EGYPT)
TURKEY
Ankara
SYRIA
IRAQ
Baghdad
IRAN
Tehran
SAUDI ARABIA
Riyadh
Mecca
Red Sea
YEMEN
G. of Aden
SAHARA
MAURITANIA
Nouakchott
C. Blanc
Dakar
GAMBIA
PORT. GUINEA
SIERRA LEONE
Monrovia
LIBERIA
MALI
NIGER
Niamey
NIGERIA
Ibadan
CHAD
SUDAN
Khartoum
White Nile
ETHIOPIA
Addis Ababa
SOMALI REP.
Mogadishu
KENYA
Nairobi
L. Victoria
TANZANIA
Zanzibar
Dar es Salaam
Comoro Is.
L. Tanganyika
L. Nyasa
G. of Guinea
EQUAT. GUINEA (Sp.)
Libreville
Yaoundé
C. AFR. REP.
DEM. REP. OF THE CONGO
Brazzaville
Congo
ANGOLA (Port.)
Luanda
Nova Lisboa
Lusaka
RHODESIA
MOZAMBIQUE (Port.)
Mozambique Chan.
SOUTH WEST AFRICA
Walvis Bay (S. Afr.)
BOTSWANA
Pretoria
Johannesburg
Lourenço Marques
SWAZILAND
LESOTHO
Durban
SOUTH AFRICA
Capetown
Cape of Good Hope
Pr. Edward Is. (S. Afr.)
International Date Line
40° N
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40° S
60° N
100° W
40° W
20° W
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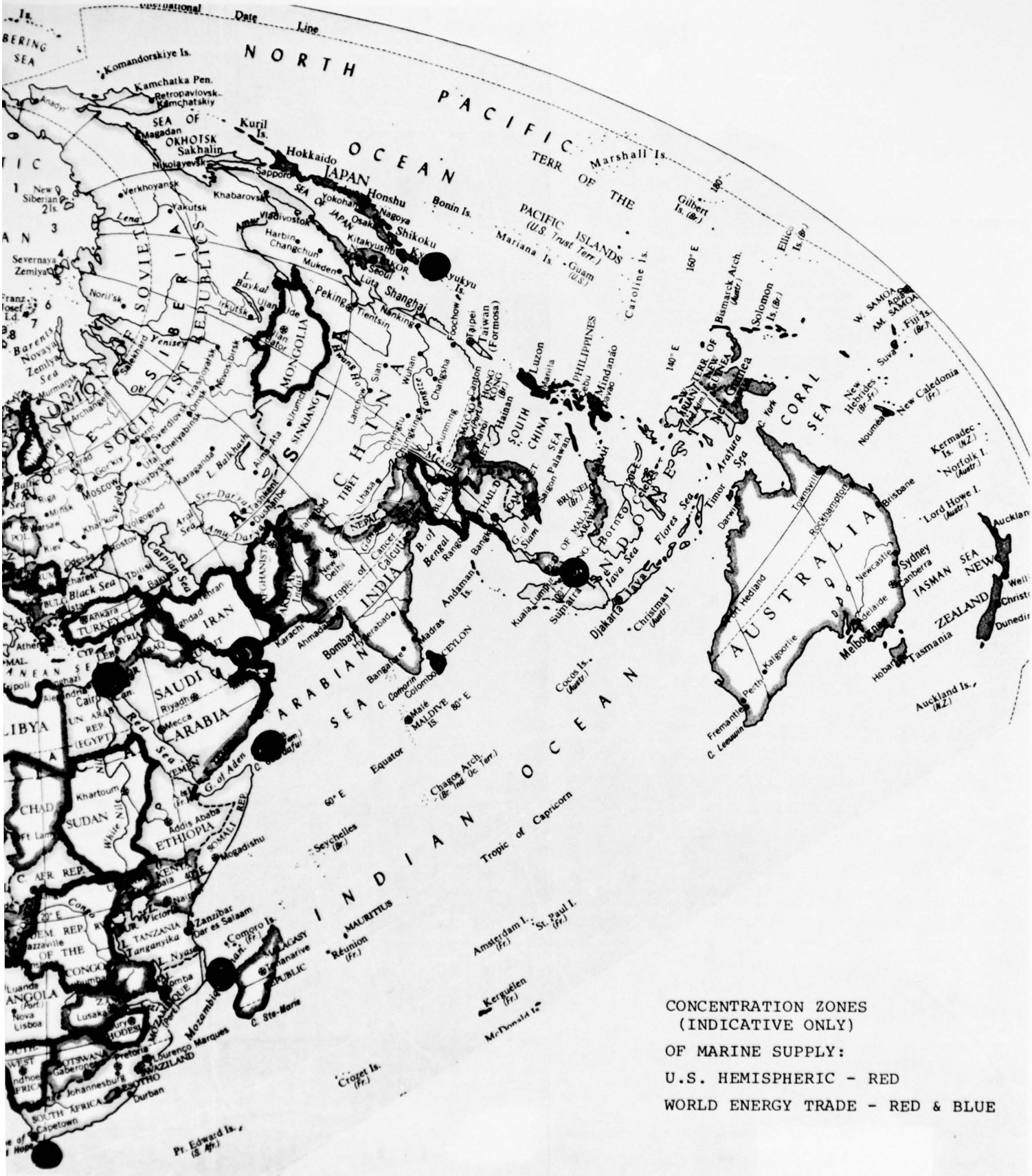
CONCENTRATION ZONES
(INDICATIVE ONLY)
OF MARINE SUPPLY:
U.S. HEMISPHERIC - RED
WORLD ENERGY TRADE - RED & BLUE

