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REPORT BY THE  
**Comptroller General**  
OF THE UNITED STATES

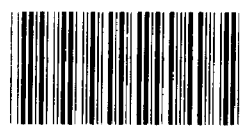
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RELEASED

**The Potential For Diversifying Oil Imports By Accelerating Worldwide Oil Exploration And Production**

Diversifying U.S. imported oil sources to reduce U.S. dependency on unstable countries in the Middle East and North Africa is not a viable short-range solution due to the lack of alternative suppliers with sufficient excess production capacity in the world. Mid- to long-range potential (5 to 15 years from now) is uncertain but more promising, partly because of increasing production from Mexico and partly because of the concentration of current oil company exploration efforts outside the Middle East and North Africa.

There is still considerable petroleum potential throughout the world, but realization of this potential depends upon accelerated exploration, especially in less developed countries. Governments' actions, such as expropriation and high rates of taxation, have discouraged private investment in oil exploration in many of the more promising areas.



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COMPTROLLER GENERAL OF THE UNITED STATES  
WASHINGTON, D.C. 20548

B-200899

The Honorable Max Baucus  
United States Senate

The Honorable Donald J. Pease  
House of Representatives

This report is in response to questions which evolved from your joint letter of December 14, 1978, concerning oil source diversification policy. As agreed, we have broadened the scope to include the potential for developing additional worldwide sources of petroleum production.

At the request of your offices, we did not obtain agency comments. Further, as arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of its issuance. At that time, we will send copies to interested parties and make copies available to others upon request.

A handwritten signature in black ink, appearing to read "James B. Athie".

Comptroller General  
of the United States



D I G E S T

Despite huge oil price increases, gains in OPEC power, the 1973 Arab oil embargo, and the continued turmoil in the Middle East, the United States sharply increased its dependence on foreign petroleum sources during the 1970s. U.S. dependency upon imported oil not only increased from about 35 percent of consumption in 1973 to over 43 percent in 1979 but also became more concentrated upon the Middle East and North Africa.

This review examines the potential for the United States to diversify its sources of imported oil and the incentives and disincentives for private U.S. oil companies to diversify their individual foreign oil sources in order to reduce dependency upon the Middle East and North Africa.

POTENTIAL FOR DIVERSIFYING  
FOREIGN SUPPLY SOURCES IS LIMITED

The potential for immediate large-scale diversification of U.S. imported oil sources is nil. There is not enough unused productive capacity currently outside the major Middle East and North African producing countries to support a major shift of U.S. import patterns without a counterbalancing shift by other major importers. However, most of the other major importing countries already are more dependent upon the Middle East and North Africa than is the United States, and they are not likely to further jeopardize their own security to improve that of the United States.

The prospects for diversification in the mid-term future are somewhat better, although still uncertain. The normal lagtime of 7 to 10 years between discovery and production means that any new discovery today will not be an important supply source until the late 1980s. Mexico and a few other non-OPEC areas offer the brightest prospects, with the potential of finding giant fields of Middle East size in Mexico. Although Mexico could become an important source of imported oil in the coming years and reduce U.S. dependency on Middle East and North African imports, Mexican oil itself will not eliminate the need for these imports. (See ch. 2.)

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OIL COMPANIES' INCENTIVES  
TO DIVERSIFY FOREIGN SOURCES

Diversification does not mean abandoning traditional oil sources; it means reducing reliance upon them by supplementing them with other sources to the point that dependency upon insecure regions, such as the Middle East and North Africa, is sufficiently reduced so that a supply disruption would not be critical to national security.

GAO visited 21 oil companies whose officials stressed that they see no disincentives to supply-source diversification. On the contrary, they said diversification is necessary to achieve a secure and continuous supply of crude oil.

The Middle East continues to present a geologic lure to oil companies. Known reserves are larger and the potential for discovering more large fields is better there than anywhere else in the world. However, the changing relationship of the international oil companies with Middle East producing governments through the power of OPEC has created a powerful incentive for the companies to diversify their sources of petroleum and has largely removed the opportunity for new equity ventures in the Organization of Arab Petroleum Exporting Countries and Iran.

The consensus of the oil industry is that, given the opportunity, it is in the interest of the oil companies to expand or shift their production activities to countries which are more stable than those of the Persian Gulf region. The opportunities for significant shifts in supply sources, however, have been limited, and few U.S. companies to date have been able to significantly reduce their dependence on Middle East and/or North African sources.

Although most of the U.S. companies GAO studied still rely heavily on the Middle East-North African regions for their crude oil production and/or purchases, their exploration activities in 1978, the year GAO analyzed, were concentrated elsewhere. While 73 percent of the total production (excluding North America and Communist areas) of the companies studied came from the Middle East and North Africa, only 18 percent of their

acreage under contract, 11 percent of the exploratory wells, and 30 percent of their geophysical exploration was in those areas. GAO concluded that individual U.S. oil companies are attempting to diversify their oil supply sources. (See ch. 3.)

#### THE POTENTIAL FOR DISCOVERING NEW PETROLEUM SOURCES

Most petroleum experts generally agree that about one trillion barrels of crude oil remain to be discovered--an amount roughly equal to that already discovered. Although a number of studies converge on the figure of two trillion barrels as the world's ultimate crude oil resource, each estimate is based on certain assumptions. Estimates of undiscovered reserves, therefore, are to be used with caution.

Oil company and Government geologists GAO interviewed said that the following areas outside the Middle East hold the most promise for future oil discoveries. (See ch. 4.)

The Arctic areas: The Beaufort Sea off Alaska and Canada, the Bering and Chukchi Sea areas off Alaska in which the U.S. Geological Survey recently made favorable seismic findings, the Rift Basin off Newfoundland, East Greenland, and the northern basins of the Soviet Union.

Antarctica, which is largely unexplored.

Mexico, which has great potential, the limits of which are still undetermined.

The North Sea, particularly the Norwegian sector above the 62<sup>d</sup> parallel.

China, which has the largest unexplored nonarctic continental shelf in the world.

Certain developing nations in Latin America and Africa, which have been only moderately explored.

#### U.S. GOVERNMENT ACTIONS TO STIMULATE EXPLORATION AND DIVERSIFICATION

The United States differs from most other industrialized countries by relying almost entirely on private oil companies for its petroleum supplies, both imported and domestically produced. In many other countries, petroleum is produced or

imported by the central government, either directly or through one or more government-controlled oil companies. Consequently, U.S. programs or policy actions for effecting changes in the petroleum industry's behavior are designed to work through the private sector.

The United States has one official program which directly influences petroleum exploration in other countries--the Overseas Private Investment Corporation. In fiscal year 1978, the Corporation formed a Minerals and Energy Staff to identify and assist in implementing projects in petroleum-importing developing countries, working through both its insurance and finance programs. A principle objective was to help oil-importing countries develop their petroleum resources, thus reducing their dependence on imported oil and serving the U.S. national interest by opening up new sources of oil supply.

A Presidential interagency task force currently is studying what is being done and what can or should be done to stimulate oil and gas exploration and development in developing countries. Its report to the President is expected to be issued in 1980.

The United States also participates in a number of international organizations which have or are developing programs to stimulate petroleum exploration and production in developing countries. The World Bank is the only such organization with a specific operational program; the Inter-American Development Bank has a program under development, and the U.N. Development Fund has a similar proposal under discussion. (See ch. 5.)

#### OBSTACLES TO FOREIGN PETROLEUM EXPLORATION

There are obvious incentives for accelerating petroleum exploration and production worldwide, as manifested in the steep oil price increases since 1973. Accelerated exploration and production is essential to increase the potential for diversifying oil imports, but certain obstacles, or disincentives, must be overcome. In the past, natural physical obstacles such as deep water, arctic conditions, or remote continental interiors, have limited or prevented exploration in some promising areas. In recent years,



however, the oil industry has made great technological advancements and nearly any place in the world can now be reached.

Most of the obstacles remaining were created by government actions and must be reduced or removed by government actions. Obstacles include:

--Political risk: Most companies GAO surveyed said the problem has been getting worse in recent years as developing countries increasingly have nationalized company assets when oil is discovered. A more subtle form of political risk is unilateral contract revisions by the host government. In many cases, the differing objective of host government and potential investor makes agreement on contract terms an inherently difficult and time-consuming process. Host governments often have strong political as well as commercial motivations and may want to avoid a public appearance of weakness in dealing with foreign multinational corporations. (See p. 64.)

--Uncertainty of U.S. tax policies: Each company noted changes in laws governing income from foreign petroleum operations and changes to the foreign tax credit now under consideration. Company officials said that major investment factors, such as projected net profits, rate of return on investment, and discounted cash flow, cannot be accurately projected when U.S. tax policy is unstable. These projections are important factors in corporate decisions when negotiating contract terms or formulating bid proposals to a foreign government. According to U.S. oil companies and Department of Energy studies, the uncertainty of U.S. foreign tax credit treatment has complicated and delayed the negotiation and completion of exploration and development contracts by U.S. companies in Peru, Bolivia, Guatemala, Indonesia, the Philippines, and Thailand. (See p. 66.)

--Excessive taxation by host governments: A number of officials said high local tax rates discouraged their companies from seeking exploration opportunities in several countries. (See p. 67.)

--Limited access to prospective areas: Private oil companies have been denied access to areas because of exclusionary policies of the host governments, international boundary or territorial disputes, and/or home-government foreign policy. (See p. 68.)

#### OBSERVATION

Diversification of foreign supply sources has been suggested by many sources within and outside the Federal Government as a possible means of reducing the adverse effects of current U.S. foreign oil dependency. GAO concludes that diversification is not a viable short-range strategy but that it holds some potential in the mid- to long-range period (beyond 5 years) if new sources can be developed in countries that are currently nonproducers or low producers and if current producers outside the Middle East and North Africa, such as Mexico and the North Sea countries, continue to increase their export capacities.

The key to discovering and developing new production sources is the aggressive acceleration of worldwide petroleum exploration. This can be achieved only if obstacles to such exploration which have been raised by governments are removed or reduced. These obstacles include the expropriation of private assets when exploration is successful, excessive rates of taxation by host governments, an uncertain U.S. tax policy relating to foreign income, and exclusionary host-government policies.

Both the Congress and the executive branch need to consider U.S. oil company operations in foreign countries as an issue to be factored into relationships with those countries. Both branches should seek better understanding of the needs and concerns of the oil companies and their potential host-government partners, especially with the less developed countries. The United States should then seek, through both bilateral and multilateral channels, to favorably influence the attitudes and policies of the governments of the less developed countries concerning private investment in petroleum exploration and development. The United States also should explore ways of helping these countries increase the commercial viability for

private development of small oil fields with little or no export potential--perhaps through risk-sharing agreements or reciprocal tax incentives. (See p. 71.)

AGENCY COMMENTS

As requested by the offices of Senator Baucus and Congressman Pease, GAO did not obtain agency comments on this report.



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ABBREVIATIONS

bpd	barrels per day
CIA	Central Intelligence Agency
DOE	Department of Energy
FESAP	Foreign Energy Supply Assessment Program
GAO	General Accounting Office
IDB	Inter-American Development Bank
IEDP	International Energy Development Program
LDC	less developed country
mbpd	million barrels per day
OAPEC	Organization of Arab Petroleum Exporting Countries
OPEC	Organization of Petroleum Exporting Countries
OPIC	Overseas Private Investment Corporation
UNDP	United Nations Development Program
USGS	U.S. Geological Survey



## CHAPTER 1

### INTRODUCTION

For some 7 years, the system of international petroleum production and supply has been undergoing drastic and systematic revision at the hands of the Organization of Petroleum Exporting Countries (OPEC) to the detriment of the petroleum importing industrialized and developing nations of the free world. Oil prices and production levels are firmly controlled by OPEC, which has also announced its intention of wresting control of crude oil sales from the private oil companies upon which the United States depends for its oil supply.

The decade of the 1970s was marked by sharply increased U.S. dependence upon foreign petroleum sources. (See table 1.) This dependency has (1) increased since the Arab oil embargo and price hike of 1973, (2) become more concentrated upon Middle East and North African oil exporting nations, 1/ and (3) contributed significantly to current economic and political problems, including reduced security of oil supplies, impairment of foreign policy options, and balance-of-payments deficits. The turmoil in Iran, the Soviet move into Afghanistan, and the current Iran-Iraq conflict have made more visible the risks of U.S. dependence on such a volatile region.

#### SHORT-TERM DEPENDENCY IS UNAVOIDABLE

The United States will have to cope with a critical dependence upon imported oil for some years to come due to the decline in U.S. petroleum production and the long leadtimes needed to develop the technology and/or facilities for large-scale conversion to other sources, such as solar, synfuels, and nuclear energy.

The ultimate solution to the world's energy needs, in our opinion, is development of such renewable sources as solar energy and its derivative forms. Developing the necessary technology to the point of commercial feasibility and deploying it throughout the U.S. national energy system, however, will require a considerable length of time. Large-scale use of solar energy is generally thought to be at least 20 years away.

Other, less desirable, energy sources will also require considerable leadtimes to deploy to a degree sufficient to appreciably reduce U.S. reliance upon petroleum. It will require up to 15

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1/For purposes of this report, the term "Middle East" includes the countries of the Arabian Peninsula, Iran, Iraq, Syria, Lebanon, Israel, and Jordan. "North Africa" includes Egypt, Libya, Tunisia, and Algeria.

**Table 1**  
**Comparative U.S. Crude Oil Dependency 1973-79**

	1973			1976			1979		
	Thousand bpd (note a)	% of consumption	% of crude oil imports	Thousand bpd (note a)	% of consumption	% of crude oil imports	Thousand bpd (note a)	% of consumption	% of crude oil imports
Production	9,208	74.0		8,132	60.6		8,533	58.0	
Net imports (note b)	3,242	26.0		5,279	39.4		6,177	42.0	
Total consumption	<u>12,450</u>	<u>100.0</u>		<u>13,411</u>	<u>100.0</u>		<u>14,710</u>	<u>100.0</u>	
Major sources of crude oil imports (note c)									
<b>Middle East</b>									
Iran (note e)	205	1.65	5.91	298	2.22	5.64	295	2.01	4.55
Iraq (note e,f)	17	0.13	0.49	26	0.19	0.49	88	0.60	1.36
Kuwait (note e,f)	44	0.35	1.27	1	0.01	0.02	4	0.03	0.06
Qatar (note e,f)	41	0.33	1.18	24	0.18	0.45	31	0.21	0.48
Saudi Arabia (note e,f)	599	4.81	17.26	1,222	9.11	23.11	1,338	9.09	20.65
United Arab Emirates (note e,f)	88	0.71	2.54	254	1.89	4.80	280	1.90	4.32
Other (note d)	-	-	-	-	-	-	9	0.06	0.14
	<u>994</u>	<u>7.98</u>	<u>28.65</u>	<u>1,825</u>	<u>13.60</u>	<u>34.51</u>	<u>2,045</u>	<u>13.90</u>	<u>31.56</u>
<b>North Africa</b>									
Algeria (note e,f)	124	0.99	3.57	408	3.04	7.72	603	4.10	9.31
Egypt (note g)	-	-	-	17	0.13	0.32	55	0.37	0.85
Libya (note e,f)	153	1.23	4.41	444	3.31	8.40	638	4.34	9.85
	<u>277</u>	<u>2.22</u>	<u>7.98</u>	<u>869</u>	<u>6.48</u>	<u>16.44</u>	<u>1,296</u>	<u>8.81</u>	<u>20.01</u>
<b>Other Africa</b>									
Gabon (note e)	-	-	-	26	0.19	0.49	42	0.28	0.65
Nigeria (note e)	409	3.29	11.78	1,014	7.56	19.18	1,066	7.25	16.46
	<u>409</u>	<u>3.29</u>	<u>11.78</u>	<u>1,040</u>	<u>7.75</u>	<u>19.67</u>	<u>1,108</u>	<u>7.53</u>	<u>17.11</u>
<b>Latin America</b>									
Ecuador (note e)	33	0.27	0.95	51	0.38	0.96	31	0.21	0.48
Mexico	8	0.06	0.23	87	0.65	1.65	432	2.94	6.67
Venezuela (note e)	405	3.25	11.67	241	1.80	4.56	292	1.98	4.51
	<u>446</u>	<u>3.58</u>	<u>12.85</u>	<u>379</u>	<u>2.83</u>	<u>7.17</u>	<u>755</u>	<u>5.13</u>	<u>11.66</u>
<b>Far East</b>									
Indonesia (note e)	249	2.00	7.17	537	4.00	10.16	376	2.56	5.80
<b>Europe</b>									
United Kingdom	-	-	-	13	0.10	0.25	197	1.34	3.04
Norway	-	-	-	35	0.26	0.66	75	0.51	1.16
	<u>-</u>	<u>-</u>	<u>-</u>	<u>48</u>	<u>0.36</u>	<u>0.91</u>	<u>272</u>	<u>1.85</u>	<u>4.20</u>
<b>Canada</b>									
Canada	998	8.02	28.75	371	2.77	7.02	267	1.82	4.12
Other Non-OPEC/OAPEC	98	0.79	2.82	218	1.63	4.12	359	2.44	5.54
Total	<u>3,471</u>	<u>27.88</u>	<u>100.00</u>	<u>5,287</u>	<u>39.42</u>	<u>100.00</u>	<u>6,478</u>	<u>44.04</u>	<u>100.00</u>
<b>Total OPEC</b>									
Total OPEC	<u>1,066</u>	<u>8.56</u>	<u>30.71</u>	<u>2,396</u>	<u>17.87</u>	<u>45.32</u>	<u>2,982</u>	<u>20.27</u>	<u>46.03</u>
Total OPEC	<u>2,367</u>	<u>19.01</u>	<u>68.19</u>	<u>4,546</u>	<u>33.90</u>	<u>85.98</u>	<u>5,084</u>	<u>34.56</u>	<u>78.48</u>
<b>Total Non-OPEC/Non OAPEC</b>									
Total Non-OPEC/Non OAPEC	<u>1,104</u>	<u>8.87</u>	<u>31.81</u>	<u>724</u>	<u>5.40</u>	<u>13.70</u>	<u>1,394</u>	<u>9.48</u>	<u>21.52</u>

a/Barrels per day.

b/Crude oil imports less crude oil exports. Imports include imports for the Strategic Petroleum Reserve.

c/1973 country figures are for September only. 1976 and 1979 figures are the daily average for the year.

d/Includes Bahrain and Syria.

e/Member of OPEC.

f/Member of OPEC.

g/Member of OPEC until April 1979.

Source: International Energy Statistical Review, Central Intelligence Agency (CIA), ER IESR 80-012, Aug. 26, 1980.

years to perfect the technology and construct the equipment to produce synthetic fuel from coal and shale. These technologies will also require massive amounts of capital, threaten serious environmental damage, and may compete with agriculture for already scarce water. Construction of nuclear plants is also time and capital-consuming--about 7 to 10 years in construction time alone. Although nuclear plant safety may be debatable, nuclear power still poses some unanswered questions concerning ultimate waste disposal and there is already world concern over the growing shortage of uranium--itself a finite resource, like petroleum.

There is no apparent way for the United States to attain energy independence quickly. Today's policies, therefore, must be designed to reduce potential adverse effects of dependency and to provide the petroleum supplies needed to sustain the economy until alternative sources can be implemented.

#### THE CONCEPT OF SUPPLY SOURCE DIVERSIFICATION

It has been suggested that the United States could improve its security of supply and achieve greater foreign policy independence by diversifying its major sources of imported oil. The recent discovery of large oil reserves in Mexico has spurred speculation in the press and the Congress that perhaps the United States could divert much of its Middle East oil imports to Mexico on the premise that Mexico would be a more secure and stable source. The advantage of diversified supply sources was recognized in the President's National Energy Plan II, which stated:

"\* \* \* since near-term domestic production cannot displace imports altogether, the U.S. should seek to diversify world oil supplies and enhance their security of supply. The U.S. should support multi-lateral assistance to increase production in non-OPEC countries, and encourage immediate efforts to assess the potential oil resources that various non-OPEC countries possess."

In general, the major advantages of U.S. oil supply source diversification would be

- increased security and continuity of supply,
- increased political independence, and
- greater supplier security.

The primary advantage to more evenly diversified foreign oil supply sources is the increased security of supply that could be thereby achieved. At present, the largest portion of our foreign

supplies comes from the Middle East and is highly vulnerable to political disruptions, military conflict, and terrorist actions.

In 1979, about 78 percent of U.S. crude oil imports came from members of OPEC and about 46 percent came from members of the Organization of Arab Petroleum Exporting Countries (OAPEC). Over 31 percent of U.S. crude oil imports came from countries around the Persian Gulf, which means that it was shipped through the Straits of Hormuz near the tip of Oman. This passage is absolutely vital to Persian Gulf shipping; some 77 ships pass through it daily, most of them oil tankers. The deep channel required by fully loaded tankers is very narrow, and traffic could easily be disrupted by air or sea forces or terrorist actions.

Greater political freedom could be gained by reducing the leverage of any single producer or bloc of producers over U.S. oil supplies. As long as the United States remains tied to the Arab world for the bulk of its oil imports, U.S. foreign policy will be influenced and constrained by that dependency and Arab supplier countries will be tempted to use oil prices and supply restraint as weapons against the United States to resolve political differences.

Also, as long as the United States continues to depend upon a single supplier country or region for a significant share of its imported oil (such as the Middle East, which supplies nearly 14 percent of total U.S. oil consumption) that region and its governments may very likely become a target for those wishing to damage the United States or to influence U.S. policy decisions. Recognizing that the United States would more than likely feel an obligation to provide for the security of its major supplier, others could provoke the United States into costly military ventures or otherwise distort its foreign posture by threatening the supplier country.