The importance of the sea lanes from the Middle East to the U.S., Western Europe and Japan are obvious. Over 75% of the world's active ocean-going tanker fleet is engaged in transporting oil from the Middle East to the rest of the world. Fully 66% 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, i.e., U.S., 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 oil 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 U.S.; 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 monarchical 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.

Indeed, Iraqi - Kuwaiti, Iraqi - Saudi, or Iraqi - Iranian armed hostilities might leave the oil flow through the Straits unimpared. Yet radical regimes in the sheikdoms might allow terrorist and sabatage 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 U.S. 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 the U.S.. 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' depth by 1978 (150,000DWT laden or 270,000 DWT tanker in ballast) and to 67' 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 of the Red Sea and the Mediterranean as well.

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 competance of this report. Also in terms of U.S. supply, the sea lanes 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 Alaska 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 USSR 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 disapearences 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 & 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 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 ration 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% 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, six 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 oil resources - two essentially conservative guesses: one indicates perhaps 50 billion barrels, the other, eqaully 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 fifteen 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% of the world's total production. Surprisingly, 1973 and 1974 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, etc.; 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 & East Coasts of Latin America, the rim of the Caribbean, N.E. offshore of USA; NW & W. Africa; both shores of Mozambique Channel; Bay of Bengal; West Coast of Malaya, Surabaya Sea, W.& S. Coasts of Australia and E. 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 mid-ocean 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 in light of 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 MMB/D in 1985; other areas needing earliest possible study and exploration lie offshore Alaska (and the Naval Petroleum Reserves).

The NW & NE 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 U.K.'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 U.S. 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.


UNITED STATES
HAWAII
Honolulu
PACIFIC OCEAN
NORTH AMERICA
NORTH
Vancouver I.
Vancouver
Los Angeles
Lower California
UNITED STATES
CANADA
Edmonton
Winnipeg
Hudson Bay
ALASKA
BERING SEA
Komandorskiye Is.
Kamchatka Pen.
SEA OF OKHOTSK
Sakhalin
ARCTIC OCEAN
Banks I.
Queen Elizabeth Islands
North Pole
Baffin B.
Thule
GREENLAND (Den.)
Davis Str.
C. Farewell
Julianehaab
ICELAND
Reykjavik
Arctic Circle
MEXICO
Monterrey
Dallas
Houston
New Orleans
Atlanta
Ohio
Detroit
Toronto
Ottawa
Montreal
Quebec
Boston
Halifax
Newfoundland
St. John's
G. of St. Lawrence
Str. of Belle I.
GULF OF MEXICO
Havana
CUBA
Miami
C. Kennedy
BAHAMA IS. (Br.)
Bermuda (Br.)
Revillagigedo Is. (Mex.)
Clipperton I. (Fr.)
Guadalajara
Mexico City
CENTRAL AMERICA
Galápagos Is. (Ec.)
Panama Can.
CARIBBEAN SEA
PUERTO RICO (U.S.)
West Indies
BARBADOS
TRIN. & TOB.
Georgetown
Paramaribo
Cayenne
ECUADOR
COLOMBIA
Bogotá
VENEZUELA
Orinoco
PERU
Lima
Callao
BRAZIL
Manaus
Madeira
Amazon
Belém
Tapajós
Tocantins
Fortaleza
Natal
Recife
Salvador
Brasília
São Francisco
Belo Horizonte
Rio de Janeiro
São Paulo
Santos
Porto Alegre
BOLIVIA
La Paz
L. Titicaca
Antofagasta
CHILE
Valparaíso
Santiago
ARGENTINA
Córdoba
Buenos Aires
URUGUAY
Montevideo
Bahía Blanca
Tierra del Fuego
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Canary Is. (Sp.)
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Equator
SOUTH ATLANTIC OCEAN
Ascension (St. Hel.)
St. Helena (Br.)
Tropic of Capricorn
Tristan da Cunha (Br.)
Gough I. (Br.)
40° N
20° N
40° W
20° W
20° S
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UNITED KINGDOM
IRELAND
London
North Sea
B. of Biscay
SPAIN
Madrid
PORT.
Lisbon
Str. of Gibraltar
Gibraltar (Br.)
Rabat
MOROCCO
Casablanca
Algiers
Tunis
Rome
Athens
Berlin
POL.
Warsaw
Riga
Minsk
Kiev
Odessa
Bucharest
Black Sea
Moscow
Leningrad
Gor'kiy
Kuybyshev
Volgograd
Rostov
Kharkov
Murmansk
Archangel
Barents Sea
Novaya Zemlya
Svalbard (Nor.)
Franz Josef Ld.
Severnaya Zemlya
New Siberian Is.
UNION OF SOVIET SOCIALIST REPUBLICS
SIBERIA
Noril'sk
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Ob'
Verkhoyansk
Yakutsk
Lena
Khabarovsk
Nikolayevsk
Magadan
Kuril Is.
Sverdlovsk
Chelyabinsk
Omsk
Novosibirsk
Krasnoyarsk
Karaganda
L. Balkhash
Tashkent
Dushanbe
Aral Sea
Caspian Sea
Baku
Tbilisi
Ankara
TURKEY
SYRIA
IRAQ
IRAN
Tehran
Baghdad
SAUDI ARABIA
Riyadh
Mecca
Red Sea
YEMEN
G. of Aden
Socotra
ALGERIA
LIBYA
Tripoli
Benghazi
Alexandria
Cairo
UN. ARAB REP. (EGYPT)
Suez Can.
SPAN. SAHARA
C. Blanc
MAURITANIA
Nouakchott
MALI
SAHARA
NIGER
Niamey
CHAD
Ft. Lamy
SUDAN
Khartoum
White Nile
ETHIOPIA
Addis Ababa
SOMALI REP.
Mogadishu
Dakar
GAMBIA
PORT. GUINEA
SIERRA LEONE
Monrovia
LIBERIA
IVORY COAST
Abidjan
Accra
TOGO
G. of Guinea
NIGERIA
Ibadan
CAMEROON
Yaoundé
C. AFR. REP.
EQUAT. GUINEA (Sp.)
Libreville
GABON
Brazzaville
DEM. REP. OF THE CONGO
Congo
Lubumbashi
KENYA
Nairobi
L. Victoria
TANZANIA
L. Tanganyika
Zanzibar
Dar es Salaam
L. Nyasa
Zomba
Comoro Is. (Fr.)
Mozambique Chan.
MOZAMBIQUE (Port.)
Luanda
ANGOLA (Port.)
Nova Lisboa
ZAMBIA
Lusaka
Salisbury
RHODESIA
SOUTH WEST AFRICA
Walvis Bay (S. Afr.)
Windhoek
BOTSWANA
Gaberones
Pretoria
Johannesburg
Lourenço Marques
SWAZILAND
LESOTHO
Durban
SOUTH AFRICA
Capetown
Cape of Good Hope
Pt. Edward Is. (S. Afr.)
International Date

GEOPOLITICS OF "INTERNAL" SUPPLY

I 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% 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 2,000, 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 our 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 our national energy consumption.

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1 Yager, P.454; quoting Darmstadter - the entire quotation, including the "data", is profoundly misleading.

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% 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 .6 trillion tons are economically recoverable under contemporary price, technological methods, etc. (SER/52)

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[2] The size of coal deposits reflect 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.

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 ninety per cent of the world's total resources of coal exist in the USSR, U.S. and China and most of it rests above the 30% latitude. It is, pre-eminently, the energy resource under the direct control of the industrial world; the amount possessed by LDCs 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% of U.S. domestic production). As a per cent of energy (BTU) in world trade, coal is generally unimportant, with Japan and Canada being overwhelmingly the major importers by 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 USSR itself probably possesses 50% of the world's total resources with the U.S. having some 19% and China possibly claiming about 8%. (SER/28) Europe's share of the world's total coal resources is thought to be about 5%. All the rest of the world is estimated

to possess some 4% of the world's total (with Australia having half of that 4%, India 21% and the remainder spread among forty other nations). A summary (modified SER/52) of the key coal deposits illustrates clearly the overwhelming importance of certain nations or regions:

(Megatons)

	Country or Region	Reserves-in-place*	Economically Recoverable
1.	USSR	273,200	136,600
2.	U.S.	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

II. Increased Supply

Virtually every industrial state seeks now to redress the declining share of coal in its energy balance where only fifteen 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.