#### OBJECTIVES, SCOPE, AND METHODOLOGY

Senator Max Baucus and Congressman Donald J. Pease requested this study of the potential for diversifying U.S. oil imports (especially to Mexico) to reduce reliance upon the Middle East. As agreed, we have expanded the scope to include the potential for developing new petroleum sources throughout the world. The objectives of the review, therefore, were to examine the potential for achieving supply source diversification, incentives and disincentives for the private oil companies that provide U.S. supplies to diversify their individual foreign oil sources and reduce dependency upon the Middle East and North Africa, the connection between diversification and accelerated petroleum exploration and production, incentives and disincentives for exploration, and progress toward such diversification.

We coordinated our work with that of other congressional agencies, using their published reports wherever possible, researched available literature, and examined records of the Departments of Energy and State. We also interviewed officials of the Departments of Energy (DOE), State, and Treasury; U.S. Geological Survey; International Energy Agency; Organization for Economic Cooperation and Development; European Economic Community; 17 U.S.-based oil companies; and 4 foreign oil companies.

Except for our interviews, all source and reference material supporting this report is already in the public domain. We based our analysis upon written and statistical material from Federal agencies (the Departments of Energy and State, Central Intelligence Agency, U.S. Geological Survey); private organizations (Resources for the Future, the Ford Foundation, Petroconsultants, Ltd.--a private petroleum consulting and data firm); publications (The Oil and Gas Journal, World Oil); and oil companies. Projections of undiscovered petroleum potential of non-OPEC less developed countries are based on published reports of the World Bank, Congressional Budget Office, and Central Intelligence Agency. We did not make an independent assessment of their validity.

We did not visit any of the developing countries to determine their perceptions, concerns, and circumstances surrounding the impediments cited by the oil companies as deterrents to exploration. We, therefore, did not assess whether the obstacles we cite in this report actually contributed to or precluded any specific nation from developing its resources as quickly as it may have wished.

This review is restricted to imported oil. Imports, however, are merely an inverse function of domestic production related to demand. National security would be enhanced by wider diversification of imported oil sources; it would also be enhanced by reducing the level of imports.

While this report concerns only conventional crude oil, we should distinguish between conventional and unconventional crude oil and its potential future importance. Unconventional oil includes heavy oil (crude oil which is usually so thick that it will not flow unless heated), tar sands, and oil shales. Unconventional oil sources may be of tremendous future importance to the United States because of their magnitude and geographic location. The combined conventional and unconventional petroleum resources of the United States, Canada, and Latin America are many times larger than those of the Middle East. Most of the American continent's unconventional oil is located in Canada's tar sands, Venezuela's Orinoco tar belt, and U.S. oil shale.

Unfortunately, most experts agree that most of these vast resources cannot be recovered economically or quickly, even at today's oil prices. Research and technological improvements are continuing, however, so these unconventional oil sources may yet be of major commercial importance.

## CHAPTER 2

### THE POTENTIAL FOR DIVERSIFYING SUPPLY

#### SOURCES IS LIMITED

Despite the advantages of diversifying sources of foreign oil supplies, the potential for achieving a significant degree of national diversification is limited unless substantial new sources of oil can be found and developed outside the Middle East and North Africa. At present, there is not enough productive capacity outside these areas to displace their oil to a significant degree. There appears to be more potential for significant diversification in the mid to long term (roughly 5 to 15 years from now), but whether this can be achieved by then depends on the expansion of current productive capacity outside the Middle East and North Africa and the development of new producers outside these regions.

Mexico holds forth a degree of hope for the mid term, although its rate of oil production may be geared more to its own economic development needs than to U.S. energy needs. Even so, Mexican oil could account for about 12 to 17 percent of U.S. oil imports by 1985 and as much as 22 percent by 1990, compared with the current 6.7 percent.

#### SHORT-TERM POTENTIAL IS NIL

Immediate supply source diversification would be possible if (1) world productive capacity outside the Middle East and North Africa significantly exceeded demand and all or most producers were eager to produce up to capacity or (2) other major importers were willing to rearrange their own sources of imported oil to accommodate supplier changes by the United States. Unfortunately, neither condition exists at present. The world's surplus productive capacity currently resides in OPEC, particularly in Middle East countries, as illustrated in table 2.

As of June 1980, OPEC could sustain a production level of 32,680,000 bpd, it had an arbitrary, self-imposed production ceiling of 30,815,000 bpd, and it was producing at a rate of 27,170,000 bpd. This represents unused available production of 3,645,000 bpd or a potential increase of 13.4 percent over current production, and unused actual sustainable capacity of 5,510,000 bpd or a potential increase of 20.3 percent. These figures may be a little too optimistic since they include prerevolution data for Iran. Iran's physical productive capacity has been reduced, since the Shah's departure, but the degree of loss is uncertain. The figures also do not reflect losses undoubtedly incurred by both Iran and Iraq in their current conflict.

Excluding Middle East producers reduces the unused available production to 1,015,000 bpd and the unused actual sustainable capacity to 1,215,000 bpd, of which Venezuela accounts for 150,000 bpd and 350,000 bpd, respectively.

Table 2

OPEC Surplus Crude Oil Productive Capacity

<u>Country</u>	<u>Productive capacity</u>		<u>Current</u>	<u>Surplus capacity</u>			
	<u>Sustainable</u> (note a)	<u>Ceiling</u> (note b)	<u>production</u> (6/80)	<u>Middle</u>		<u>Non</u>	
				<u>East</u>		<u>Mid-East</u>	
				* **		* **	
(thousand bpd)							
Algeria	1,150	1,150	1,000	-	-	150	150
Ecuador	225	225	230	-	-	(5)	(5)
Gabon	225	225	200	-	-	25	25
Indonesia	1,650	1,650	1,545	-	-	105	105
Iran	3,500***	3,500	1,500	2,000	2,000	-	-
Iraq	3,500	3,500	3,300	200	200	-	-
Kuwait	2,500	1,500	1,300	1,200	200	-	-
Libya	2,200	2,200	1,700	-	-	500	500
Neutral Zone	600	600	545	55	55	-	-
Nigeria	2,200	2,200	2,110	-	-	90	90
Qatar	600	600	440	160	160	-	-
Saudi Arabia	9,500	9,500	9,500	-	-	-	-
United Arab Emirates:							
Abu Dhabi	2,035	1,370	1,400	635	(30)	-	-
Dubai	370	370	340	30	30	-	-
Sharjah	25	25	10	15	15	-	-
Venezuela	<u>2,400</u>	<u>2,200</u>	<u>2,050</u>	-	-	<u>350</u>	<u>150</u>
<b>TOTAL</b>	<u>32,680</u>	<u>30,815</u>	<u>27,170</u>	<u>4,295</u>	<u>2,630</u>	<u>1,215</u>	<u>1,015</u>

a/Maximum sustainable or operational capacity is the maximum production rate that can be sustained for several months; it considers the experience of operating the total system and is generally some 90-95 percent of installed capacity. This capacity concept does not necessarily reflect the maximum production rate sustainable without damage to the fields.

b/Ceiling capacity reflects production ceilings applied by some countries. These ceilings usually represent constraint only on annual average output, thus production may exceed the ceilings in a given month or quarter.

\* Difference between current production and sustainable capacity.

\*\* Difference between ceiling and current production.

\*\*\* The Iranian fields have suffered from maintenance neglect and loss of experienced personnel. The sustainable capacity has definitely deteriorated from the prerevolution level of 5,500,000 bpd, but the precise amount is unknown. Therefore, we show only the ceiling capacity of 3,500,000 bpd.

Source: International Energy Statistical Review, Aug. 26, 1980, CIA.

Table 2 indicates the limited potential for shifting U.S. imports within OPEC away from the Middle East; there is some small potential for increasing imports from Venezuela, Nigeria, Gabon, Indonesia, Algeria, and Libya. Of the non-Arab countries in this group, Venezuela has the largest current unused productive capacity but its production is limited by insufficient reserves. It is probably in the decline phase of its oil development and needs to locate more reserves to be able to maintain its capacity. Indonesia's annual production is steadily declining as new discoveries have failed to match its production rate for several years; its small unused production capacity is likely to disappear in the near future. The unused capacity of the remaining non-Arab countries (Nigeria and Gabon) amounts to only 1.78 percent of current U.S. imports. Libya recently hinted at a drastic reduction of exports. Increasing the U.S. reliance upon Libya or other North African Arab countries would not improve the U.S. position.

Table 3 shows the surplus productive capacity as percentages of 1979 U.S. crude oil imports of 6,478,000 bpd. From this comparison we see that idle capacity available to sustain U.S. source diversification efforts is limited. Even if countries that have surplus capacity were willing to produce and export the excess to the United States, only in the case of Venezuela could there be a marked increase over the current share of U.S. imports.

Table 3

OPEC Surplus Crude Oil Productive Capacity  
 Outside the Middle East and North Africa  
Compared with Share of U.S. Imports

<u>Area</u>	<u>Percent share of U.S. 1979 imports</u>	<u>Surplus sustainable capacity</u>	<u>Surplus ceiling capacity</u>	<u>Percent increase of U.S. share if surplus included</u>
		----- (bpd) -----		
Africa:				
Gabon	0.65	25,000	25,000	0.39
Nigeria	16.46	90,000	90,000	1.39
Far East:				
Indonesia	5.80	105,000	105,000	1.62
Latin America:				
Venezuela	<u>4.51</u>	<u>350,000</u>	<u>150,000</u>	<u>5.40/2.32</u>
Total	<u>27.42</u>	<u>570,000</u>	<u>370,000</u>	<u>8.80/5.72</u>

No producers outside OPEC have unused productive capacity that could be employed to increase exports to the United States. Mexico is producing at capacity and plans to increase its capacity



gradually to mesh with its domestic fiscal policies, as we discuss later. Canada is no longer self-sufficient in crude oil and has severely restricted its exports to the United States in favor of meeting its own needs first. Norway has been following a policy of restrained development to minimize economic and social disruptions to its own economy; it is beginning to accelerate its exploration, development, and production to meet greater revenue needs, but the market will not feel the results for at least 7 years. The United Kingdom has not yet held back production, but is known to be studying a policy proposal to reduce production in order to conserve its oil for its own needs as long as possible.

Other major oil importers are not likely to be willing to sacrifice themselves for the sake of the United States by shifting their import patterns more toward the Middle East so the United States can shift away from it. Most of these countries are far more dependent upon the Middle East for their total oil needs than is the United States. Table 4 compares the sources of oil imports of the United States and other major oil importers.

#### MID-TERM PROSPECTS ARE UNCERTAIN

From what is known today about world oil resources, it is doubtful that significant diversification away from the Middle East-North Africa area can be achieved unless new discoveries are made in other areas. The normal lag-time of 6 to 12 years between pre-drilling exploration, exploratory drilling, development drilling, installation of production facilities, and building of necessary transportation and marketing infrastructure preclude any new oil discovery from being an important supply source until the late 1980s.

Oil production in the non-OPEC developing countries is expected to rise rapidly over the next few years. On the other hand, rising consumption in these countries is expected to absorb most, if not all, of the growth. Mexico, of course, has the brightest prospects, with the potential of finding giant fields the size of Middle East fields; and Egypt is expected to be able to produce over one million bpd in the 1980s. A January 1979 World Bank report projects that, by 1985 non-OPEC less developed countries will produce 8.4 million bpd and export 3.6 million bpd, compared to projected 1980 exports of 2.7 million bpd.

If these projections prove correct, it leaves less than one million bpd of incremental exports from 1980 to 1985 for which the United States could compete. Even if the United States could obtain access to half this amount--a highly optimistic assumption since this supply will undoubtedly be the subject of intense bidding between major consumers seeking diversification--it would not materially reduce U.S. dependence on the Middle East and North Africa.

Table 4

Selected Countries: Crude Oil Imports by Source  
as a Percentage of Imports

	U.S.		Japan		West Germany		France		Italy	
	<sup>a</sup> 1973	1979	<sup>a</sup> 1973	1979	<sup>a</sup> 1973	1979	<sup>a</sup> 1973	1979	<sup>a</sup> 1973	1979
<u>Middle East</u>										
Iran	5.9	4.6	31.9	9.7	10.8	10.8	7.7	4.9	11.0	1.9
Iraq	0.5	1.4	-	5.4	1.9	2.1	13.3	19.4	15.2	19.5
Kuwait	1.2	0.1	10.0	9.6	4.4	2.5	11.2	3.9	8.5	9.5
Qatar	1.2	0.5	-	2.9	0.8	0.5	2.4	3.0	0.8	1.0
Saudi Arabia	17.3	20.7	23.6	34.5	30.9	16.7	22.1	35.4	27.5	29.2
UAE	2.5	4.3	10.5	10.2	7.1	7.0	9.8	6.8	-	2.3
Other		0.1	-	-	1.1	0.8	0.4	1.7	-	-
	<u>28.6</u>	<u>31.7</u>	<u>76.0</u>	<u>72.3</u>	<u>57.0</u>	<u>40.4</u>	<u>66.9</u>	<u>75.1</u>	<u>63.0</u>	<u>63.4</u>
<u>North Africa</u>										
Algeria	3.6	9.3	-	0.1	10.4	9.1	8.0	4.0	2.4	2.5
Egypt	-	0.8	-	-	-	0.3	-	-	-	-
Libya	4.4	9.8	0.6	0.1	18.2	16.1	4.6	3.2	23.8	13.1
	<u>8.0</u>	<u>19.9</u>	<u>0.6</u>	<u>0.2</u>	<u>28.6</u>	<u>25.5</u>	<u>12.6</u>	<u>7.2</u>	<u>26.2</u>	<u>15.6</u>
<u>Other Africa</u>										
Gabon	-	0.6	-	-	1.4	0.7	1.2	1.0	0.1	0.1
Nigeria	11.8	16.5	2.1	-	7.3	13.5	9.0	7.7	0.4	2.6
	<u>11.8</u>	<u>17.1</u>	<u>2.1</u>	<u>-</u>	<u>8.7</u>	<u>14.2</u>	<u>10.2</u>	<u>8.7</u>	<u>0.5</u>	<u>2.7</u>
<u>Latin America</u>										
Ecuador	0.9	0.5	-	-	-	-	-	-	-	-
Mexico	0.2	6.7	-	-	-	-	-	-	-	-
Venezuela	11.7	4.5	0.1	0.2	1.8	1.3	1.3	0.8	0.7	1.1
	<u>12.8</u>	<u>11.7</u>	<u>0.1</u>	<u>0.2</u>	<u>1.8</u>	<u>1.3</u>	<u>1.3</u>	<u>0.8</u>	<u>0.7</u>	<u>1.1</u>
<u>Far East</u>										
Indonesia	7.2	5.8	13.1	14.4	-	0.4	-	-	-	-
<u>Europe</u>										
United Kingdom	-	3.0	-	-	-	11.0	-	2.2	-	-
Norway	-	1.2	-	-	-	3.2	2.0	1.2	-	-
	<u>-</u>	<u>4.2</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>14.2</u>	<u>2.0</u>	<u>3.4</u>	<u>-</u>	<u>-</u>
Canada	28.8	4.1	-	-	-	-	-	-	-	-
Other Non-OPEC	2.8	5.5	8.1	12.9	3.9	4.0	7.0	4.8	9.6	17.2
Total	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>

<sup>a</sup>/September 1973 (pre-crisis level).

Source: International Energy Statistical Review, CIA, August 26, 1980.

## Mexico as a future source

Supplemental oil and gas from Mexico, abundant as they could potentially be, will not be the solution to U.S. energy problems. They could, however, partly compensate for declining domestic production and help moderate U.S. dependence on the Middle East and North African oil. Actually, Mexico has already substantially increased its oil exports to the United States, as shown below.

(Daily average in thousands of bpd)

<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
71	87	179	318	434

In 1979, 6.6 percent of U.S. crude oil imports came from Mexico.

Those who are looking toward Mexico as the solution to U.S. energy problems, however, may be disappointed by most estimates of future production. According to Mexico's original 6-year plan, (1976-1982), production would increase from 1.1 million bpd in 1977 to 2.2 million bpd by 1982; but this schedule was revised to reflect the 1982 target being met by 1980. The Mexican Government has stated that after 1980 oil production would not be increased beyond Mexico's capacity to use the oil export revenues. Therefore, production levels beyond 1980 are uncertain. Under Mexican law, no president may serve more than one 6-year term or commit his successor to his policies. Since President Lopez Portillo's term expires in 1982, estimates beyond the near term are highly speculative and depend upon assumptions made regarding future political and economic developments.

At present, Mexico's official energy policy is to first satisfy its domestic needs, then to export any surplus production in order to build an economic development fund, and to restrain overall production in order to limit export income to a level that the Mexican economy can digest without suffering fiscal distress. Therefore, the volume of Mexico's petroleum exports will depend upon both production and internal consumption, which in turn will depend upon Mexico's rate of economic growth and development. Domestic oil consumption will be affected by the success of the government's program to convert domestic energy consumption from oil to natural gas. Although Mexico may not rival Saudi Arabia as the world's leading petroleum exporter, it will have sufficient quantities available to place it among the world's primary petroleum exporting countries.

Mexican oil consumption has more than doubled during the 1970s, reaching over one million bpd in 1978. Increases in demand should continue throughout the 1980s, because as petro-revenues are used to develop the economy more energy demand will be created, particularly for oil and gas. The mix of oil and gas consumed will depend on the success of the oil-to-gas conversion program.

Almost 87 percent of Mexico's surplus crude oil was sold to the United States in 1978, with most of the remainder going to Israel (5.8 percent), Spain (4.0 percent), Canada (0.6 percent) and Brazil (0.4 percent). Mexico has announced plans to further diversify its oil customers, thereby reducing the percentage of sales to the United States to about 60 percent by 1981. Table 5 shows the projected U.S. share of estimated Mexican oil exports for the next decade.

Table 5

Estimated Quantities of Mexican Oil  
Available to the United States  
1980 to 1990

<u>Year</u>	Estimated exportable Mexican oil (note a) (000 bpd)	U.S. market share (note b) (percent)	Available to the United States (000 bpd)
1980	500 - 1,100	66	330 - 730
1981	900 - 1,200	60	540 - 720
1982	1,100 - 1,300	60	660 - 780
1983	1,200 - 1,400	60	720 - 840
1984	1,300 - 1,600	60	780 - 960
1985	1,400 - 2,000	60	860 - 1,200
1986	1,700 - 2,100	60	1,020 - 1,260
1987	1,900 - 2,300	60	1,140 - 1,380
1988	2,000 - 2,400	60	1,200 - 1,440
1990	3,000	60	1,800

a/ Based on DOE and Congressional Research Service estimates.

b/ Our assumptions based on announced PEMEX goals.

These estimates can be seen in perspective by comparing them with the total U.S. crude oil consumption shown in table 6. Mexican oil imports could become an increasing share of U.S. consumption over the next decade.

If these projections are realistic, Mexico could become a major source of imported oil in the coming years, thereby providing the opportunity for a partial shift of U.S. dependency away from the Middle East and North Africa. Given the constraints of Mexico's production plans, however, Mexican imports will not be capable of entirely replacing U.S. Middle East oil imports.

For further information on U.S.-Mexican energy relationships, see GAO reports, "Prospects for a Stronger United States-Mexico Energy Relationship" (ID-80-11, May 1, 1980) and "Oil and Natural Gas From Alaska, Canada, and Mexico--Only Limited Help for U.S." (EMD-80-72, Sept. 11, 1980).

Table 6

Potential Mexican Crude Oil Exports to the United States  
as Percent of U.S. Consumption and Imports  
1979 to 1990

Year	Projected range of exports to the United States (000 bpd)	Projected U.S. crude oil consumption (note a) (000 bpd)	Export range as percent of U.S. consumption	Projected U.S. net crude oil imports (note a) (000 bpd)	Export range as percent of U.S. net crude oil imports
1979	b/434	b/14,497	3.0	b/6,177	7.0
1980	333 - 730	14,656	2.3 - 5.0	6,325	5.3 - 11.5
1981	540 - 720	14,817	3.6 - 4.9	6,477	8.3 - 11.1
1982	660 - 780	14,980	4.4 - 5.2	6,632	10.0 - 11.8
1983	720 - 840	15,145	4.8 - 5.5	6,791	10.6 - 12.4
1984	780 - 960	15,312	5.1 - 6.3	6,954	11.2 - 13.8
1985	860 - 1,200	15,480	5.6 - 7.8	7,121	12.1 - 16.9
1986	1,020 - 1,260	15,650	6.5 - 8.1	7,292	14.0 - 17.3
1987	1,140 - 1,380	15,822	7.2 - 8.7	7,467	15.3 - 18.5
1988	1,200 - 1,440	15,996	7.5 - 9.0	7,646	15.7 - 18.8
1990	1,800	16,350	11.0	8,018	22.4

a/Growth rates of 1.1 percent of U.S. crude oil consumption and 2.4 percent for U.S. net crude oil imports are based upon projections in Exxon's report "World Energy Outlook", Dec. 1979, and are used here solely for comparative purposes.

b/These are actual figures, according to the U.S. Energy Information Administration's "Monthly Energy Review," June 1980.

#### Canada as a future source

Canada is committed to energy self-reliance and plans to make every effort to use or reserve oil and gas for future internal use before exports are considered. Any oil and gas exports from Canada, then, will be approved for short periods and priced at world levels. Overall, the size of any exports will not be significant to U.S. needs.

Oil exports will continue to be phased out, and after 1981 the United States will receive only relatively small amounts of oil through exchanges and short-term limitations on the use of heavy oil in Canada. These exports will be important to the Northern Tier States; however even these exports will be reduced starting in the mid-1980s when Canada will be able to use this oil internally.

Notwithstanding the optimism on potential gas resources in Canada, gas exports will likely maintain their current market position in the United States through the 1980s (5 percent of U.S. consumption). After 1990, exports may begin to decrease as more gas is needed in Canada.

GAO reports, "Prospects for Cooperation and Trade of Energy Resources Between the United States and Canada" (ID-80-2, Nov. 8, 1979) and "Oil and Natural Gas From Alaska, Canada, and Mexico-- Only Limited Help for U.S." (EMD-80-72, Sept. 11, 1980), contain further information on U.S.-Canadian energy relations.