* Note that "reserves-in-place" rank the U.S. & Europe above the USSR while the more general measure used earlier of "total resources" gives a clear lead to the USSR. 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 USSR will rank highest in all three categories: total resources, reserves-in-place and economically recoverable.

In 1960 coal represented 47% of world energy consumption; by 1965, it was 38% and in 1970 coal declined to 31%; by 1980 - assuming moderate success in achieving greater production and use of coal, its' share in world energy consumption could be 27% and 22% 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 U.S. in 1960; by 1990 nearly one 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 to be found from coal. Nor will increased coal production-conservatively estimated-eliminate dependence upon oil imports:

(WJL/SA) One expert and cautious source estimates Free World Supplies of Coal up to 1985 (MM 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 3MMB/D of oil and, by 1990 represent another, additional 3.6 MMB/D - for an estimated total additional supply of 6.6 MMB/D to be achieved over ten years. Such an increase would be no greater than the increase in Saudi production alone from 1971 to 1975, (Franssen/129). In other terms, an increase in available energy on the order of 6.6 MMB/D in 1985 would be some 4% of the estimated QBTU consumption of the industrial free world.

In the case of the U.S., as cited in the (WJL/SA) forecast, increased coal production, translated into oil equivalents would be about 3 MMB/D 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 the nuclear.

Since the increased production for the U.S. is all from domestic sources, it is clearly important that this increase be achieved - a forecast increase by 1985 of 272 MM tons which is far below the current "conservative" FEA projected increase of 440 MM 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 (WJL/SA) 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 MMB/D by 1985. (about 2% of the national QBTU consumption) Twenty plants producing SNG at 250 MMCu ft 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 one MMB/D of oil or some possible 10% of 1985 oil imports.

Despite its advantages 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 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 three 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 comprising supply and demand could gravely offset coal production targets. As in the case of oil and gas, each of the factors in the above paragraph are crucial to success; their <u>timing</u> and "<u>inter-locking</u>" aspects make success in some, but not in others, insufficient, suggesting a requirement for "synchronization" which can be met probably only through early and continuous U.S. Government oversight and possibly involvement on an unprecedented scale.

J. 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*, dwarfing present, producing sources, will come pre-eminently from the Middle East and the USSR 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 hand to receive and process for distribution. Were such available, NG could be an important source of energy for all the industrial world - and 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 shutdown. Moreover, unlike oil with its relative 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

*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.

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 cut-offs. 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 application pending before the USG were approved (3tcf), plus the .4tcf already approved, U.S. regions importing supply could be dependent from 15-30% on overseas sources for their gas needs. The Boston region, for example, could be over 40% dependent on LNG imports for its gas supply. In order to lessen the risk, the Energy Resources Council limits LNG imports from any country to no more than 1tcf, with a maximum of 2tcf a year imported from all sources; 2 tcf would be about 10% of total NG consumption in the early 80'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, etc.

B. Location

Currently, it is thought that while NG may be only some six percent of the world's total recoverable fossil fuel resources, NG provides for nearly 19% of the world's production of energy. If the world experiences a 4% 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 U.S., 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 NG prospects are not bright for continuing to meet the free world's industrial states' NG 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 USSR.

Currently, we believe the USSR may possess nearly 36% of the world's total gas reserves - easily the NG giant; the Middle East may have 24% - 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% and West Europe possess 10% 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 USSR becomes clear: with 60% of the world's NG consumption, North America (meaning overwhelmingly the U.S.) possesses 14% of the reserves; West Europe consumes 13% but has 10% of the world's total of NG, the USSR consumes 19% but may possess 36% of the total).*

*data on NG reserves suffer form 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.

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 U.S. at current rates of production, having less than eleven 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%. For Europe, Groningen alone supplies 40% of total European supplies (NG being 13% of energy consumption now but rising to perhaps 19% by early 80's). In both cases - Europe and the U.S. - whether its percent of energy consumption met by NG rises or falls, the volumetric demand for gas increases; NG represents about 18% of world energy today; by 1990 it may be 13% but its volume could increase by 25%. 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% 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% (1975) but perhaps, by 1985, 75%. For the U.S., NG (and SNG) might be only 17 Tcf - against 21 Tcf production in 75 - 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% (30% in 1976).