## CONCLUSION

The potential for immediate large-scale diversification of U.S. imported oil sources is nil because there is not enough unused productive capacity outside the major Middle East and North African producing countries to support a major shift of U.S. import patterns without a counterbalancing shift by other major importers. Most of the other major importing countries are already more dependent upon the Middle East and North Africa than is the United States and are not likely to sacrifice their own security to improve that of the United States.

The prospects for diversification in the mid-term future are somewhat better, although still uncertain. The normal lag-time of 6 to 12 years between discovery and production means that any new oil discovery will not be an important supply source until the late 1980s. Mexico and some other non-OPEC areas offer the brightest prospects. Mexico could become an important source of imported oil in the coming years, accounting for possibly as much as 22 percent of U.S. oil imports by 1990, but it will not replace Middle East imports unless U.S. oil consumption unexpectedly declines sharply.

This situation is likely to prevail throughout the foreseeable future unless major new discoveries are made outside the Middle East and North Africa.

## CHAPTER 3

### DIVERSIFICATION AT THE COMPANY LEVEL

Oil company officials we talked with see supply source diversification as necessary to achieve a secure and continual supply of crude oil. We should emphasize that diversification does not mean abandoning traditional oil sources but, rather, reducing reliance upon them by supplementing with other sources to the point that dependency upon the Middle East and North Africa is not so great as to be critical should a supply disruption occur.

The Middle East continues to present a geologic lure to oil companies, since both known reserves and the potential for undiscovered reserves are larger there than anywhere else in the world. However, the changing relationship of the international oil companies with the major producing governments has created a powerful incentive for the companies to diversify their sources of petroleum and has largely removed the opportunity for new equity ventures in OAPEC countries and Iran.

The opportunities for significant shifts in supply sources, however, have been limited; and few U.S. companies that are dependent upon the Middle East and North Africa have achieved any significant reduction to date in their dependence on those areas. When Venezuela and Ecuador nationalized their oil industries in the mid-1970s, a number of U.S. and foreign companies lost production facilities and have not maintained their Latin American sources through purchase contracts. Venezuela, for example, is selling directly to a number of U.S. utilities and refiners which previously purchased Venezuelan oil from companies that lost equity production in Venezuela. This has made these companies even more dependent upon the Middle East and other sources.

#### INCENTIVE TO DIVERSIFY SOURCES

OPEC's rise to power has changed oil company strategies. Some OPEC members have fully nationalized company assets; most have gradually increased their equity participation and have gained operational control of company facilities in their respective countries.

Retreating from their loss of ownership production, some companies attempted to preserve their traditional sources of supply through long-term supply contracts with the host governments. Many of these contracts were unilaterally abrogated by the OPEC governments within the last few years and converted to short-term contracts as OPEC tightened its control over disposition of its oil. With the advent of the high spot-market prices of the past year, some of these short-term contracts have been unilaterally terminated by the governments so they could sell the oil on the spot market--sometimes to the company left holding a worthless purchase contract.

OPEC producer countries now appear to be on the verge of moving their campaign against the oil companies one step further. The November 12, 1979, issue of the "Oil and Gas Journal" reported that the managing director of Petroleos de Venezuela said that (1) OPEC hopes to decrease the roles of crude oil traders and other oil trade intermediaries, (2) OPEC is restructuring world oil trade by insisting on more direct sales between it and consumers, and (3) the great bulk of sales of crude oil from exporting countries " \* \* \*, will, when the process has been completed, be made directly by the government entity in charge of international marketing to refiners on a long-term contract basis."

Thus, the oil companies, especially the "international majors," are seeing their role diminish by oil producers asserting control over the disposition of their oil. The majors have lost much of their power to determine crude oil production volumes and prices and are widely regarded as becoming captive to the policies and directions of the producing countries.

Some OPEC nations also have recently adopted new terms of sale which insist on the use of the oil companies' advanced technology and capital in the search for oil and gas. For example:

--Algeria has adopted an exploration surcharge of \$3 a barrel. If the purchaser elects to explore in Algeria and is approved by the government, the amount paid in surcharge will be applied against its exploration costs.

--Libya has drastically cut its contract sales for 1980 and is entering into new production-sharing exploration agreements; companies that are successful would be given preference in purchasing government oil as well as their production shares.

Other OPEC nations want access to the West's refining technology. For example, Saudi Arabia has entered into crude oil processing agreements in Europe with the British Petroleum Company, Ltd. (BP), Mobil, and Petrola (Greece).

The weakening of the major international oil companies is reflected in the decrease of company-owned and produced crude oil (equity crude) the major international companies have at their disposal. Table 7 shows a DOE analysis of the declining trend for six major U.S. oil companies between 1972-76.



Table 7

Decline of Selected Companies' Equity Production of  
Petroleum Liquids Relative to Total Supply (note a)  
1972 to 76

(Volume in thousands of bpd)

	1972		1973		1974		1975		1976	
	Volume	Percent	Volume	Percent	Volume	Percent	Volume	Percent	Volume	Percent
<b>Exxon</b>										
Equity	5,734	93.3	5,525	82.2	4,271	67.1	3,684	68.1	2,683	48.1
Total supply	6,145		6,718		6,367		5,411		5,576	
<b>Gulf</b>										
Equity	3,086	100	2,429	80.6	1,700	65.8	1,001	51.3	702	40.6
Total supply	3,086		3,012		2,585		1,952		1,730	
<b>Mobil</b>										
Equity	2,312	96.4	2,043	81.5	1,278	51.9	1,227	54.8	1,170	54.3
Total supply	2,399		2,507		2,462		2,240		2,156	
<b>Royal Dutch/Shell (note b)</b>										
Equity	3,826	59.7	3,855	57.3	3,435	58.1	2,821	58.9	2,113	44.7
Total supply	6,408		6,729		5,917		4,786		4,732	
<b>Socal</b>										
Equity	3,324	100	3,052	81.7	2,144	56.2	1,867	61.7	2,026	57.2
Total supply	3,324		3,736		3,814		3,025		3,542	
<b>Texaco</b>										
Equity	3,296	82.0	3,215	70.9	2,355	52.3	2,034	54.0	2,066	51.5
Total supply	4,021		4,535		4,507		3,770		4,015	

a/Excludes purchases in the third-party crude oil market and the spot market.

b/Does not include data from Shell Oil Company, a U.S.-based company.

Source: An Analysis of Current Trends in United States Access to World Oil, Department of Energy, July 1, 1978.

A more recent and telling estimate shows that where equity oil was once measured in millions of barrels per day for the leading multinational companies, not one of them is expected to have as much as one million barrels per day of equity crude outside North America in 1980.

Table 8

Selected Countries' Principal Sources of  
Equity Oil Production Outside North America  
Estimates for 1980  
(000 bpd)

	<u>Exxon</u>	<u>Texaco</u>	<u>Mobil</u>	<u>Socal</u> (note a)	<u>Gulf</u>	<u>Phillips</u>	<u>Occidental</u> (note a)	<u>Conoco</u> (note a)	<u>BP</u>	<u>Royal Dutch Shell</u>	<u>Amoco</u>
<u>Middle East</u>											
Abu Dhabi	40	-	40	-	-	-	-	-	155	80	-
Dubai	-	-	-	-	-	-	-	104	-	-	-
Oman	-	-	-	-	-	-	-	-	-	100	-
Turkey	-	-	-	-	-	-	-	-	-	25	-
	<u>40</u>	<u>-</u>	<u>40</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>104</u>	<u>155</u>	<u>205</u>	<u>-</u>
<u>North Africa</u>											
Egypt	-	-	-	-	-	5	-	-	-	-	140
Libya	80	-	40	-	-	-	109	161	-	-	-
	<u>80</u>	<u>-</u>	<u>40</u>	<u>-</u>	<u>-</u>	<u>5</u>	<u>109</u>	<u>161</u>	<u>-</u>	<u>-</u>	<u>140</u>
<u>Other Africa</u>											
Angola	-	-	-	-	50	-	-	-	-	-	-
Nigeria	-	10	80	10	170	35	-	-	-	280	-
	<u>-</u>	<u>10</u>	<u>80</u>	<u>10</u>	<u>220</u>	<u>35</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>280</u>	<u>-</u>
<u>Europe</u>											
United Kingdom	195	40	65	45	20	-	111	20	525	195	-
Norway	-	-	-	-	-	180	-	-	-	-	-
Other	35	-	15	5	-	-	-	7	-	45	-
	<u>230</u>	<u>40</u>	<u>80</u>	<u>50</u>	<u>20</u>	<u>180</u>	<u>111</u>	<u>27</u>	<u>525</u>	<u>240</u>	<u>-</u>
<u>Far East</u>											
Australia	200	-	-	10	-	-	-	-	-	-	-
Indonesia	-	285	30	285	-	10	-	6	-	-	-
Malaysia	45	-	-	-	-	-	-	-	-	-	-
	<u>245</u>	<u>285</u>	<u>30</u>	<u>295</u>	<u>-</u>	<u>10</u>	<u>-</u>	<u>6</u>	<u>-</u>	<u>-</u>	<u>-</u>
<u>Latin America</u>											
Argentina	-	-	-	-	-	-	-	-	-	-	50
Colombia	-	-	-	5	-	-	-	-	-	-	-
Peru	-	-	-	-	-	-	61	-	-	-	-
Trinidad	-	-	-	-	-	-	-	-	-	-	94
	<u>-</u>	<u>-</u>	<u>-</u>	<u>5</u>	<u>-</u>	<u>-</u>	<u>61</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>144</u>
<u>Other</u>	<u>10</u>	<u>25</u>	<u>-</u>	<u>10</u>	<u>15</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>10</u>	<u>25</u>
<u>Total</u>	<u>605</u>	<u>360</u>	<u>270</u>	<u>370</u>	<u>255</u>	<u>230</u>	<u>281</u>	<u>298</u>	<u>680</u>	<u>735</u>	<u>309</u>

<sup>a/</sup>Data corrected by company.

Source: International Petroleum Finance, New York, Vol. 3, Feb. 11, 1980, as reported in OPEC Bulletin, Feb. 25, 1980.

Our analysis of the general trend over the 10 years 1969 through 1978 shows a rise in both net <sup>1</sup>/ crude oil production and acreage holdings of U.S. companies until about 1973 to 1974 and a marked decline from that point on.

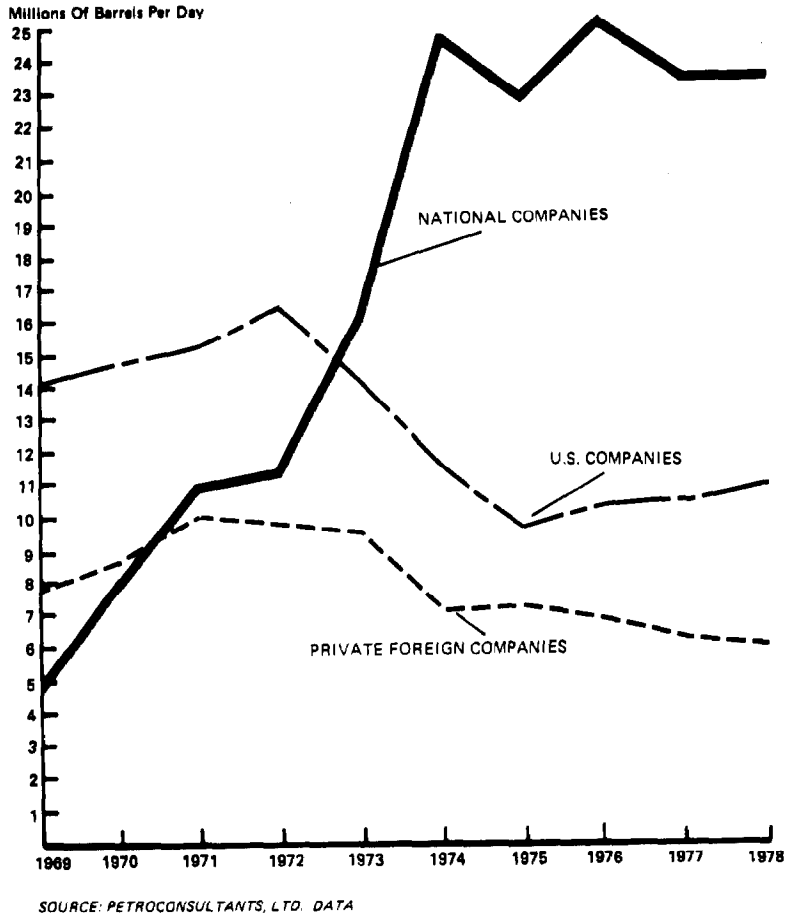
Most U.S. companies ended the 10-year period with lower figures in both categories. Foreign privately owned companies followed the same pattern. On the other hand, many national oil companies were created during this time, and national companies improved their positions, as shown in figures 1 and 2.

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<sup>1</sup>/The terms "net" and "gross" are often used in describing acreage holdings and petroleum production of individual oil companies. They are also used, but less frequently, in defining the amount of exploratory work done by an individual company, such as the number of exploratory (wildcat) wells completed or the number of crew-months or party-months of geophysical exploration completed (i.e. seismic surveys, field gravity surveys, etc). Oil companies frequently form joint ventures with other companies to explore and develop contract area holdings as a means of spreading the risk. Under such arrangements, each company will hold or own a certain share (expressed as a percentage, usually in proportion to its investment) of the contract acreage and will share any production developed or exploration losses incurred. "Gross acreage" means the total amount of acres of all ventures in which an individual company is participating; "net acreage" refers only to an individual company's share of a given venture or the total of the percentage shares of all ventures in which it participates. "Gross production" is a company's beneficial share of production from properties operated by the company and others. Gross production excludes quantities belonging to other joint lease owners or participants but includes royalties and quantities due others upon production. "Net production" is equivalent to gross production less royalties and quantities due others upon production, whether or not there are options to take payment in kind in lieu of cash.

Figure 1

Net Free World Crude Oil Production  
Outside the U.S. and Canada 1969-78

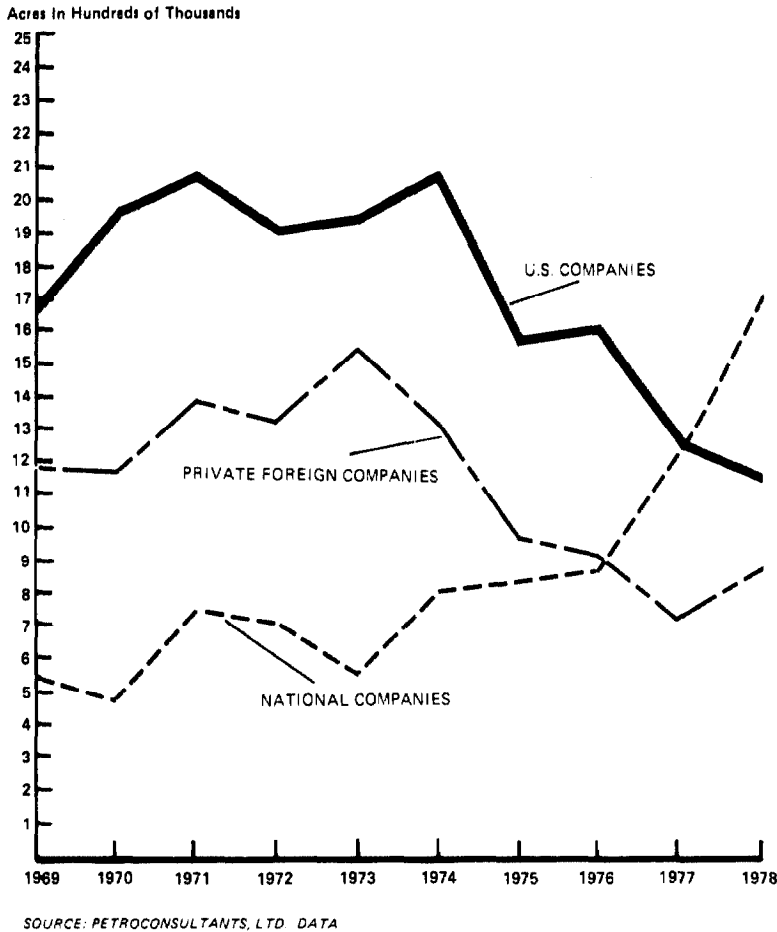


While many governments, both producers and importers, have established their own national oil companies, most of the expertise, technology, and equipment for exploring and producing oil and gas still rests with the international oil companies. U.S. experts consider the national companies of only two or three producing governments comparable in exploration and production ability to major international companies. Exploration and production in the extreme frontier areas (deep water, arctic regions, and remote continental interiors) where much of the remaining potential lies is almost exclusively the domain of the international majors.

International oil companies, therefore, remain essential to consuming and producing nations alike because of their production expertise, access to processing facilities, distribution systems, and access to the great oil markets which permit them to handle very large volumes of oil.

Figure 2

Net Free World Acreage Held Outside the  
U.S. and Canada 1969-78



WHERE U.S. OIL COMPANIES ARE  
EXPLORING AND PRODUCING

Oil company officials told us that supply source diversification was an important company objective and that they were trying to accomplish it. To determine their progress, we analyzed selected U.S. companies' foreign crude oil production and exploration based on data from the companies and from Petroconsultants, Ltd. We included non-U.S.-based BP and Royal Dutch/Shell for comparison.

Trends in crude oil sources

U.S. companies' crude oil production and purchases over a period of years indicate mixed success in diversifying sources as of the end of 1979, the most recent year we examined. (See table 9.) While most companies have experienced changes in their supply source pattern, only Occidental and Phillips achieved a definite degree of diversification during the period examined--1969 through 1979. Royal Dutch/Shell had a fairly well-balanced source pattern at the beginning of the period and gradually improved it, even though, like many other companies, it suffered a significant loss of Latin American sources.

Table 9

Trends in Sources of Petroleum Liquids (note a)  
Selected Companies  
(Volume is thousands of bpd)

	1969		1970		1971		1972		1973	
	Volume	%	Volume	%	Volume	%	Volume	%	Volume	%
<b>EXXON</b>										
United States	867	18	946	18	932	18	970	18	947	16
Canada (note b)	154	3	170	3	183	3	225	4	275	5
Latin America	1,404	30	1,455	27	1,396	27	1,265	24	1,395	23
Middle East	2,267	48	2,654	50	2,594	49	2,742	51	3,140	53
*North Africa	-	-	-	-	-	-	-	-	-	-
Other Africa	-	-	-	-	-	-	-	-	-	-
Far East/Asia	1	+	59	1	123	2	131	2	164	3
Europe	37	1	35	1	28	1	22	1	19	+
Total	<u>4,730</u>	<u>100</u>	<u>5,319</u>	<u>100</u>	<u>5,256</u>	<u>100</u>	<u>5,360</u>	<u>100</u>	<u>5,940</u>	<u>100</u>
*Libya included with Middle East										
<b>TEXACO (note c)</b>										
United States	866	29	939	29	940	27	916	23	876	19
Canada	90	3	112	4	124	3	147	3	187	4
Latin America	335	11	303	9	268	8	275	7	331	7
Middle East	1,165	39	1,294	40	1,638	46	2,100	52	2,519	56
North Africa	185	6	162	5	131	4	117	3	96	2
Other Africa	-	-	1	-	5	-	5	-	5	-
Far East	310	11	382	12	373	11	429	11	492	11
Europe	36	1	35	1	37	1	32	1	29	1
Total	<u>2,987</u>	<u>100</u>	<u>3,228</u>	<u>100</u>	<u>3,516</u>	<u>100</u>	<u>4,021</u>	<u>100</u>	<u>4,535</u>	<u>100</u>
<b>SOCAL (note c)</b>										
United States	547	24	547	22	536	19	528	16	509	14
Canada	64	3	74	3	79	3	104	3	125	3
Latin America	79	3	86	3	80	3	63	2	67	2
Middle East	1,077	47	1,284	50	1,648	57	2,043	61	2,418	65
North Africa	185	8	162	6	131	4	117	4	84	2
Other Africa	-	-	-	-	5	+	5	+	4	+
Far East	299	13	353	14	360	12	415	12	483	13
Other	50	2	53	2	51	2	48	2	46	1
Total	<u>2,301</u>	<u>100</u>	<u>2,559</u>	<u>100</u>	<u>2,890</u>	<u>100</u>	<u>3,323</u>	<u>100</u>	<u>3,736</u>	<u>100</u>
<b>CONOCO</b>										
United States	179	34	188	30	197	32	206	33	205	34
Canada	64	12	71	11	76	13	87	14	94	15
Latin America	7	1	6	1	5	1	4	1	4	1
Middle East	15	3	43	7	53	9	64	10	88	15
North Africa	263	50	316	51	275	45	265	42	211	35
Other Africa	-	-	-	-	-	-	-	-	-	-
Far East	-	-	-	-	-	-	-	-	-	-
Europe	-	-	-	-	-	-	-	-	1	+
Total	<u>528</u>	<u>100</u>	<u>624</u>	<u>100</u>	<u>606</u>	<u>100</u>	<u>626</u>	<u>100</u>	<u>603</u>	<u>100</u>
<b>SUN</b>										
United States	206	59	215	59	225	62	236	64	228	62
Canada	13	4	14	4	14	4	15	4	15	4
Latin America	118	33	112	31	102	28	91	25	90	24
Middle East	15	4	22	6	24	6	27	7	35	10
Africa	-	-	-	-	-	-	-	-	-	-
Far East	-	-	-	-	-	-	-	-	-	-
Europe	-	-	-	-	-	-	-	-	-	-
Total	<u>352</u>	<u>100</u>	<u>363</u>	<u>100</u>	<u>365</u>	<u>100</u>	<u>369</u>	<u>100</u>	<u>369</u>	<u>100</u>

+ Less than 0.5 percent.

a/Includes crude oil, condensates, and natural gas liquids from both equity production and long-term purchases.

b/Includes heavy oil production (1975-3,000 bpd; 1976-5,000 bpd; 1977-5,000 bpd; 1978-8,000 bpd; 1979-20,000 bpd).

c/Gross production - all others are net.

Source: Annual reports.