Currently, the only significant gas exporters are the Netherlands, Canada, Iran and the USSR. In 1974 the Dutch share of NG exports was 41% (to West Germany, Belgium, France and Italy). Canada's share was 23% (all to the U.S.); the USSR exported 12% of NG in world trade to East Europe and to West Germany, Italy, Austria and Finland, with Iran's share of exports at 8% (to the USSR). The U.S. and West Germany were the largest importers taking nearly 25% each of NG exports, with the USSR, Belgium and France taking some 10% each. LNG, in 1974, was 11% of world gas trade with Brunei supplying 40% of LNG, Libya 28%, Algeria 20% and Alaska 11%. 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% 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: [from Franssen/156: Tcf]

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

The probable maximum LNG exports until 1985 may have been already defined - .4 Tcf (largely Algeria) because of the inordinate delays from bad planning and poor technology and design, re-negotiations, persistent uncertainties over price, U.S. regulatory delays, etc. and the exceptional lead times 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 USSR) 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 U.S. last year.

Once more, these international contributions to energy balances will be dwarfed by oil in world trade.

D. The USSR

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 U.S. and Japan.

For example, by 1980, the USSR could be producing some 12.6 Tcf/yr., importing (for convenience sake) some .5 Tcf/yr., exporting perhaps 1.5 Tcf/yr. to Europe - which could represent by then 10% of Europe's consumption. LNG exports - not before the early 80's - could mean .7Tcf/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 USSR 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 USSR 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.

Nuclear Energy, 1976 - 2000*

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.

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*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."
Walter J. Levy, S.A., "How Much Nuclear Power in 1985?"

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 re-assessed. 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
(GWe)

Country/ Region	1973 OECD Forecast			1980			1985			1990		2000	
	1980	1985	1990	1	2	3	1	2	3	1	2	1	2
U.S.	132	280	580	77	82	88	185	205	180	339	385	805	1,000
Canada	7	15	31	7	7	7	18	18	15	41	41	115	115
EC	57	134	283	59	56	48	146	159	111	285	292	633	623
Japan	32	60	100	16	17	15	50	49	35	90	84	190	157
Others	35	78	146	31	32	23	64	99	56	100	202	215	585
Free World	263	567	1,068	190	194	181	463	530	397	855	1,004	1,958	2,480

1. Edison Electric Institute
2. OECD/IAEA, "Uranium - Resources, Production and Demand"
3. Walter J. Levy, S.A., "How Much Nuclear Power in 1985"

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 two years, orders for nuclear reactors have been cancelled and orders for a great many others have been delayed for up to five years. Currently, the U.S. has 58 nuclear power plants on line; projected plants for 1985 are now 170, when in 1974 there had been an anticipated 209.

Such postponements reinforce a point made repeatedly in this report;progress in energy matters depends upon the timely taking of closely inter-related 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 scare 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 world-wide. 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 twenty year period, created more fuel than it used) 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 re-assessment of the requirement for enriched uranium and thus of the ore itself, substantially freeing nations from the constraints 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% of electricity produced both in the U.S. and Europe of the Nine and 83% of Japanese electricity was derived from 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, etc. 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 slow-downs, 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% of U.S. energy consumption and 9% of the gross inland energy consumption of Europe of the Nine. While nuclear power may contribute no more than 14% of Free World primary energy supply in 1985 and some 24% in 1990, electricity may represent 30% 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 can not 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 visable 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, 26-30% of U.S. electrical generating capacity may be derived from

nuclear energy; currently nuclear energy represents only 5% of total electrical generating capacity. In Japan, a similar proportion of electricity will be generated from nuclear power plants by 1985. The EC member countries estimate that 45% of the Community's electrical energy will come from nuclear sources by 1985, (compared to 6% at present). In Germany, 40% of electrical requirements will derive from nuclear generated electricity in 1985, in Italy, 50% in 1985, reaching 80% in the 1990's, and the comparable 1985 figure for the U.K. is 25%. 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, the Walter J. Levy, S.A. study, "How Much Nuclear Power in 1985," which offers 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 U.S., only 554 million barrels of oil a year, (or 9% 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 substantial. 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 inter-dependent, i.e., 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 U.S., 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:

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

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 by-product 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 fifteen years at least, and probably even longer.

Table II

Free World: Estimated Uranium Resources as of January 1, 1975 (thousand metric tons)

	Under $15/lb U_3O_8 Production Cost				$15-30/lb U_3O_8 Production Cost			
	Reasonably assured	%	Additional	%	Reasonable assured	%	Additional	%
U.S.	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	%	1975	%	1980	%	1985	%
U.S.	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	

Source: OECD as quoted in Levy.

Current estimates of Free World uranium reserves indicate that the ore could possibly not be produced in sufficient volume by 1980, and almost certainly not by 1985. 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[1]	Low[2]
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

[1]Assuming no plutonium recycle.

[2]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%; 72% 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% of total uranium resources ("reasonably assured" plus "additional" at under $15/lb and $15-30/lb); by 1990, cumulative demand will have accounted for 37-43% 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	%	1985	%	1990	%	2000	%
Light Water	170	88	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 U.S., some difference in comparative uranium-supply security, may emerge - but not to any appreciable extent before the '90's. 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 conceivably 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, etc. indicate that some possibly large reserves will be located in the ldcs.

Enrichment

Enrichment capacity is now a potential bottleneck in the continued development of nuclear energy. In this case, and for a time, the United States Government provides about 95% 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 ten 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
(10^3 tonnes SW/year)[1]

	1980	1985	1988
U.K.	.4	.4	(.4)
U.S.[2]	27.7	44.9	50.8
URENCO[3]	1.0	10.0	10.0
RURODIF[1]	6.5	10.8	10.8
EURODIF II[4]	---	6.0	9.0
UCOR (SOUTH AFRICA)	---	---	5.0
Total Capacity	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 17.2 million tons SW/yr. for 1985 and 23.1 million tons SW/yr 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
(10^3 tonnes SW, 0.25% 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 USSR 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 U.S. may still retain over 60% of total world enrichment capacity; the USSR may have only 40% of world enrichment capacity in 1985.

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 by-product 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 U.S. 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 U.S. 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.

E. Conclusion

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.

Competition 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 U.S. 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 plutionium, 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.

IV. 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 fifteen to twenty-five years, it is not likely that the significance of imports to national energy budgets will be greatly diminished as a per cent of those budgets. Even if that percentage represented by oil is smaller, volumetric requirements will increase. Some fifty 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 % of Imports (Crude and Product) traced to Original Source (1975) - C.I.A.

Arab

	Saudi Arabia	Kuwait	Libya	Iraq	UAE	Algeria
United States	14	.5	6	-	3	5
Canada	21	3	1	3	4	-
Japan	30	10	1	2	8	-
W. Europe	28	6	6	8	6	4
UK	25	12	3	3	4	2
Germany	19	3	15	1	8	1
Italy	26	4	10	18	3	3
France	31	6	2	11	11	6
Spain	50	1	6	12	-	1
Netherlands	22	11	1	3	9	1

Non-Arab

	Iran	Venezuela	Indonesia	Nigeria	Canada
United States	8	18	8	14	13
Canada	23	32	-	2	-
Japan	24	-	11	1	-
W. Europe	16	2	-	6	-
U.K.	20	4	-	7	-
Germany	15	3	-	10	-
Italy	14	2	-	.5	-
France	12	2	-	8	-
Spain	9	2	-	-	-
Netherlands	30	1	-	12	-

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.

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 U.S. 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 U.S. received a far higher percentage of its imports from Venezuela than did any other of the listed states.

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

Now look at exports from the producing nations' perspective:

Estimated % of Oil exports (1975) to Listed Importing Nations (C.I.A.)

(Arab countries)

From:	MB/D Total	U.S.	Canada	Japan	W. Europe
Saudi Arabia	7080	10	3	19	47
Kuwait	2100	-	2	20	37
Libya	1520	14	-	4	48
Iraq	2250	-	1	4	41
UAE	1700	7	3	24	45
Algeria	930	28	-	-	54

(Not Arab Countries)

From:	MB/D Total	U.S.	Canada	Japan	W. Europe
Iran	5350	5	4	21	36
Venezuela	2350	16	11	-	11
Indonesia	1310	28	-	40	-
Nigeria	1790	41	-	4	41
Canada	1460	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 U.S. dominate a producing nations' export market. (Venezuelan exports to the U.S. 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 U.S. receives 10% of members' exports while Western Europe gets 42% and Japan 15%; for OPEC as a whole the U.S. receives 18% of their exports while Western Europe receives 40% and Japan 16%. Put in MMB/D, OAPEC exports some 1.8 to the U.S., 7.5 to Western Europe and 2.7 to Japan; OPEC exports some 5.4 to the U.S., 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 U.S. 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 significance 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 possessors of uranium reserves--South Africa, Canada,USA,Australia-- the sources of additional and probably needed uranium lie within the Ldcs.

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 the USSR and Middle East supplies become more available.

PART V Governments and Enterprises in International Energy

I. 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 decision-making 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, etc. 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 "non-majors" who sought an advantage for themselves in accomodating 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 necessary 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 industry, 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 US which will be wrestling with the questions of government-and-industry or government-vs.-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 towards 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 consistent with national energy objectives? And yet preserve and encourage private enterprises in the undertaking? These questions reflect a minimal role for the USG; 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.

2. 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 non - "majors", 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 these 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 numbers and consequence of private and governmental oil companies, usually non-integrated, 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 "non-majors". There have been plenty of signals that the process will probably accelerate.