1974		1975		1976		1977		1978		1979	
Volume	%	Volume	%	Volume	%	Volume	%	Volume	%	Volume	%
890	16	846	17	812	15	795	16	829	17	791	18
224	4	174	4	154	3	148	3	138	3	160	4
1,243	22	947	19	1,013	19	841	16	659	14	660	15
3,152	55	2,797	56	3,132	59	3,062	60	2,752	59	2,431	55
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
164	3	181	4	188	4	196	4	220	5	248	5
15	+	14	+	26	+	49	1	93	2	154	3
<u>5,688</u>	<u>100</u>	<u>4,959</u>	<u>100</u>	<u>5,325</u>	<u>100</u>	<u>5,091</u>	<u>100</u>	<u>4,691</u>	<u>100</u>	<u>4,444</u>	<u>100</u>

807	18	759	20	699	18	640	16	582	16	526	14
183	4	143	4	125	3	124	3	123	3	168	5
271	6	222	5	173	4	172	4	133	4	128	4
2,755	61	2,217	59	2,582	64	2,528	63	2,280	64	2,377	65
3	-	-	-	-	-	-	-	-	-	-	-
4	-	6	-	12	-	22	1	20	1	16	+
458	10	397	11	397	10	422	11	392	11	389	11
26	1	26	1	27	1	25	1	22	1	22	1
<u>4,507</u>	<u>100</u>	<u>3,770</u>	<u>100</u>	<u>4,015</u>	<u>100</u>	<u>3,931</u>	<u>100</u>	<u>3,551</u>	<u>100</u>	<u>3,626</u>	<u>100</u>

472	12	437	14	420	12	408	12	394	12	386	12
122	3	111	4	93	3	96	3	96	3	108	4
65	2	50	2	12	+	11	+	9	+	7	-
2,652	70	1,969	65	2,552	72	2,419	71	2,348	71	2,242	70
-	-	-	-	-	-	-	-	-	-	-	-
1	+	4	+	17	+	27	+	19	1	-	-
455	12	416	14	420	12	418	12	395	12	382	12
49	1	38	1	29	1	24	2	28	1	74	2
<u>3,816</u>	<u>100</u>	<u>3,025</u>	<u>100</u>	<u>3,543</u>	<u>100</u>	<u>3,403</u>	<u>100</u>	<u>3,289</u>	<u>100</u>	<u>3,199</u>	<u>100</u>

204	42	194	43	185	39	175	36	165	34	159	33
89	18	78	17	70	15	78	16	71	15	74	15
2	1	2	1	-	-	-	-	-	-	-	-
95	20	96	21	109	23	123	25	119	25	106	22
91	19	84	18	111	23	113	23	114	24	118	24
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	1	+	7	1	8	2
1	+	1	+	1	+	1	+	3	1	17	4
<u>482</u>	<u>100</u>	<u>455</u>	<u>100</u>	<u>476</u>	<u>100</u>	<u>491</u>	<u>100</u>	<u>479</u>	<u>100</u>	<u>482</u>	<u>100</u>

219	66	219	68	209	83	198	80	184	79	168	85
13	4	11	3	10	4	9	4	10	4	11	6
66	20	53	17	-	-	-	-	-	-	-	-
33	10	37	12	34	13	40	16	39	17	17	9
-	-	-	-	-	-	-	-	-	-	1	+
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
<u>331</u>	<u>100</u>	<u>320</u>	<u>100</u>	<u>253</u>	<u>100</u>	<u>247</u>	<u>100</u>	<u>233</u>	<u>100</u>	<u>197</u>	<u>100</u>

	1969		1970		1971		1972		1973	
	Volume	%	Volume	%	Volume	%	Volume	%	Volume	%
<b>OCCIDENTAL</b>										
United States							10	2	10	4
Canada							-	-	-	-
Latin America							-	-	-	-
Middle East							-	-	-	-
North Africa							442	98	258	96
Other Africa							-	-	-	-
Far East							-	-	-	-
Europe							-	-	-	-
Total							<u>452</u>	<u>100</u>	<u>268</u>	<u>100</u>
<b>ARCO</b>										
United States	421	62	406	62	397	61	401	61	391	60
Canada	34	5	36	5	36	6	37	6	42	6
Latin America	127	19	118	18	111	17	95	15	89	14
Middle East	58	9	68	10	77	12	87	13	94	14
North Africa	-	-	-	-	-	-	-	-	-	-
Other Africa	-	-	-	-	-	-	-	-	-	-
Far East	-	-	-	-	1	+	8	1	18	3
Other	38	6	31	5	25	4	24	4	22	3
Total	<u>678</u>	<u>100</u>	<u>659</u>	<u>100</u>	<u>647</u>	<u>100</u>	<u>652</u>	<u>100</u>	<u>656</u>	<u>100</u>
<b>GULF</b>										
United States	524	19	544	18	509	16	477	15	440	15
Canada	75	3	80	3	88	3	104	3	113	4
Latin America	205	8	201	7	197	6	206	7	253	8
Middle East	1,664	62	1,787	61	1,986	63	1,842	60	1,693	56
North Africa	-	-	-	-	-	-	-	-	-	-
Other Africa	220	8	316	11	377	12	452	15	509	17
Far East	-	-	-	-	-	-	-	-	-	-
Europe	6	+	6	+	6	+	5	+	4	+
Total	<u>2,694</u>	<u>100</u>	<u>2,934</u>	<u>100</u>	<u>3,163</u>	<u>100</u>	<u>3,086</u>	<u>100</u>	<u>3,012</u>	<u>100</u>
<b>PHILLIPS</b>										
United States	268	79	271	83	266	80	268	79	257	76
Canada	-	-	-	-	-	-	-	-	-	-
Latin America	26	8	23	7	22	7	22	7	25	7
Middle East	3	1	12	4	14	4	13	4	9	3
North Africa(Egypt)	-	-	-	-	-	-	-	-	-	-
Other Africa	40	12	20	6	26	8	23	7	36	11
Far East	-	-	-	-	-	-	-	-	-	-
Europe	-	-	-	-	3	1	11	3	11	3
Total	<u>337</u>	<u>100</u>	<u>326</u>	<u>100</u>	<u>331</u>	<u>100</u>	<u>337</u>	<u>100</u>	<u>338</u>	<u>100</u>
<b>BRITISH PETROLEUM</b>										
United States										
Middle East										
North Africa										
Other Africa										
Europe (North Sea)										
Other										
Total										
<b>ROYAL DUTCH/SHELL</b>										
United States	771	15	835	14	870	14	927	14	996	15
Canada	238	5	251	4	248	4	271	4	317	5
Latin America	1,115	22	1,167	20	1,135	18	1,008	16	1,008	15
Middle East	2,094	40	2,340	40	2,495	40	2,618	41	2,825	42
North Africa	495	10	550	9	470	8	480	7	295	4
Other Africa	219	5	452	8	602	10	650	10	680	10
Far East	167	3	236	4	312	5	369	6	473	7
Europe	51	1	44	1	23	+	35	1	72	1
Other	15	+	28	+	31	1	50	1	63	1
Total	<u>5,165</u>	<u>100</u>	<u>5,911</u>	<u>100</u>	<u>6,186</u>	<u>100</u>	<u>6,408</u>	<u>100</u>	<u>6,729</u>	<u>100</u>



1974		1975		1976		1977		1978		1979	
Volume	%	Volume	%	Volume	%	Volume	%	Volume	%	Volume	%
8	5	7	5	7	4	8	3	7	2	5	1
-	-	2	1	2	1	2	1	2	1	2	1
-	-	-	-	4	2	5	2	32	9	58	16
-	-	-	-	-	-	-	-	-	-	-	-
166	95	135	94	161	92	171	68	171	53	153	44
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	1	67	26	114	35	132	38
<u>174</u>	<u>100</u>	<u>144</u>	<u>100</u>	<u>175</u>	<u>100</u>	<u>253</u>	<u>100</u>	<u>326</u>	<u>100</u>	<u>350</u>	<u>100</u>
383	64	370	62	363	71	408	72	527	82	538	95
28	5	23	4	11	2	-	-	-	-	-	-
60	10	54	9	-	-	-	-	-	-	-	-
97	17	123	21	106	21	119	21	83	13	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
25	4	22	4	30	6	35	6	31	5	29	5
2	+	2	+	2	+	2	+	2	+	2	+
<u>595</u>	<u>100</u>	<u>594</u>	<u>100</u>	<u>512</u>	<u>100</u>	<u>564</u>	<u>100</u>	<u>643</u>	<u>100</u>	<u>569</u>	<u>100</u>
476	18	426	21	399	22	402	24	400	25	-	-
99	4	91	4	81	5	76	4	75	5	-	-
226	9	197	10	165	9	96	6	73	5	-	-
1,345	50	993	49	832	46	744	44	716	45	-	-
-	-	-	-	-	-	-	-	-	-	-	-
520	19	320	16	323	18	368	22	324	20	-	-
-	-	-	-	-	-	-	-	1	+	-	-
3	+	3	+	2	+	2	+	5	+	-	-
<u>2,669</u>	<u>100</u>	<u>2,030</u>	<u>100</u>	<u>1,802</u>	<u>100</u>	<u>1,688</u>	<u>100</u>	<u>1,594</u>	<u>100</u>	-	-
256	75	244	67	246	63	255	64	259	59	263	60
-	-	-	-	-	-	-	-	-	-	-	-
23	7	17	5	-	-	-	-	-	-	-	-
9	3	6	2	6	2	6	1	5	1	-	-
-	-	5	-	5	-	5	-	4	-	4	1
38	11	30	9	34	10	39	11	41	10	37	9
-	-	-	-	-	-	6	1	18	4	6	1
12	4	63	17	93	25	93	23	117	26	126	29
<u>338</u>	<u>100</u>	<u>365</u>	<u>100</u>	<u>390</u>	<u>100</u>	<u>404</u>	<u>100</u>	<u>444</u>	<u>100</u>	<u>436</u>	<u>100</u>
-	-	-	-	-	-	-	-	720	19	-	-
3,620	82	2,720	79	2,520	71	2,060	61	1,700	46	-	-
-	-	-	-	-	-	-	-	-	-	-	-
660	15	480	14	420	12	440	13	360	10	-	-
-	-	20	1	180	5	410	12	460	12	-	-
160	3	220	6	420	12	480	14	480	13	-	-
<u>4,440</u>	<u>100</u>	<u>3,440</u>	<u>100</u>	<u>3,540</u>	<u>100</u>	<u>3,390</u>	<u>100</u>	<u>3,720</u>	<u>100</u>	-	-
964	16	937	20	962	20	966	20	1,006	21	-	-
317	5	282	5	349	8	377	8	345	7	-	-
844	14	633	13	256	5	247	5	280	6	-	-
2,433	41	1,923	40	1,995	42	1,972	41	1,721	37	-	-
128	2	33	1	123	3	146	3	113	2	-	-
704	12	520	11	479	10	455	9	382	8	-	-
405	7	287	6	316	7	384	8	417	9	-	-
75	1	96	2	136	3	274	6	385	8	-	-
47	1	75	2	116	2	26	1	65	1	-	-
<u>5,917</u>	<u>100</u>	<u>4,786</u>	<u>100</u>	<u>4,732</u>	<u>100</u>	<u>4,847</u>	<u>100</u>	<u>4,714</u>	<u>100</u>	-	-

## Areas being explored today

We analyzed Petroconsultants' production and exploration data for areas other than North American and Communist countries for 1978, the most recent year available. We found that, although most of the companies still rely heavily on the Middle East and/or North Africa for their crude oil production and/or purchases, their exploration activities show much more of a worldwide distribution. Except for Aramco 1/, the companies did very little exploration in the Middle East in 1978, and much of it was outside OPEC as well. For ease of presentation, we have divided the companies into three groups.

- Group I: Companies averaging over 1 million bpd net production--Exxon, Texaco, Mobil, and Socal. These four are also partners in Aramco and are the only private companies with interests in Saudi Arabia proper. (Getty Oil Company is exploring and producing in the Neutral Zone shared by Saudi Arabia and Kuwait. The Japanese-owned Arabian Oil Company is producing from offshore areas of the Neutral Zone.)
- Group II: Companies averaging between 250,000 and 1 million bpd net production--Gulf, Occidental, Conoco, and The Standard Oil Company of Indiana (Amoco).

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1/The Arabian American Oil Company was organized in 1933 as the California-Arabian Standard Oil Company by Socal to develop its original discovery in Saudi Arabia. Aramco has remained the sole concession-holder in Saudi Arabia (except in the Neutral Zone). Texaco became a 50-percent shareholder in 1936, the name was changed to Aramco in 1944, and Exxon and Mobil purchased interests in 1948. In 1973, the Saudi Government acquired a 25-percent interest in production assets, rights, and operations in exchange for payment to the companies for their asset book value and the right to buy back the major part of the government's share of the oil produced at specified prices, which were less than market prices. In 1974, Aramco agreed to an increase in government ownership to 60 percent, with the understanding that complete government takeover would follow. Agreement on terms for full transfer of assets to Saudi Arabia was essentially reached in 1976. The agreement has not yet been finalized, although Saudi Arabia paid for the final 40 percent in 1980. Under the agreement, Aramco would continue to operate the Saudi oil fields under a service contract and would share exclusive marketing rights with the Saudi Government.

Group III: Companies averaging less than 250,000 bpd net production--Atlantic Richfield Company (ARCO), Getty, Phillips, and Cities Service Corporation (CITCO).

Our analysis is summarized in tables 10 and 11 which show the relative Middle East vs. non-Middle East and OPEC vs. non-OPEC concentration of these companies' 1978 oil production sources compared with their exploration activities as measured by (1) net acreage held under lease contract (a prerequisite to active exploration) at the end of 1978, (2) net number of exploratory wells completed during 1978, and (3) net number of crew-months of geophysical exploration work in 1978. Table 10 shows that, although the sampled companies as a group obtained 73 percent of their net crude oil production from the Middle East and North Africa, only 20 percent of their net acreage under contract, 11 percent of their net exploratory well completions, and 31 percent of their net geophysical work was in those areas. Table 11 shows that 82 percent of the group's net crude oil production came from OPEC countries, while 24 percent of their net acreage holdings, 44 percent of their net exploratory well completions, and 40 percent of their net geophysical work was in OPEC countries.

Figures 3 through 14 illustrate the same information by company.

Occidental and Gulf, both Group II companies, present interesting studies in diversification efforts. Occidental started overseas oil exploration and production in Libya in the 1960s. At that time, Libya was Occidental's sole source of production. Company officials told us that Occidental realized the vulnerability of its small financial base and heavy dependency on Libyan production well before it became the focal point of OPEC's successful maneuver to break the oil companies' attempt at a unified stand against OPEC's original 1971 demands for price increases. At that time Libya threatened to shut Occidental down completely if it did not agree to negotiate independently. Although Occidental had obtained exploration concessions in the North Sea, Peru, Venezuela, and Nigeria in 1971 and had made discoveries in the North Sea and Peru, it was not able to develop production from these areas by 1971. From 1971 to 1978, most of its capital has gone into developing its North Sea and Peru discoveries.

Occidental has encountered a number of obstacles in developing its concession in Peru. It had to design special drilling rigs that could be lifted in sections by helicopter into the nearly inaccessible interior jungles. According to Occidental, its projected favorable rate of return was cast into doubt when the U.S. Internal Revenue Service determined that projected taxes that would be paid to Peru would not qualify for the foreign tax credit against Occidental's U.S. income taxes. More recently, Peru unilaterally changed the contract terms from a 50/50 production-sharing arrangement to an effective 84 percent for Peru and 16 percent for Occidental by requiring Occidental to pay income tax on its 50-percent share at a tax rate of 68.5 percent.

By the mid-1970s, Gulf was producing a major share of its crude oil supply from its concessions in Kuwait and Iran. Since then, its holdings in both countries have been nationalized. Kuwait originally agreed in 1974 to continue to provide oil to Gulf through a participation agreement which was to run for 5 years but was terminated by Kuwait in 1975. Gulf continues to purchase crude oil from Kuwait, however. In like manner, Gulf's Iranian source has also been converted from production to purchases; in the light of the current situation in Iran, it must be considered a most tenuous source. Gulf also suffered nationalization actions in South America and completely lost its crude oil sources in Ecuador and its equity production in Venezuela. Although it has embarked upon a number of explorations in such places as Oman, Pakistan, and Angola, Gulf has not been successful in replacing its previous production sources. Its total worldwide crude oil supply through both production and purchases has dropped from an average 2,669,000 bpd in 1974 to 1,594,000 bpd in 1978.



Table 10

Selected U.S. Oil Company Crude Oil Production and Exploration Activities  
Comparison by Middle East, North Africa, and Other Areas  
Excluding North America and Communist Areas  
1978 (note a)

	Middle East		North Africa		Subtotal Middle East & North Africa		All Other		Middle East		North Africa		Subtotal Middle East & North Africa			
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%		
	EXXON								AMOCO							
Acreage	8,830	5	26,570	16	35,400	21	132,959	79	2,125	9	5,596	23	7,721	32		
Exploratory wells	1.9	3	0	0	1.9	3	70.8	97	0	0	7.0	38	7.0	38		
Geophysical work	14.3	16	1.8	2	16.1	18	73.9	82	.1	.5	2.2	11	2.3	11.5		
Production	1,416,164	75	90,405	5	1,506,569	80	386,065	20	154,795	21	363,795	51	523,590	72		
	MOBIL								GULF							
Acreage	5,941	12	12,630	26	18,571	38	29,733	62	4,618	10	722	2	5,340	12		
Exploratory wells	1.9	9	3.7	16	5.6	25	16.6	75	2.5	10	.9	3	3.4	13		
Geophysical work	10.1	21	18.1	37	28.2	58	20.6	42	5.0	19	9.3	34	14.3	53		
Production	384,987	81	29,986	3	914,973	84	176,369	16	326,027	59	0	0	326,027	59		
	TEXACO								OCCIDENTAL							
Acreage	8,807	10	89	+	8,896	10	81,658	90	0	0	12,880	51	12,880	51		
Exploratory wells	1.9	5	0	0	1.9	5	32.8	95	0	0	2.0	13	2.0	13		
Geophysical work	13.3	31	0	0	13.3	31	29.8	69	0	0	7.0	32	7.0	32		
Production	1,419,924	71	0	0	1,419,924	71	577,885	29	0	0	172,270	49	172,270	49		
	SOCAL								CONOCO							
Acreage	8,742	7	89	+	8,831	7	110,437	93	347	1	18,493	39	18,840	40		
Exploratory wells	1.9	6	2	6	3.9	12	27.5	88	0	0	2.3	21	2.3	21		
Geophysical work	13.3	27	0	0	13.3	27	36.2	73	.5	3	12.1	66	12.6	69		
Production	1,386,592	77	0	0	1,386,592	77	424,244	23	109,000	47	114,000	49	223,000	96		
	GROUP I TOTAL								GROUP II TOTAL							
Acreage	32,320	8	39,378	9	71,698	17	354,787	83	7,090	5	37,691	26	44,781	31		
Exploratory wells	7.6	5	5.7	3	13.3	8	147.7	92	2.5	3	12.2	18	14.7	21		
Geophysical work	51	22	19.9	9	70.9	31	160.5	69	5.6	7	30.6	35	36.2	42		
Production	5,107,667	75	120,391	2	5,228,058	77	1,564,563	23	589,822	32	655,065	35	1,244,887	67		

+ Less than 0.5 percent.

Source: Developed from Petroconsultants' Ltd. data, except for Arco, Conoco, Getty, and Phillips which was provided by companies.

Table 11

Selected U.S. Oil Company Crude Oil Production and Exploration Activities  
Comparison by OPEC and Non-OPEC Areas  
Excluding North America and Communist Areas  
1978 (note a)

	Texaco				Mobil				Exxon	
	OPEC		NON-OPEC		OPEC		NON-OPEC		OPEC	
	Number	%	Number	%	Number	%	Number	%	Number	%
<b>Group I</b>										
Acreage held	18,084	20	72,470	80	28,059	58	20,245	42	40,688	24
Exploratory wells	23.6	68	11.1	32	11.3	51	10.9	49	17.9	25
Geophysical work	29.6	69	13.5	31	22.1	45	26.7	55	20.6	23
Production	1,888,023	95	109,768	5	1,042,113	95	49,229	5	1,522,465	80
<b>Group II</b>										
	AMOCO				Gulf				Occidental	
Acreage held	1,241	5	23,151	95	11,264	25	34,205	75	16,942	67
Exploratory wells	0.3	2	18.0	98	19.0	74	6.7	26	3.0	20
Geophysical work	0.4	2	19.3	98	12.2	45	14.9	55	7.0	32
Production	154,795	21	568,345	79	446,113	81	107,130	19	172,270	49
<b>Group III</b>										
	ARCO				Getty				Phillips	
Acreage held	6,216	22	21,791	78	7,059	42	9,644	58	3,298	5
Exploratory wells	3.2	91	0.3	9	1.9	46	2.2	54	10.2	57
Geophysical work	13.0	87	2.0	13	3.5	30	8.1	70	16.1	54
Production	113,934	98	1,856	2	135,518	67	65,575	33	57,000	36

Unit No. Key for Tables 10 and 11

Acreage held is in thousands of acres.  
Exploratory wells is the number completed during 1978.  
Geophysical work is in the number of crew-months during 1978.  
Production is in average barrels per day during 1978.

a/All figures are net.

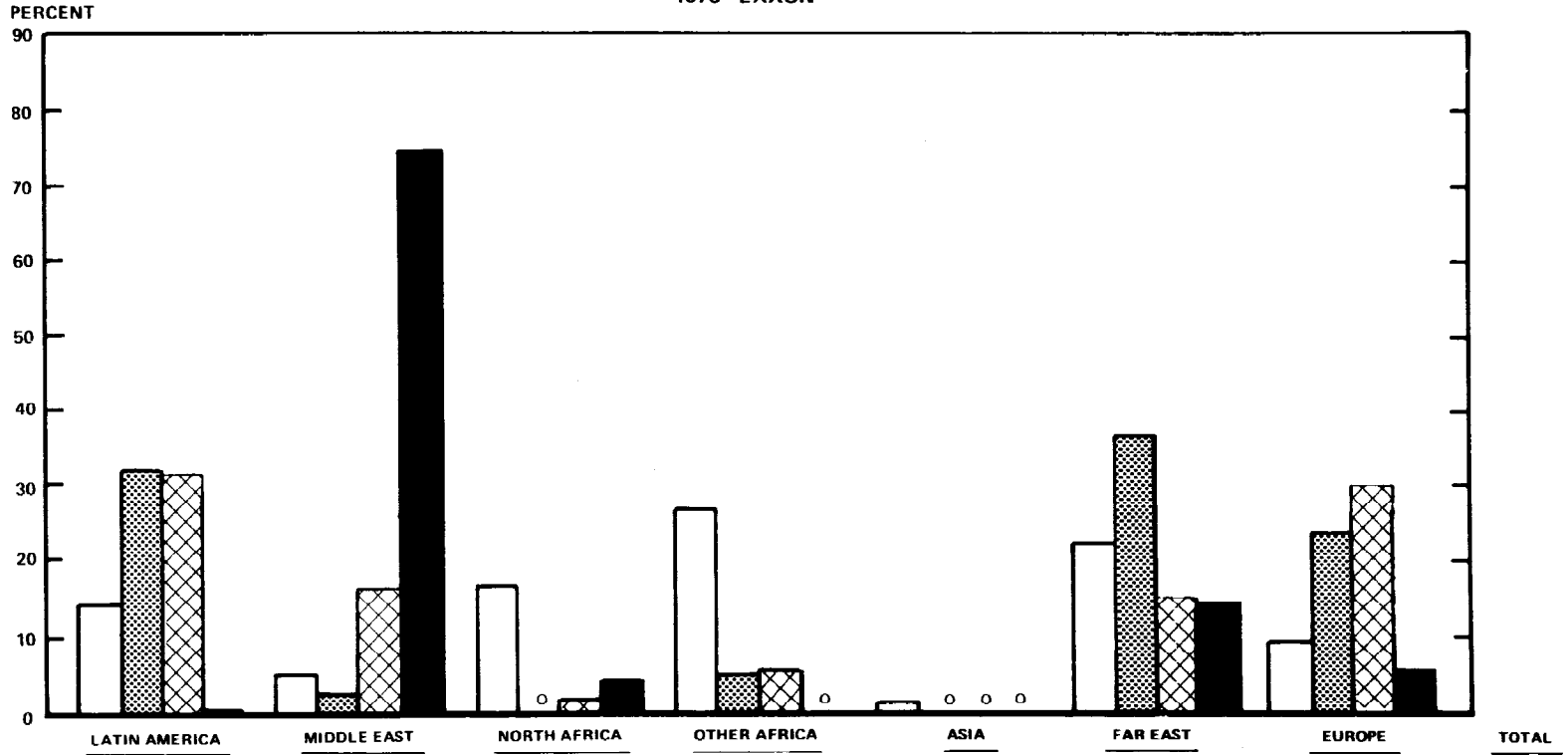
Source: Developed from Petroconsultant's Ltd. data, except for Arco and Getty which are company data.

All Other		Middle East		North Africa		Subtotal Middle East & North Africa		All Other		Middle East		North Africa		Subtotal Middle East & North Africa		All Other	
Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
ARCO																	
16,671	68	558	2	0	0	558	2	27,449	98	41,265	6	93,640	14	134,905	20	554,473	80
11.2	62	0	0	0	0	0	0	3.5	100	16.6	4	17.9	7	28.5	11	231.0	89
17.4	38.5	0	0	0	0	0	0	15	100	59.9	16	57.6	15	117.5	31	261.4	69
199,550	28	82,853	72	0	0	82,853	72	32,937	28	5,913,152	64	779,818	9	6,692,970	73	2,489,716	27
GETTY																	
40,129	88	1,104	7	680	4	1,784	11	14,919	89								
22.3	87	.4	10	0	0	.4	10	3.7	90								
12.8	47	3.3	28	0	0	3.3	28	8.3	72								
227,216	41	125,156	62	0	0	125,156	62	75,937	38								
PHILLIPS																	
12,585	49	19	0	15,391	24	15,910	24	50,041	76								
13.1	87	0	0	0	0	0	0	18.0	100								
15.1	68	0	0	7.1	27	7.1	27	19.1	73								
180,969	51	5,444	3	4,362	2	9,806	5	177,995	95								
CITCO																	
28,794	60	174	2	0	0	174	2	9,098	98								
3.4	79	.1	3	0	0	.1	3	3.1	97								
5.7	31	0	0	0	0	0	0	7.5	100								
10,483	4	2,210	10	0	0	2,210	10	20,066	90								
GROUP III TOTALS																	
98,179	69	1,855	2	16,571	14	18,426	16	101,507	84								
55.0	79	.5	2	0	0	.5	2	28.3	98								
51	58	3.3	5	7.1	12	10.4	17	49.9	83								
618,218	33	215,663	41	4,362	1	220,025	42	306,935	58								



NON-OPEC		SOCAL				GROUP I TOTAL				TOTAL - ALL GROUPS			
Number	%	OPEC		NON-OPEC		OPEC		NON-OPEC		OPEC		NON-OPEC	
Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
127,671	76	17,711	15	101,557	85	104,542	25	321,943	75	165,834	24	522,529	76
54.9	75	15.1	48	16.2	52	67.9	42	93.1	58	113.3	44	144.5	56
69.4	77	26.9	54	22.6	46	99.2	43	132.2	57	153.2	40	225.6	60
370,169	20	1,780,475	98	30,361	2	6,233,076	92	559,527	8	7,575,880	82	1,625,298	18
CONOCO													
8,523	33	8,834	19	37,785	81	38,281	23	103,664	72				
12.1	80	5.4	59	3.8	41	27.7	41	40.6	59				
15.1	68	3.5	19	14.7	31	23.1	27	64.0	73				
180,969	51	250,510	99	2,284	1	1,023,688	54	858,728	46				
CITCO													
62,653	95	6,438	69	2,834	31	23,011	19	96,922	81				
7.6	43	2.4	77	0.7	23	17.7	62	10.8	38				
12.1	46	0.3	4	7.2	96	30.9	51	29.4	49				
120,000	64	2,664	12	19,612	88	319,116	61	207,043	39				



Figure 3

DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA AND COMMUNIST AREAS  
1978 EXXON



ACREAGE HELD	23,597	8,830	26,570	44,797	10,858	37,976	15,731	168,359
EXPLORATORY WELLS	23.4	1.9	0	3.6	0	26.6	17.3	72.8
GEOPHYSICAL WORK	28.3	14.3	1.8	5.3	0	13.5	26.8	90.0
PRODUCTION	12,997	1,416,164	90,405	0	0	270,197	102,871	1,892,634

 THOUSANDS OF ACRES HELD AT YEAR-END  
 NO. OF WELLS COMPLETED DURING YEAR

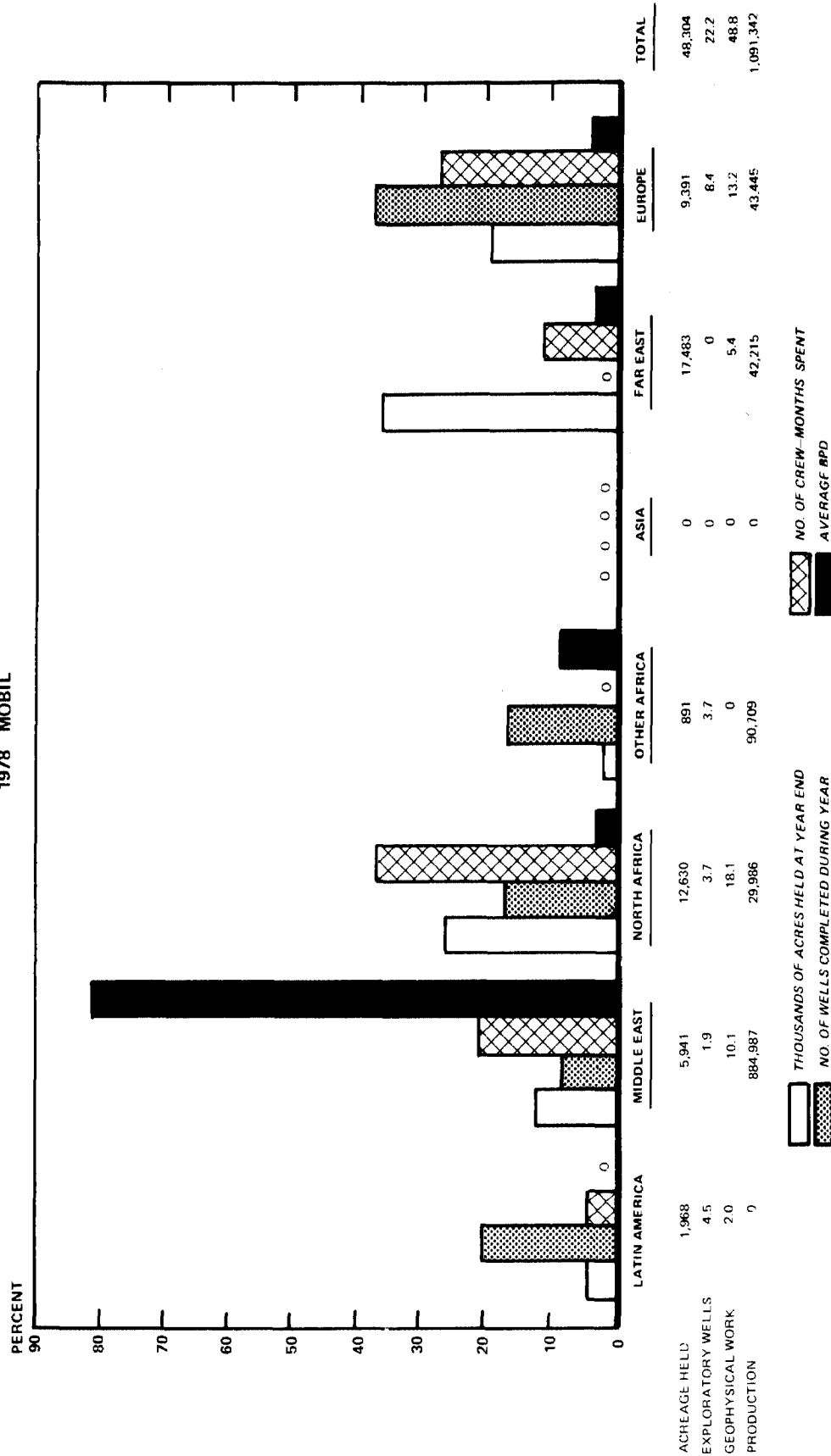
 NO. OF CREW-MONTHS SPENT  
 AVERAGE BPD

SOURCE: DEVELOPED FROM PETROCONSULTANTS DATA



Figure 4

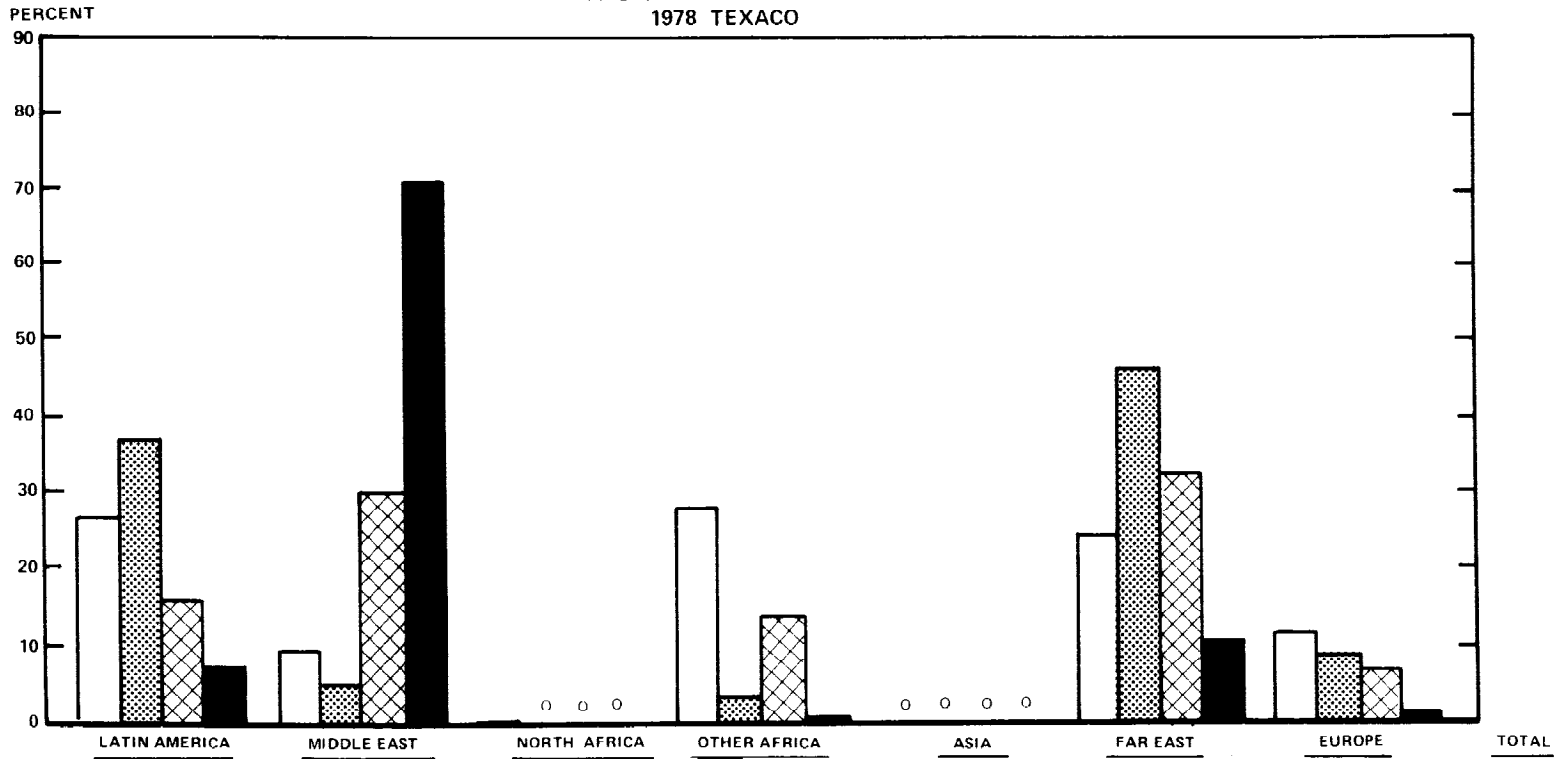
DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA  
AND COMMUNIST AREAS  
1978 MOBIL



SOURCE: DEVELOPED FROM PETROCONSULTANTS DATA.

Figure 5

DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA AND COMMUNIST AREAS  
1978 TEXACO



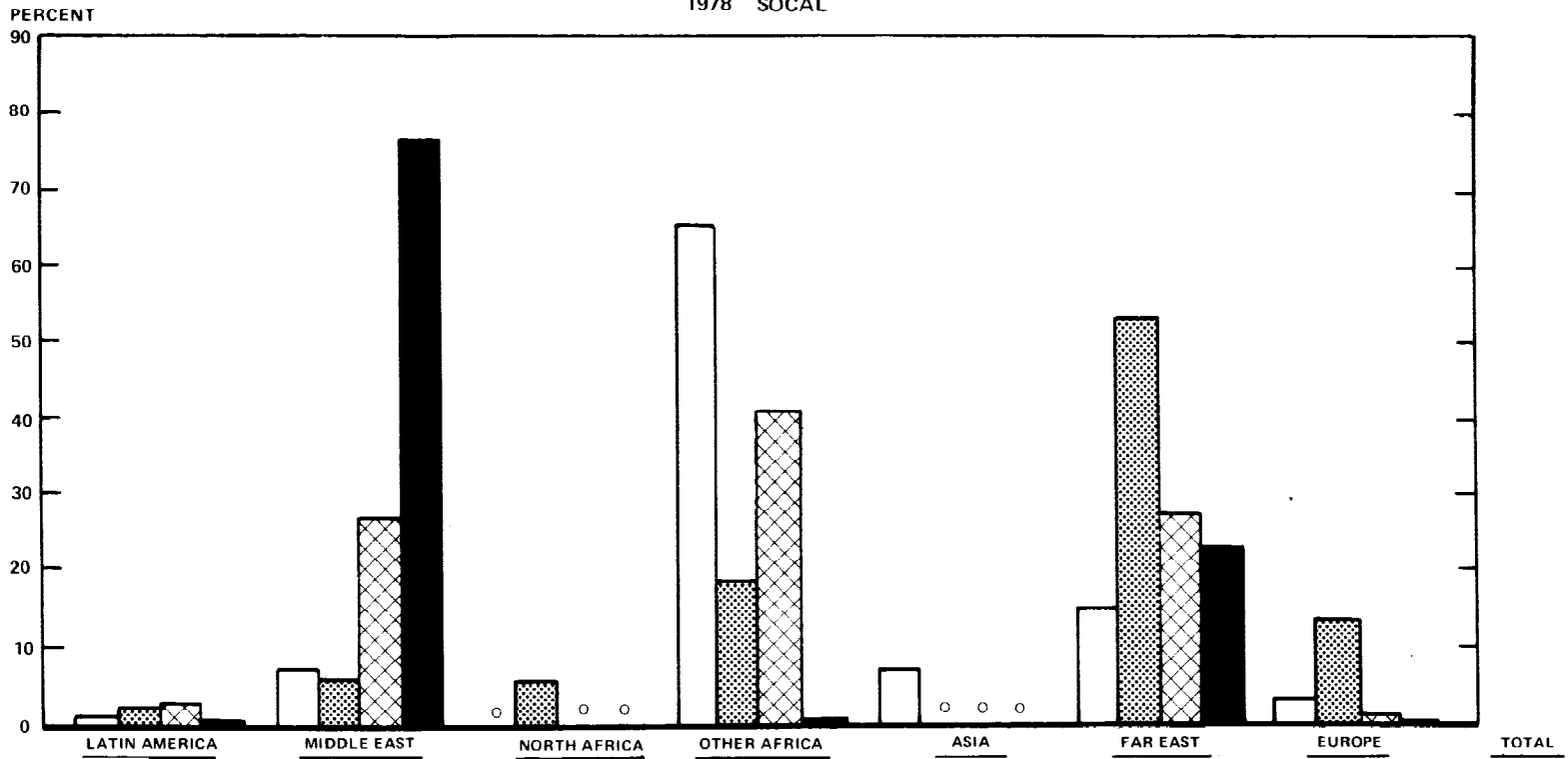
	LATIN AMERICA	MIDDLE EAST	NORTH AFRICA	OTHER AFRICA	ASIA	FAR EAST	EUROPE	TOTAL
ACREAGE HELD	24,161	8,807	89	24,953	0	22,216	10,328	90,554
EXPLORATORY WELLS	12.5	1.9	0	1.2	0	16.1	3.0	34.7
GEOPHYSICAL WORK	7.0	13.3	0	5.9	0	14.0	2.9	43.1
PRODUCTION	133,325	1,419,924	0	19,574	0	403,861	21,125	1,997,809

THOUSANDS OF ACRES HELD AT YEAR-END  
 NO. OF WELLS COMPLETED DURING YEAR  
 NO. OF CREW-MONTHS SPENT  
 AVERAGE BPD

SOURCE: DEVELOPED FROM PETROCONSULTANTS DATA.

Figure 6

DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA AND COMMUNIST AREAS  
1978 SOCIAL



	LATIN AMERICA	MIDDLE EAST	NORTH AFRICA	OTHER AFRICA	ASIA	FAR EAST	EUROPE	TOTAL
ACREAGE HELD	1,883	8,742	89	78,014	8,509	18,194	3,837	119,268
EXPLORATORY WELLS	0.7	19	2.0	5.7	0	16.7	4.4	31.4
GEOPHYSICAL WORK	1.6	13.3	0	20.2	0	13.7	0.6	49.5
PRODUCTION	8,716	1,386,592	0	9,683	0	403,861	1,984	1,810,836

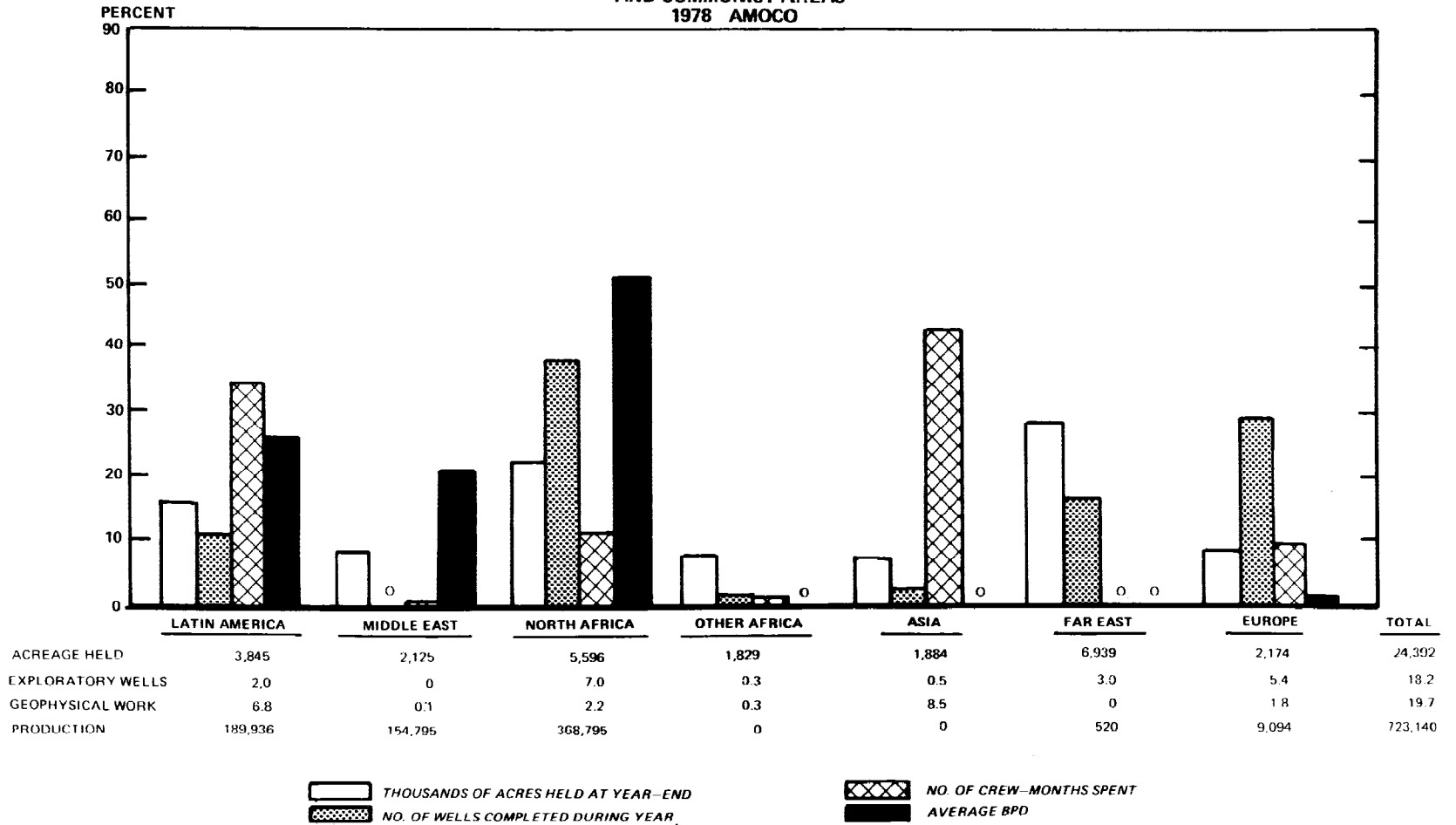
THOUSANDS OF ACRES HELD AT YEAR-END  
 NO. OF WELLS COMPLETED DURING YEAR

NO. OF CREW-MONTHS SPENT  
 AVERAGE BPD

SOURCE: DEVELOPED FROM PETROCONSULTANTS DATA.