In 1961, governments controlled about 8% of crude production as did the "non-majors"; nearly 83% 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%, the role of "non-majors" to about 18% and the share for the "majors" had declined to about 72%. The role of government today is at least 70% with the balance a nearly indefinable mix of "non-majors" and "majors". In refining, the role of "majors" slipped from nearly 70% in 1961 to about 54% in 1972 (with "non-majors" acquiring some 25% in 1972); in marketing, the "majors" went from about 64% in 1961 to nearly 52% in 1972 while "non-majors" captured some 27% by 1972 and governments had acquired about 21%.

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 view point of producer governments, it is the ability of "majors" to move nearly 52% of oil in world trade to the consumers' markets which is presently so consequential. Moreover, in a period of general over-supply, 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.

3. 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

U.S. 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 aspect.

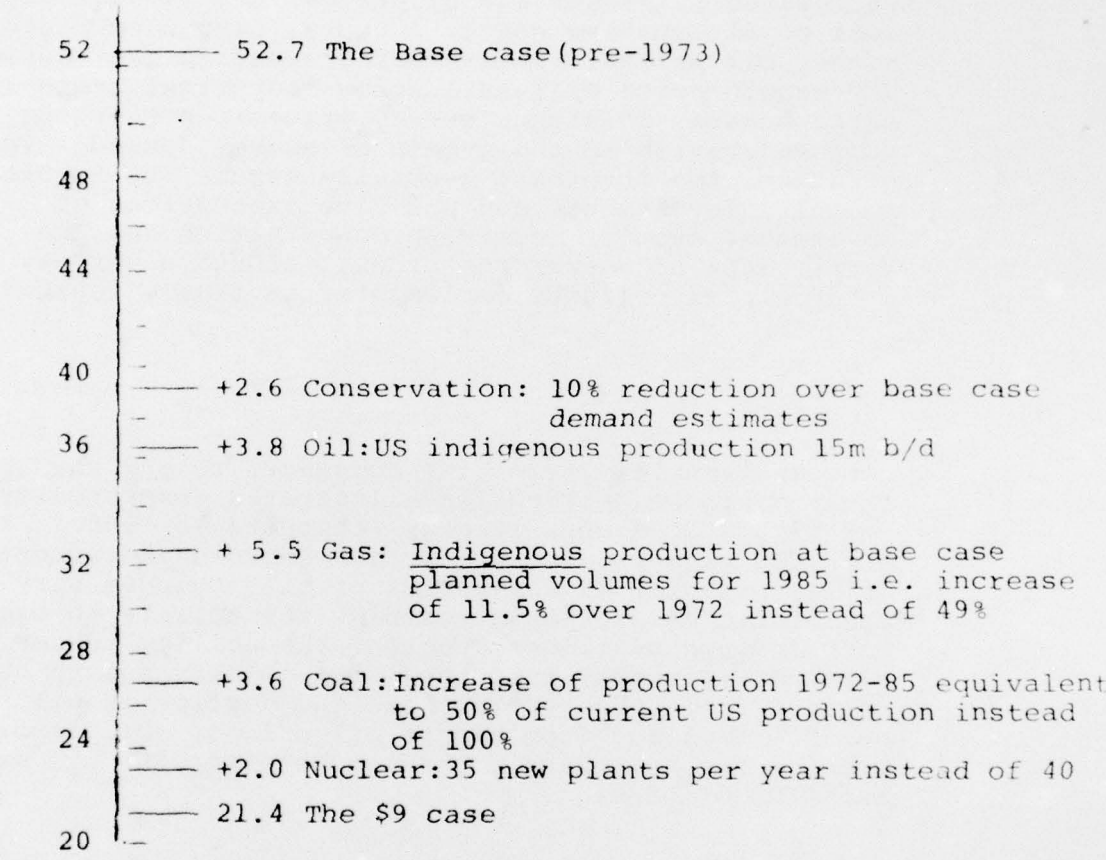
A. SUMMARY AND OVERVIEW

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:

OECD OIL IMPORTS - 1985



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% 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 USSR 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.