Figure 7

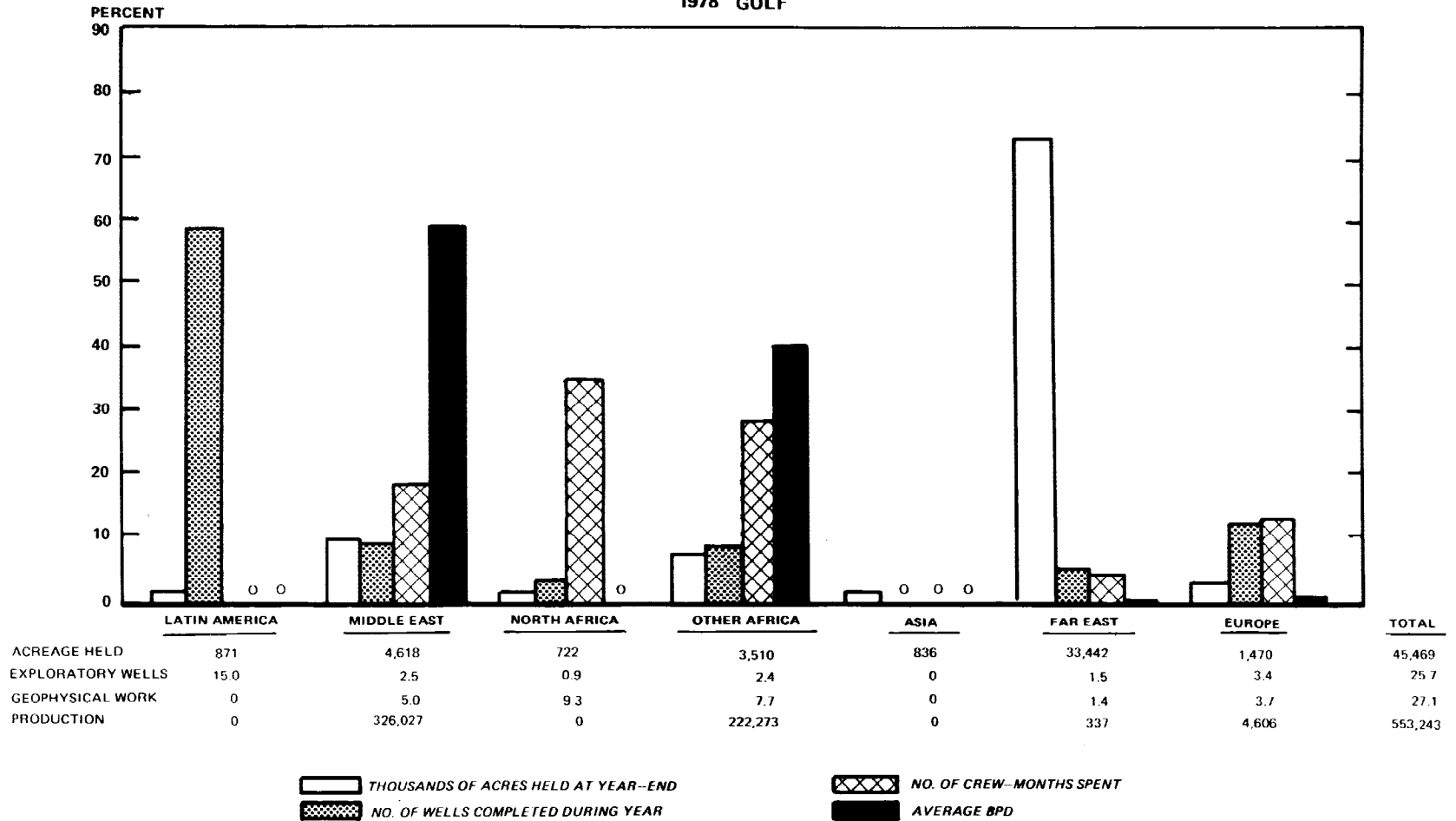
DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA AND COMMUNIST AREAS  
1978 AMOCO



SOURCE: DEVELOPED FROM PETROCONSULTANTS DATA.

Figure 8

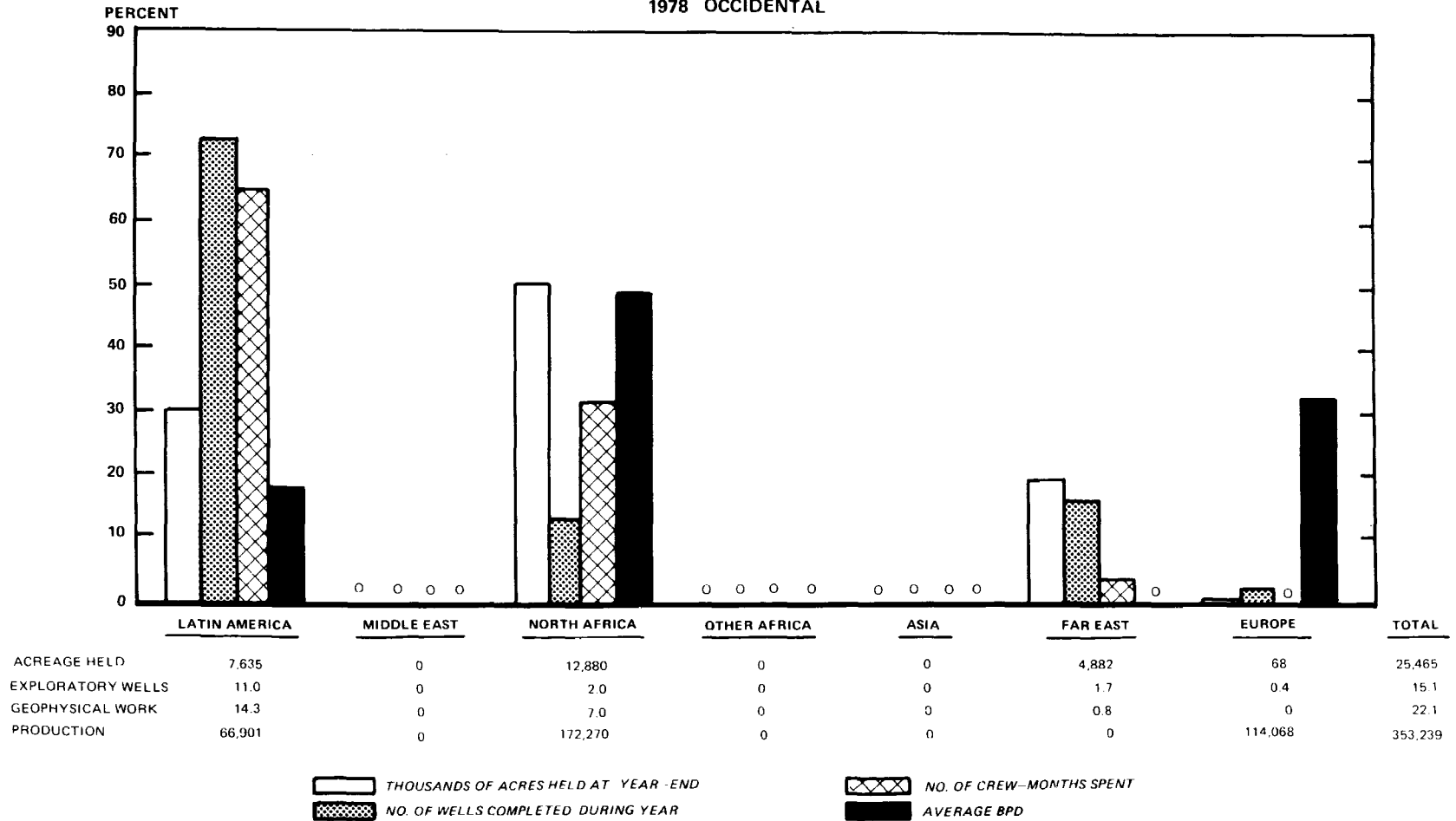
DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA  
AND COMMUNIST AREAS  
1978 GULF



SOURCE: DEVELOPED FROM PETROCONSULTANTS DATA.

Figure 9

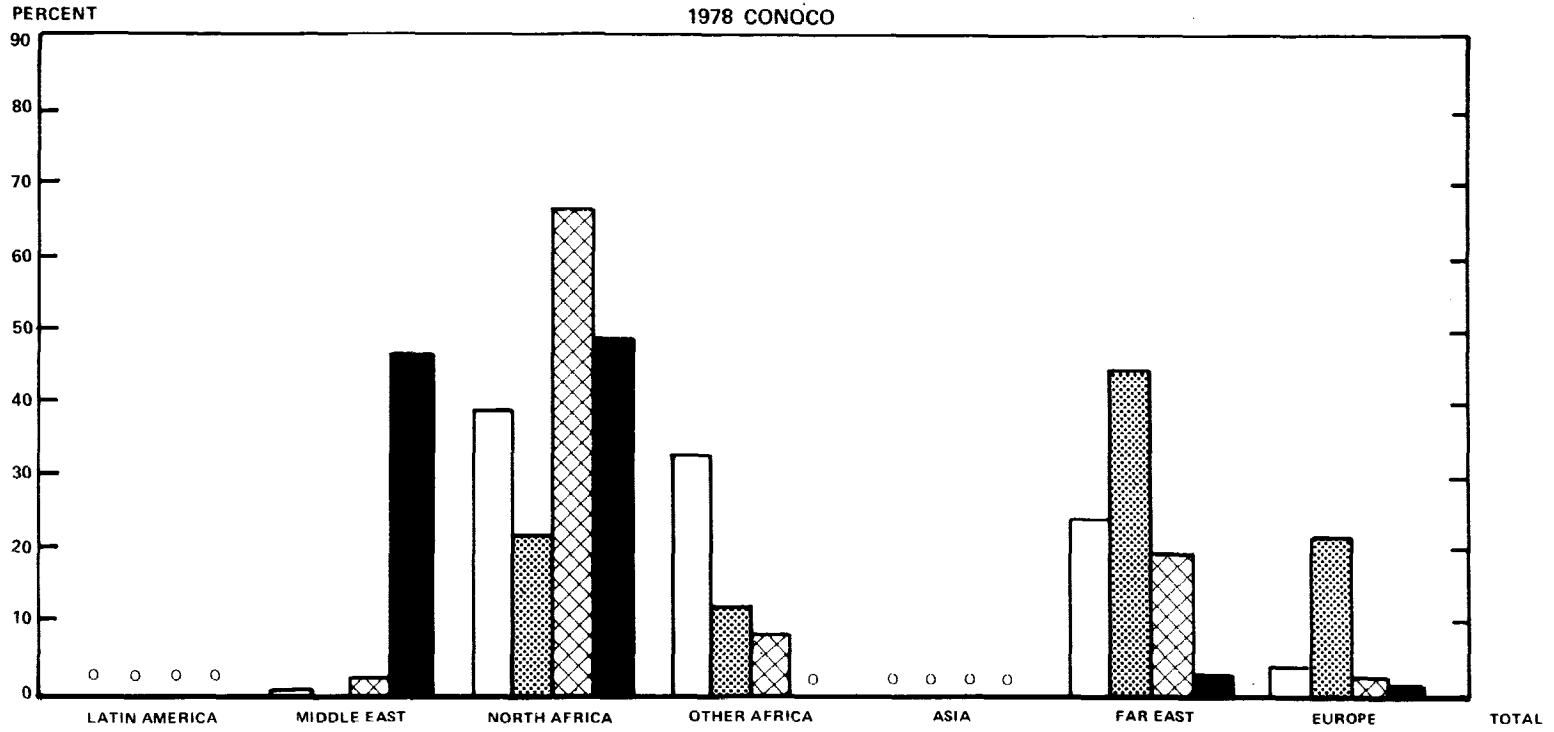
DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA AND COMMUNIST AREAS  
1978 OCCIDENTAL



SOURCE: DEVELOPED FROM PETROCONSULTANTS DATA.

Figure 10

DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA AND COMMUNIST AREAS  
1978 CONOCO



	LATIN AMERICA	MIDDLE EAST	NORTH AFRICA	OTHER AFRICA	ASIA	FAR EAST	EUROPE	TOTAL
ACREAGE HELD	0	347	18,493	5,309	0	11,430	2,055	47,634
EXPLORATORY WELLS	0	0	2.3	1.3	0	4.8	2.3	10.7
GEOPHYSICAL WORK	0	0.5	12.1	1.6	0	3.6	0.5	18.3
PRODUCTION	0	109,000	114,000	0	0	7,096	3,387	233,483

THOUSANDS OF ACRES HELD AT YEAR-END  
 NO. OF WELLS COMPLETED DURING YEAR  
 NO. OF CREW-MONTHS SPENT  
 AVERAGE BPD

SOURCE: DEVELOPED FROM PETROCONSULTANTS DATA.

Figure 11  
 DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA  
 AND COMMUNIST AREAS  
 1978 ARCO

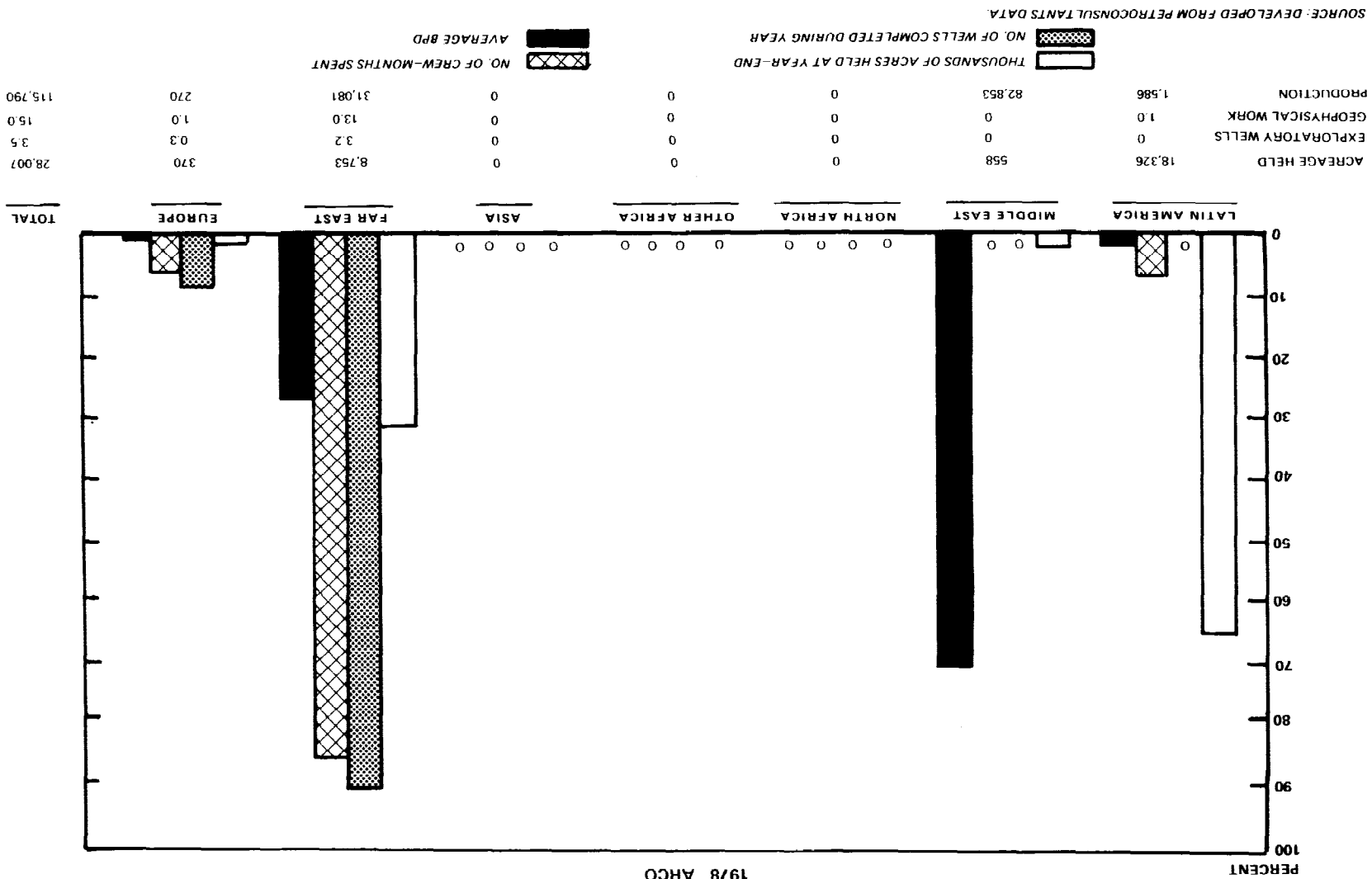
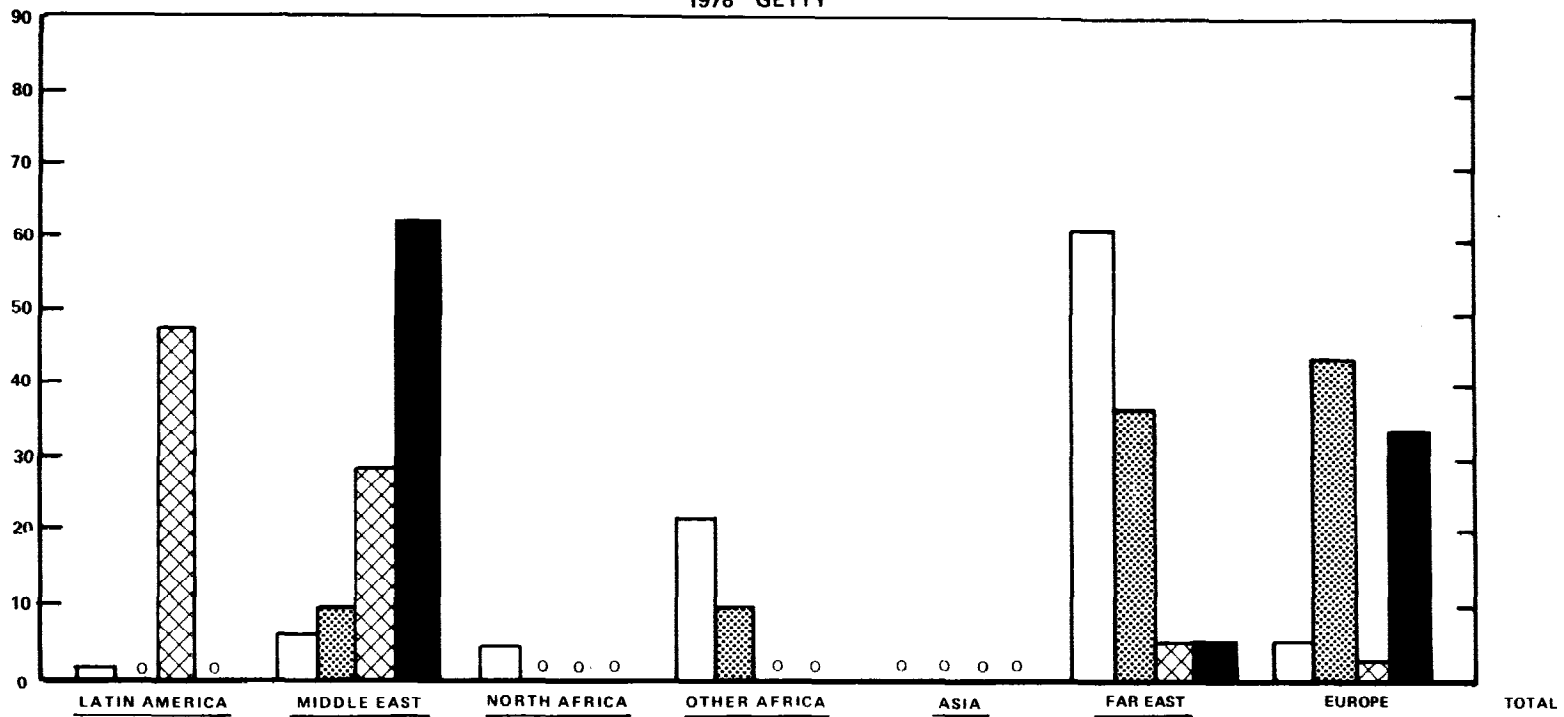




Figure 12

DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA  
AND COMMUNIST AREAS  
1978 GETTY



ACREAGE HELD	196	1,104	680	3,568	0	10,193	962	16,703
EXPLORATORY WELLS	0	0.4	0	0.4	0	1.5	1.8	4.1
GEOPHYSICAL WORK	5.5	3.3	0	0	0	2.5	0.3	11.6
PRODUCTION	0	125,156	0	0	0	10,362	65,575	201,093

THOUSANDS OF ACRES HELD AT YEAR-END  
 NO. OF WELLS COMPLETED DURING YEAR

NO. OF CREW-MONTHS SPENT  
 AVERAGE BPD

SOURCE: DEVELOPED FROM PETROCONSULTANTS AND GETTY DATA.

DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA AND COMMUNIST AREAS

1978 PHILLIPS

Figure 13

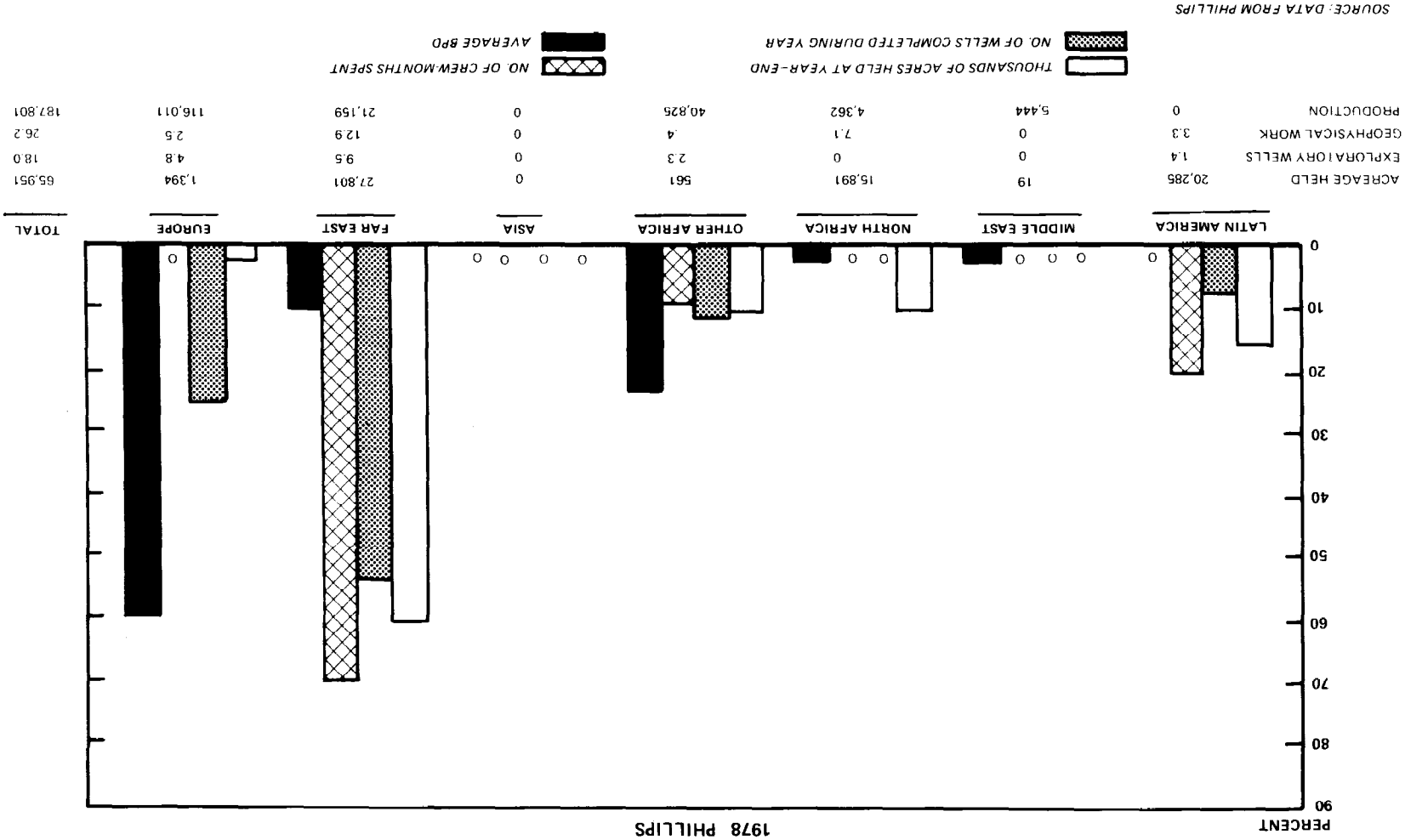
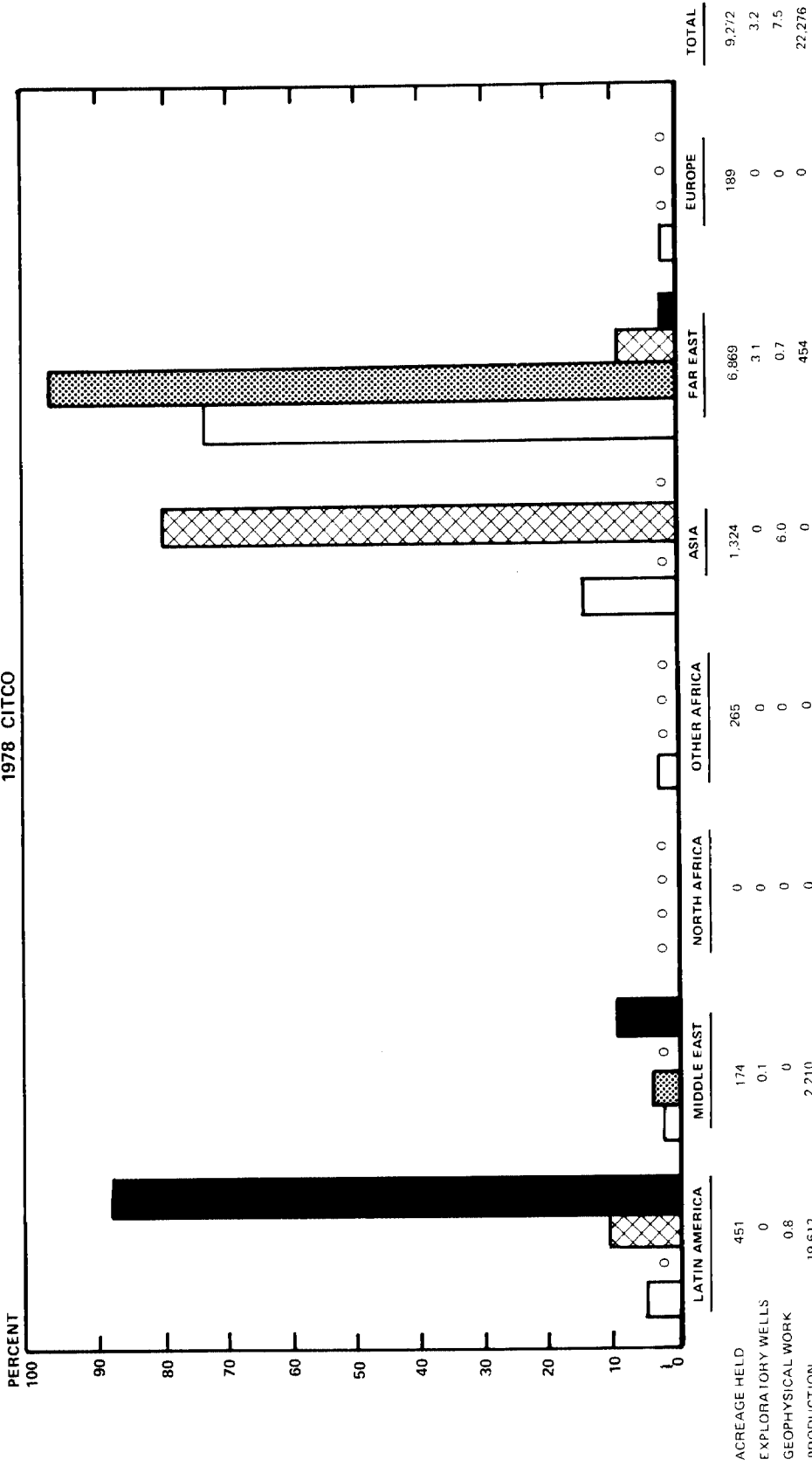


Figure 14

DISTRIBUTION OF CRUDE OIL PRODUCTION AND EXPLORATION ACTIVITIES OUTSIDE NORTH AMERICA  
AND COMMUNIST AREAS  
1978 CITCO



NO. OF CREW-MONTHS SPENT  
 AVERAGE BPD

THOUSANDS OF ACRES HELD AT YEAR END  
 NO. OF WELLS COMPLETED DURING YEAR

SOURCE: DEVELOPED FROM PETROCONSULTANTS DATA.

## CHAPTER 4

### POTENTIAL FOR DISCOVERING

#### NEW PETROLEUM SOURCES

Future diversification on a significant scale will be possible only if large amounts of petroleum can be discovered and produced in countries outside the Middle East and North Africa, preferably those that are not currently oil exporters. Expansion of such production also could:

- Increase aggregate world oil and gas supplies, thereby limiting the demand on existing suppliers and reducing the probability and magnitude of oil price increases.
- Further U.S. security interests (including nuclear non-proliferation objectives) by enhancing the political, economic, and energy security of oil-dependent importers.
- Reduce the need for the United States to import oil from its existing suppliers to extend production beyond the levels they consider optimal.
- Increase economic development in those less developed countries where oil and gas is found and alleviate the burdens imposed by oil price increases.
- Extend the period available for improving and installing the alternate technologies that will become increasingly important over the long run.

Most experts generally agree on the estimated remaining undiscovered volume of oil and gas in the world. They also agree that there is still much potential for additional discoveries but differ widely over whether current exploration levels are adequate to realize this potential.

#### ESTIMATES OF UNDISCOVERED OIL AND GAS

With notable exceptions, there is generally a consensus among petroleum experts that about as much conventional oil remains to be discovered as the one trillion barrels already discovered.

A number of studies over the past several years by the Rand Corporation, U.S. Geological Survey (USGS), Mobil, BP, Exxon, and others converge around a figure of 2 trillion barrels as the total world petroleum resource base.

A review of estimates during the past three decades reveals that the range in the late 1940s was 400 billion to 600 billion barrels; in the 1950s it was 1,000 billion to 1,500 billion barrels, and during the past two decades there has been considerable

convergence toward the current consensus of about 2 trillion barrels. (See table 12.)

Table 12

Estimates of World Ultimate  
Crude Oil Recovery

<u>Date of estimate</u>	<u>Estimator</u>	<u>Organization</u>	<u>Billion barrels</u>
1962	L.G. Weeks	Consultant	2,000
1965	T.A. Hendricks	USGS	2,480
1967	W.P. Ryman	Esso (Exxon)	2,090
1968	-	Shell Oil Company	1,800
1969	M. King Hubbert	National Academy of Sciences	1,350-2,100
1969	L.G. Weeks	Consultant	2,200
1970	J.D. Moody	Mobil	1,800
1971	H.R. Warman	BP	1,200-2,000
1972	J.D. Moody and H.H. Emmerick	Mobil	1,800-1,900
1972	Richard L. Jodry	Sun	1,952
1972	H.R. Warman	BP	1,800
1973	Wim Vermeer	Shell Oil Company	1,930
1973	H.R. Warman	BP	1,915
1974	J.D. Moody and R.W. Esser	Mobil	2,000
1974	M. King Hubbert	USGS	2,000
1975	J.D. Moody and R.W. Esser	Mobil	2,030
1975	-	Exxon	1,945
1975	B. Grossling	USGS	2,600-6,500
1975	P. O'Dell	Erasmus University, Rotterdam	3,575-4,233
1977	M. King Hubbert	Congressional Research Service	2,000
1977	-	World Energy Conference	1,900
1978	Richard Nehring	Rand Corporation	1,700-2,300
1979	A.A. Meyerhoff	Consultant	2,230

During our review, the most often cited estimate was that of a survey conducted for the 1977 World Energy Conference in Istanbul, Turkey. Questionnaires soliciting estimates were sent to over 40 government, industrial, and scientific organizations in the Eastern and Western Hemispheres. At the time of the meeting, opinions had been forwarded from 29 organizations, including many oil companies. The average of the estimates received was 1,900 billion barrels with two-thirds of the replies averaging 1,760 billion barrels, excluding deep-water Arctic and Antarctic zones.

## Uncertainty of estimates

The convergence of the majority of experts around 2 trillion barrels as the world's ultimate crude oil resources should be viewed with caution. The uncertainty of these estimates is probably greater than this consensus would lead one to believe because all current estimates of undiscovered resources are based on certain assumptions. The danger is that, although the experts who make these estimates are aware of the large number of uncertainties and qualifications inherent in them, the non-experts who often use them are not.

Many different approaches are applied in attempting to assess the world's ultimate petroleum resource base, but most estimates are based on the use of geological analogies, statistical techniques, or a combination of both.

Numerous data problems are involved in making accurate estimates of world petroleum resources. The oil industry, since its beginning, has found some 30,000 oil and gas fields. For the United States and a few other countries, a considerable amount of information is readily available, but for most countries, the available data is scanty and incomplete or has not been published. Also, most of the data is held privately by individual petroleum companies, which makes it difficult for independent groups to confirm oil company analyses.

Despite the importance of the subject, no systematic and thorough attempts have been made to estimate world petroleum resources by country on a uniform and comparable basis. The Colorado School of Mines and the International Institute for Applied Systems Analysis have proposed developing this information as a cooperative survey with oil companies, governments, and other institutions. To date, they are not funded.

The Department of Energy in association with the USGS has initiated a similar project, called the Foreign Energy Supply Assessment Program, to attempt to compile all known geological information, maps, production and reserve data, exploration drilling statistics, etc., for each productive and prospective petroleum province of the world, both onshore and offshore.

## PROSPECTIVE OIL AND GAS AREAS

According to the generally accepted theory that petroleum is of organic origin <sup>1/</sup>, petroleum is formed and can exist only in thick layers of sedimentary rocks. The world's surface can be divided into three major categories.

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<sup>1/</sup>This theory is that petroleum was created by the gradual compaction of organic material under great pressure and temperatures in layers of sedimentary (porous) rocks.

1. The present-day ocean floor, which comprises over 70 percent of the earth's surface and is largely nonsedimentary rock.
2. Combined continental shields and high mountains, which comprise another 13 percent of the earth's surface; any oil or gas formed in these areas has either been destroyed, leaked out, or both.
3. Sedimentary basins, which comprise about 17 percent of the earth's surface.

Exxon, in a June 1978 report, claims that sufficient survey work has been done in all the world's basins to indicate their dimensions, the amounts and general types of sediments they contain, and their general structural properties.

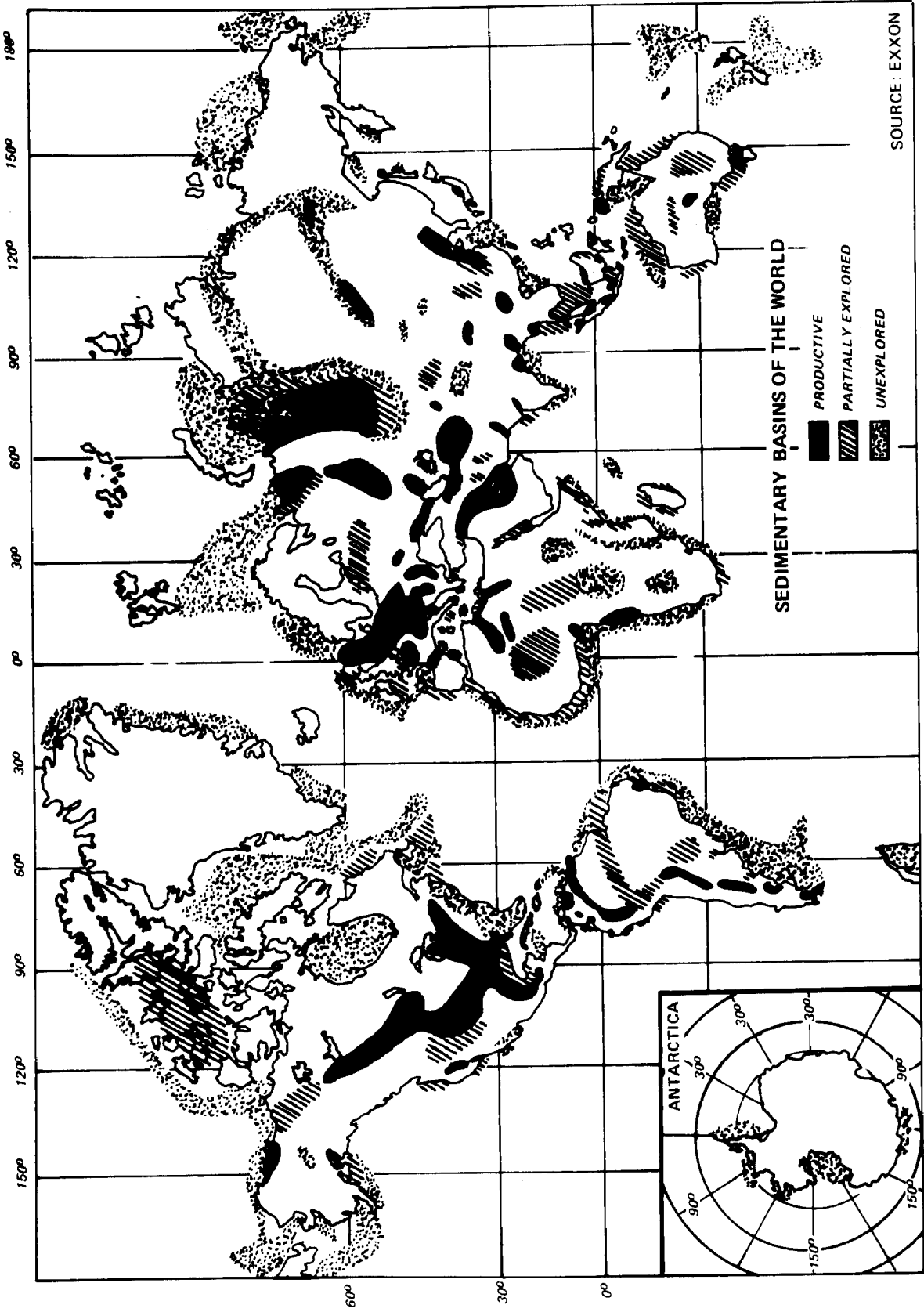
Approximately 600 sedimentary basins have been identified on land and under the oceans in continental shelves and slopes by major U.S. oil companies and the USGS. (See map on p. 48) In roughly 400 of these basins, exploratory drilling has been done in varying amounts and with varying degrees of success. About 160 basins are capable of producing commercial quantities of oil and gas, and very large amounts of oil (perhaps more than 50 percent of future discoveries) are expected to be discovered in these basins. The other 240 basins have been drilled without yielding commercial discoveries to date.

The remaining 200 basins have had essentially no drilling as yet--in most cases, because they are in harsh physical environments or because government restraints have restricted access to them. Exxon estimates that perhaps half the essentially unexplored basins may eventually prove productive. Socal, in a recent report, indicates that a significant part of the sedimentary basins are lacking in oil or gas because some of the critical elements needed for oil and gas accumulation were never present. Socal estimates that the known oil and gas occurred in only 4 percent of the earth's surface.

Although estimates of where future discoveries will occur are highly speculative and uncertain, most oil company and government geologists we interviewed said that the following areas outside of the Middle East and North Africa hold the most promise.

--The Arctic areas including the Beaufort Sea off Alaska and Canada, the Bering and Chukchi Sea areas off Alaska in which the USGS recently made favorable seismic findings, the Rift Basin off Newfoundland, East Greenland, and the northern basins of the Soviet Union.

--Antarctica, which is largely unexplored.





- Mexico, which has great potential, whose limits are still undetermined.
- The North Sea, particularly the Norwegian sector above the 62d parallel.
- China, which has the largest unexplored non-arctic continental shelf in the world.
- Certain developing nations in Latin America and Africa which have been only moderately explored. The tremendous heavy oil potential of Venezuela should also be noted.

The CIA report, "The World Oil Market in the Years Ahead," August 1979, stated that:

"With adequate exploration, prospects are good for expanding the reserve base of Mexico, Argentina, Brazil, Egypt, India, Peru, and Malaysia. Locating fields of Middle East size, however, appears possible only in Mexico, and perhaps in Egypt. In some countries, notably Syria, Brunei, and Angola, substantial exploratory work is needed just to keep the present reserve base from declining.

"Geological prospects elsewhere in the developing countries are uncertain at best. Areas in Asia with potential may include the Bay of Bengal, onshore Burma, the Andaman Islands, and the South China Sea. The coast of East Africa, particularly along Somalia, has also been left largely untouched. More work is also needed to prove up and expand reserves in the upper regions of the Amazon Basin and offshore areas of Brazil."

#### EXTENT OF EXPLORATION

The analyses of Dr. Bernardo Grossling, formerly of the USGS and now with the Inter-American Development Bank, are often cited by those who claim that large prospective petroleum-producing areas have been neglected. Dr. Grossling's premise is that large prospective areas, particularly in Latin America and Africa, have not been adequately explored. He points out that drilling density varies greatly throughout the world. The United States is by far the most densely drilled area, with the Soviet Union next but lagging far behind. He presents the following data on the number of wells that have been drilled per square mile of prospective area to reveal what he calls a "drilling gap".