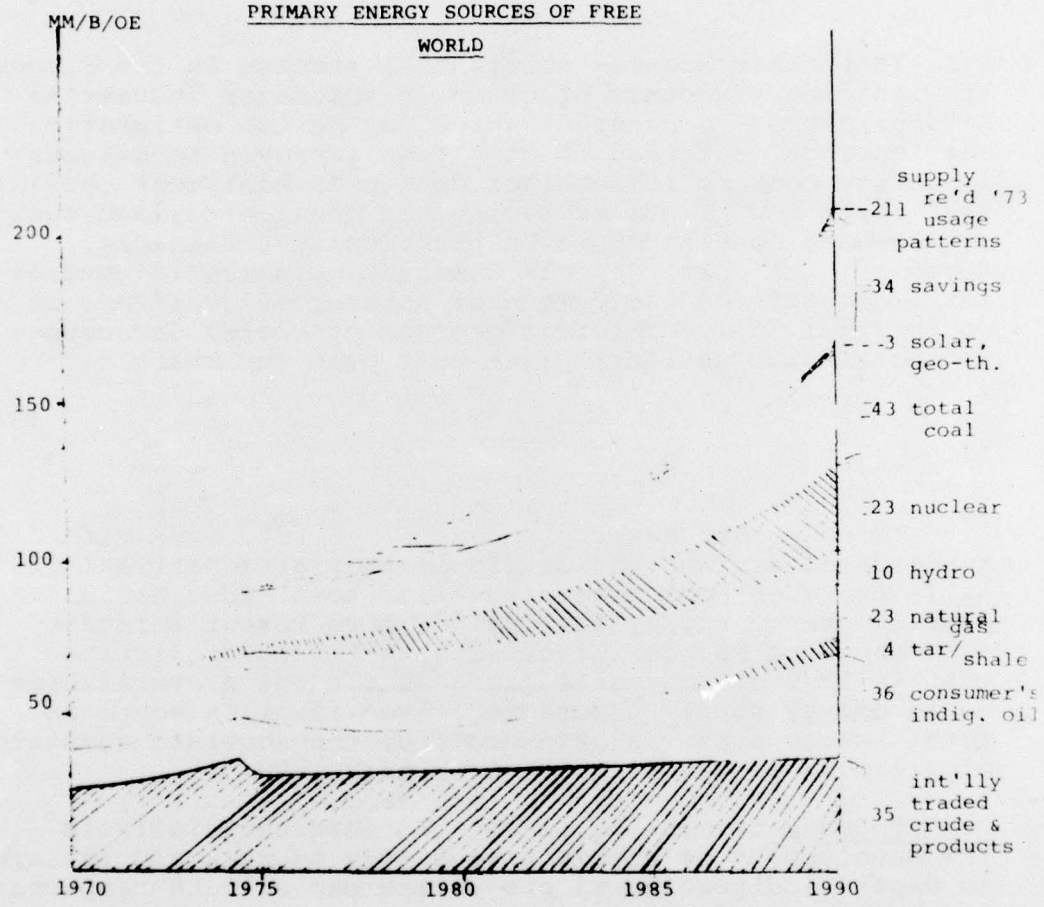
It further assumes substantial success in the discovery of significant amounts of crude in the major industrial nations/areas - a prospect which may be too optimistic. The "savings" referred to come from improved techniques in energy consumption, better design of equipment, buildings, transport, new plants replacing old ones, etc., 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% 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% 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% 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 M.E. (now gas as well as oil).

PRIMARY ENERGY SOURCES OF FREE WORLD



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 U.S., uranium deposits appear to be concentrated most prominantly in Canada, Australia and South Africa, while enrichment capacity may still be dominated by the U.S. 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 U.S.' 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).

Under these circumstances, the immediate and near-term measures available to energy-deficient states lie in "defensive" undertakings such as the strategic crude and product reserves, maintaining adequate refining capacities and retaining sufficient control over the tanker fleets. Less "defensive"--and of a longer term is the intensified search for oil in areas closer to the industrial nations and more absolutely under their control.

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 U.S., 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 U.S., 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 farther 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 ever more 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".

II

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 under-developed 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 (LDCs) and to some extent they share the world view common to most LDCs. 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 U.S. and its allies. The systems seem to be exploitative and designed, perhaps consciously, perhaps inadvertantly, to secure the interest of the industrialized countries at the expense of the LDCs. 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 neo-colonial 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 LDCs. Moreover, by increasing their links to other LDCs the cost of any precipitous action possibly being considered by external powers is increased.

Non-oil producing LDCs, 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 resource dependence; Europe and Japan are in far less favorable resource endowment positions than is the U.S. Essentially this means that the U.S., with less at risk, has relatively greater freedom of action. The differences in resource endowment mean that the European and Japances perceptions of an energing world order may be significantly different from the U.S.'.

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 U.S. 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 U.S. 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 position even to guess intelligently about the capabilities and intentions of the USSR 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 U.S., 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.

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 twenty-first 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 when 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 U.S. 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 ten, fifteen 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; non-fuel 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?

APPENDIX I

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 organiaztions 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:

Commision 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 Company, Inc., "A Long-Range Outlook for Energy, OPEC, and World Oil Prices," New York, April 1976.

Royal Dutch/Shell April 1976

Walter J. Levy, S.A. London

Exxon Corporation, "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 this Volume I (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.