<u>Region</u>	<u>Number of wells per square mile of prospective area</u>
Conterminous United States	1.17
Soviet Union	.15
Argentina, Mexico, Venezuela	.05
Other Latin America	.01
Middle East	.01
South and Southeast Asia, Indonesia	.01
Africa and Madagascar	.003

Available data reveals that exploration continues to be concentrated in the United States. In 1977, for example, comparison of activity in the United States versus the rest of the free world shows that over 70 percent of the exploratory wells, over 80 percent of the total wells, nearly 80 percent of the total footage drilled, and almost half of the free world's geophysical activity occurred in the United States.

Figure 15 shows that most of the free world's exploratory wells from 1970 to 1978 were drilled in the United States, with a marked increase occurring after 1973. Canada also shows considerable activity, particularly since 1975. The rest of the free world, however, shows no increasing trend in the number of exploratory wells drilled. In 1978, for example, 10,677 exploratory wells were drilled in the United States, 3,144 in Canada and only 1,305 in Latin America, Africa, Europe, and the Far East combined.

Exploration statistics, however, must be interpreted with caution because there is no consensus among experts in or out of the oil industry as to how much activity is adequate.

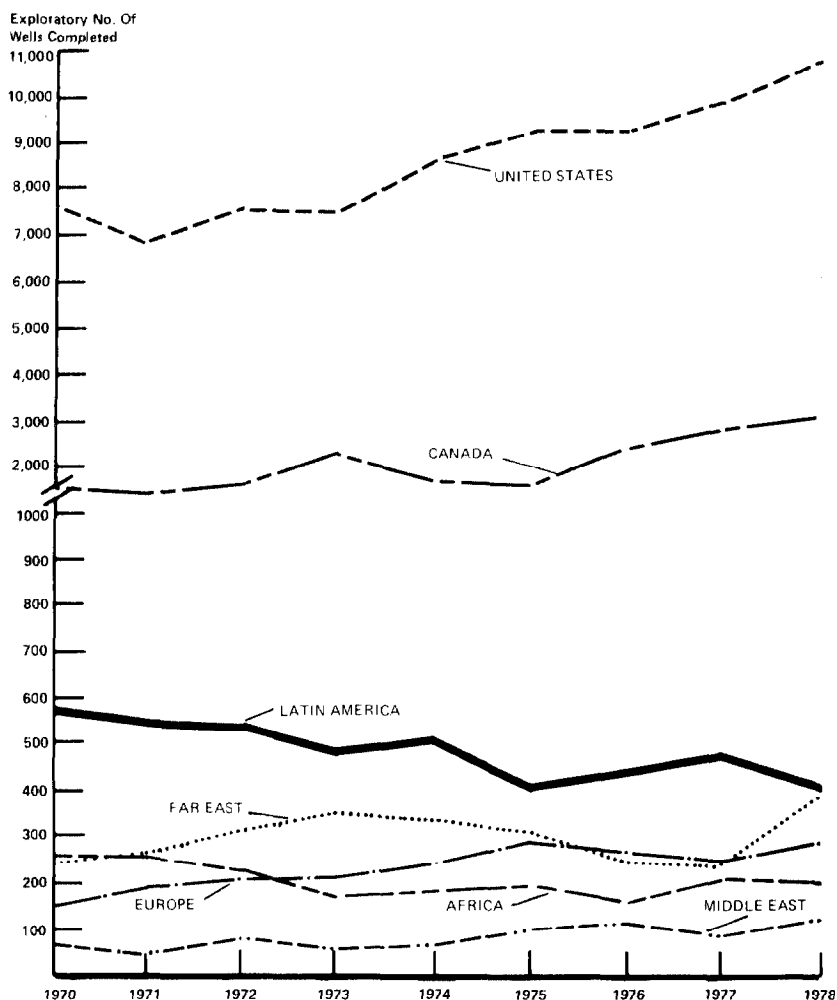
For example, in a June 1978 paper, "Exploration in Developing Countries," Exxon claimed that exploration activity in non-OPEC less developed countries (LDCs) was rather extensive for the 1967-76 decade as a whole. Excluding the United States, Canada, Western Europe, Australia, Japan, and the Communist areas, exploratory wells were drilled in 71 countries. Another 19 countries were explored by seismic survey without drilling, and 20 countries were not explored at all; these 20 are mostly small island nations or those with poor geologic prospects.

In 1976, the most recent year for which data was available for the Exxon study, exploratory drilling took place in 37 countries. Detailed seismic surveys, but no drilling, took place in 15. Oil companies held contract acreage in 30 countries. There was no activity in 31 countries, in some cases because of government policies or political uncertainties.

Our analysis of 1978 activities in non-OPEC LDCs shows that U.S. oil companies held acreage contracts in 57 countries, drilled exploratory wells in 36, and performed geophysical surveys in 27.

Figure 15

FREE-WORLD EXPLORATORY WELL COMPLETIONS 1970-78



Source: Basic Petroleum Data Book, American Petroleum Institute.

Dr. Grossling maintains that political and economic constraints have caused the oil industry to neglect many areas of the world and that areas, such as Latin America and Africa, if drilled as intensively as the United States, would turn out to be far more productive than generally assumed. He does not predict that another Middle East would be found but expects that more intensive exploration would find greater resources than have so far been found.

Although industry and Government geologists we talked to were not as optimistic as Dr. Grossling about prospects in areas that have not been extensively drilled, they recognized the need for increased exploration in LDCs.

A study prepared for the World Bank by l'Institut Francais du Petrole classified the adequacy of exploration in 70 developing countries as shown in table 13.

Table 13

Adequacy of Exploration in 70 Developing Countries

<u>Type of country</u>	<u>Number of countries</u>	<u>Exploration</u>		
		<u>Inadequate</u>	<u>Moderate</u>	<u>Adequate</u>
Oil producer and net importer	12	6	4	2
Nonproducer with known reserves	10	3	3	4
Nonproducer with no discoveries	45	28	13	4
Non-OPEC producer and exporter	<u>3</u>	<u>1</u>	<u>2</u>	<u>0</u>
Total	<u>70</u>	<u>38</u>	<u>22</u>	<u>10</u>

The study concluded that only 7 of the 23 countries with high or very high prospects have been explored adequately, 6 have been explored moderately, and the rest inadequately. Of the 15 countries with fair prospects, only one has been explored adequately, 3 moderately, and 11 inadequately.

Countries whose prospects warrant increased exploration include such comparatively large consumers of petroleum as India, Argentina, Turkey, the Philippines, Colombia, Peru, Pakistan, and Vietnam.

About half the world's known reserves of oil occurs in "supergiant" fields (accumulations of more than 5 billion barrels). Few of the basins explored in recent years contain geological structures where such large fields might be found. Experts we talked with and read indicated that none of the unexplored basins possess geological characteristics that suggest the discovery of another "Middle East" where most of the known supergiant fields have been found. <sup>1/</sup> The focus of exploration has therefore shifted to smaller fields, and improvements in technology have enhanced the ability of drillers to discover them.

In introducing its program to accelerate petroleum production in the developing countries (see ch. 5), the World Bank stated:

"In principle, therefore, the prospects for increased exploration in the lightly explored basins, situated mainly in developing countries, would appear to be good. However, in currently producing basins, the

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<sup>1/</sup>Supergiant fields have been found in Saudi Arabia, Kuwait, Iran, Iraq, Abu Dhabi, Libya, Algeria, China, the Soviet Union, Venezuela, the United States (Texas and Alaska), and Mexico. The Mexican fields are the only supergiants discovered in the past decade.

largest and most attractive structural prospects were explored first and there is a strong incentive to re-evaluate older prospects; more intensive exploration may discover smaller, but now profitable fields in these basins. As the industry turns to 'second tier' geological prospects, in many cases prospective areas in developed countries have the advantage that the essential infrastructure is in place and that they are close to the markets. These circumstances probably explain much of the difference in relative drilling intensity between developed and developing countries. A balance that may appear appropriate from a global point of view, or from that of the oil companies interested in supplying the world market, may be inappropriate from the viewpoint of a developing country which attaches high priority to increasing its oil self-sufficiency and would wish to explore its oil potential as quickly as possible."

## CHAPTER 5

### U.S. GOVERNMENT ACTIONS TO STIMULATE

#### EXPLORATION AND DIVERSIFICATION

The United States differs from most other industrialized countries by relying almost entirely upon its private oil companies for petroleum supplies, whether imported or domestically produced. In many other countries, the government owns one or more major oil companies. Consequently, U.S. programs or policy actions to effect changes in petroleum industry behavior are designed to work through the private sector. The United States has only one official activity, the Overseas Private Investment Corporation (OPIC), which directly influences petroleum exploration in other countries. Several other U.S. programs which were started for other purposes have various indirect relationships to foreign petroleum exploration.

A Presidential interagency task force is currently studying what is being done and what can or should be done to stimulate oil and gas exploration and development in developing countries. Its report to the President recommending what, if any, action the Government should take is now in draft form and is expected to be issued in late 1980.

#### OVERSEAS PRIVATE INVESTMENT CORPORATION

OPIC was created by the Foreign Assistance Act of 1969 " \* \* \* to mobilize and facilitate the participation of United States private capital and skills in the economic and social development of friendly less developed countries and areas, thereby complementing the assistance objectives of the United States."

OPIC operates two major programs--investment insurance and finance. Under the insurance program, OPIC insures U.S. private investments against certain political and commercial risks, such as expropriation, war, and currency inconvertibility in friendly LDCs. OPIC's finance program provides (1) preinvestment assistance for conducting surveys on a risk-sharing basis to find projects and confirm their viability, (2) loan guarantees, and (3) direct loans to small businesses to promote economically and financially viable projects in friendly LDCs.

Late in fiscal year 1977, OPIC expanded its programs to include minerals and energy projects by offering coverage during exploration, production, and processing. In fiscal year 1978, a Minerals and Energy Staff was established within OPIC to identify and help implement potential projects in petroleum-importing LDCs, using both the insurance and finance programs. A principal objective of this expansion was to help oil-importing countries develop their petroleum resources, thus reducing their dependence on imported oil and serving the U.S. national interest by opening up new sources of oil supply.

By the end of fiscal year 1979, OPIC had issued \$277 million in insurance for petroleum exploration and development projects in Egypt, Greece, and Ghana and an additional \$46.5 million in coverage for the expansion of an oil storage and transshipment facility in Panama. It had also insured an unsuccessful oil exploration project in Jordan, now terminated. Early in fiscal year 1980, OPIC issued insurance for loans to an oil field development project in Pakistan. In its 1979 annual report, OPIC reported that it then had under consideration 45 registrations for potential energy projects in 21 countries.

OPIC's basic legislation specifies operations in less developed countries. Yugoslavia and Romania, however, are exceptions and the People's Republic of China recently was made eligible for OPIC programs.

Other legislation has recently been introduced to overcome problems OPIC has had insuring petroleum projects because of restrictive language in its statute and legislative history which discouraged involvement in petroleum projects.

#### OTHER U.S. PROGRAMS

The following U.S. programs, while established for other purposes, may have some degree of influence, either directly or indirectly, on accelerating foreign petroleum exploration.

#### International Energy Development Program

The International Energy Development Program (IEDP), established in response to a 1977 Presidential directive, attempts to help developing countries meet their energy needs through increased reliance on indigenous resources while averting premature and/or excessive commitments to nuclear energy programs. The IEDP has also been referred to as the LDC Program.

IEDP's purpose is to (1) analyze LDC energy needs, uses, and resources, (2) encourage exploration and development of their conventional energy resources, (3) provide research, development demonstration, and application of modern energy technologies, and (4) provide training, education, and institutional development. This is being carried out in three phases.

In Phase I, DOE uses Brookhaven National Laboratories and Argonne National Laboratory to collect, collate, and analyze available existing data from U.S. domestic sources on each country to be studied. In Phase II, a team of DOE and USGS experts visit the country, consult its energy officials, and report their findings, conclusions, and recommendations.

Phase I is completed for Egypt, Peru, South Korea, Argentina, Portugal, and Indonesia. Phase II is completed for Egypt and Peru.

A Phase III effort was being planned to consist of extensive followup work by an incountry field team. This team would conduct several years of actual development work with the country's staff and produce a detailed, indepth assessment of the country's energy potential and policy options with specific plans for implementation.

### Foreign Energy Supply Assessment Program

Despite the importance of the subject, no systematic and thorough attempts have been made to estimate the undiscovered petroleum potential of each country of the world on a uniform and comparable basis other than by private petroleum companies for their own use. The USGS proposed such a project several times, but was denied approval and funding by both the Department of Interior and the Office of Management and Budget at different times. Without this information, U.S. policymakers lack a reliable data base for making decisions concerning petroleum potential.

Recognizing this deficiency, DOE in association with the USGS, has initiated the Foreign Energy Supply Assessment Program (FESAP) to provide a reliable and credible information data base on worldwide petroleum resources and potential, by country. This project will attempt to compile all known geological information, maps, production and reserve data, exploration drilling statistics, etc. for each productive and prospective petroleum province outside the United States both on and offshore, and to estimate the recoverable oil and gas potential by country, with no attempt to judge the country's economic/political need to produce oil. The USGS has already done this for the United States and reported its results in USGS Circular 725, "Geological Estimates of Undiscovered Recoverable Oil and Gas Resources in the United States."

FESAP differs from the IEDP in scope, methodology, and purpose. The IEDP covers all energy sources, while FESAP concentrates only on petroleum potential. The IEDP bases its analyses on data existing in the United States and on fairly extensive incountry data research, while FESAP relies upon collecting existing geological data without leaving the United States. The IEDP concentrates on those countries most likely to turn to nuclear power in an effort to divert them to non-nuclear sources; FESAP concentrates on those with the greatest known petroleum potential and then works down to the others. The IEDP's purpose is to stimulate and assist the LDC in deciding on non-nuclear energy sources, while the FESAP's purpose is to provide a data base for U.S. decisionmakers. The two programs are intended to supplement, rather than overlap or interfere with, each other.

A FESAP report has been completed on Nigeria, and studies are in process for Venezuela and Trinidad. The next series of



studies planned will cover the Persian Gulf countries and Indonesia. DOE had hoped to complete the project with a worldwide report by 1985 but, because of staff and budget constraints, now considers this date highly optimistic.

The FESAP's three initial objectives are to:

- Estimate ranges of current and future oil and natural gas production capacities from existing fields for several key producing countries, based on analyses of available geological and engineering data.
- Estimate long-term availability of undiscovered oil and gas from several key producing countries, based on analysis of the resource base using geological and engineering analogs.
- Apply the skills and techniques developed in achieving the two preceding objectives to make similar projections for nonproducing countries.

A fourth objective is to estimate the possible rate of production based on the estimates of discovered and undiscovered oil tempered by reservoir characteristics and development rates.

USGS officials pointed out that the program could be completed sooner if the FESAP were included as a regular work program of the USGS. Under the current arrangements, it is not included in the USGS budget and USGS has been unable to acquire additional staff to accomplish the work. USGS more or less "squeezes" the staff time for FESAP out of its other programs by assigning FESAP work segments to individuals to work on part-time or between other assignments. USGS and DOE each have only one employee assigned fulltime to this project. USGS officials said they would like to have more staff for this project, but cautioned that additional funding could accelerate the work only so far. With sufficient funding, the limiting factor would become the availability of qualified petroleum geologists and engineers. USGS feels that, given the funds, it could undoubtedly find a small number of additional qualified staff, but these individuals are definitely in short supply and high demand at the present time.

#### Export-Import Bank

The Export-Import Bank seeks to foster the export of U.S. goods, including those involved in overseas petroleum exploration and production, by providing loans, loan guarantees, and insurance to foreign purchasers of U.S. equipment.

## U.S. PARTICIPATION IN INTERNATIONAL ORGANIZATIONS

The United States also participates in a number of international organizations which have or are developing programs to stimulate oil and gas exploration and development in LDCs.

The World Bank is the only such organization with an operational program intended specifically to accelerate oil and gas exploration and development in LDCs, but the Inter-American Development Bank has a similar program under development.

### World Bank

Before 1973, the World Bank did not finance petroleum production projects, mainly because private capital was available and commercial production was uneconomical in most developing countries at 1973 international oil prices. After the large increase in petroleum prices in 1973, the Bank started to review its energy development lending policies.

In July 1977, acting on a recommendation from the London Economic Summit Meeting, the Bank expanded its energy sector lending program to include projects for developing and producing fuel and nonfuel mineral resources, including petroleum. It stopped short of funding exploration.

Under this program, the Bank provided loans for four oil and gas development projects in developing countries as outlined below.

--In July 1977, the Bank loaned the equivalent of \$150 million to the Government of India to develop the oil and gas reserves of the Bombay High and Basse North fields (discovered in 1974 and 1975 respectively). This \$571 million project is the third phase of India's Oil and Natural Gas Commission development program for the Bombay High offshore area. It is expected to be completed by December 31, 1980.

--In July 1978, the Bank approved a loan equivalent to \$4.9 million to the Natural Gas Organization of Thailand to finance the foreign exchange cost of a natural gas development engineering project. The project is the first phase in the development of Thailand's natural gas potential and comprises preparatory work to enable construction of a gas pipeline by 1981. The total cost of the project was programed at \$5.7 million.

--In November 1978, Turkey received a loan equivalent to \$2.5 million to finance the foreign exchange cost of a comparative evaluation study of enhanced oil recovery techniques to be applied to the Bati Raman oil field and detailed design and engineering of a pilot plant for testing the chosen method.

--In December 1978, the Bank approved a development credit loan equivalent to \$30 million to the Islamic Republic of Pakistan to help finance a petroleum development project to (1) boost domestic oil supplies by increasing production from the Dhodak oil field from 1,500 bpd to approximately 9,500 bpd by 1981, (2) assist the Pakistan Oil and Gas Development Corporation to strengthen its capacity for effectively conducting oil operations, and (3) evaluate the potential of the Dhodak field discovery and prepare for its rapid exploitation. The project is scheduled to be completed by December 3, 1981, except for the training segment. The total project cost is \$73 million.

On January 16, 1979, the Bank's Board of Directors approved a program which basically further extended the energy sector lending policy established in July 1977 to include oil and gas exploration projects. The extended program would provide approximately \$500 million over the next 3 years to finance oil and/or gas development and exploration projects in LDCs. In addition to providing financial assistance for oil, gas, and coal production, the program includes advice on national energy planning and assistance for predevelopment activities as outlined below.

- Financing expert assistance in national energy planning.
- Technical assistance loans or credits to provide assistance in commissioning new geological surveys or in evaluating and updating data from earlier surveys.
- Engineering loans and credits to finance appraisal drilling for fuel mineral projects.
- The Bank is willing to help and advise LDC governments and foreign collaborators in concluding agreements for petroleum exploration and production and to finance the eventual production facilities. The Bank is considering loans or credits to member governments of oil-importing LDCs to cover their shares of exploration costs undertaken in association with a foreign enterprise. In countries where foreign investors are unwilling to invest in petroleum exploration, the Bank is prepared to consider lending to cover costs of exploration done by an exploration company under a service contract.

According to a Bank official, this program is to complement the international oil companies' efforts by helping the developing countries to develop marginal oil resources which are not large enough to attract international oil companies.

The Bank estimated that its support of petroleum projects would increase oil production in LDCs by 0.4 million barrels a day in 1981 and 1.4 million barrels a day in 1983.

Even though the Bank contributes only 20 percent of the funds for any one of these projects, it is important because it attracts private capital and facilitates agreements between LDCs and foreign oil companies for petroleum exploration and/or development which might not otherwise be possible.

In August 1980, the World Bank announced that it had committed \$4.5 billion for energy projects in the past 2 fiscal years and that its present plans call for energy loans of \$13 billion from fiscal year 1981 through fiscal year 1985. The Bank's president in his introduction to the Bank's August 1980 report, "Energy in the Developing Countries," stated that the \$13 billion commitment was still some \$12 billion short of "\* \* \* what is both desirable and feasible \* \* \*" and that the Bank's resources today are not adequate to meet the energy needs of the developing countries as well as provide support for their other essential needs. He proposed to "\* \* \* explore whether the establishment of an energy affiliate of the Bank would provide the additional financing that is needed for investing in energy in the developing countries."

#### Inter-American Development Bank

The Inter-American Development Bank (IDB) has an established policy of encouraging exploration and/or development of mineral resources, including oil and gas. However, it has provided no funding for oil and/or gas projects to date.

The IDB has proposed to provide \$16 million (through co-financing) to evaluate Bolivia's natural gas reserves as part of a World Bank program and has proposed to finance a petroleum project in Barbados.

In 1979, the IDB proposed to establish the Inter-American Energy and Minerals Fund to provide eligible public and private investors with (1) insurance against currency inconvertibility, expropriation, and war risk, and (2) political and commercial guarantees of loans to approved projects. The Fund could reinsure its risks under appropriate circumstances. The IDB would administer the Fund and would contribute \$50 million--\$25 million annually from its earnings for the first 2 years, of which a total of \$20 million would be for an insurance reserve, and \$30 million for a guarantee reserve. Guarantees outstanding would not exceed four times the guarantee reserve.

The IDB proposal is currently being revised, and a Treasury Department official said he does not expect it to be voted on by the member countries until 1981.

#### International Energy Agency

The International Energy Agency was not established to deal with petroleum exploration and production in LDCs and has done no work in this area.

## United Nations

The United Nations Development Program (UNDP) provides funding for conventional energy projects in LDCs, including energy surveys, which help LDC governments to assess their energy resources (including oil and gas) and develop energy policies. The UNDP has also provided funds to train personnel in all related specialized disciplines.

In 1973, the United Nations established the U.N. Revolving Fund for Natural Resources Exploration administered by the UNDP. For economic and other reasons, the Fund has limited its assistance to exploration for hard minerals only.

In 1979, the UNDP Administrator recommended to the UNDP Governing Council that the Fund be authorized to provide assistance in the predrilling phases of petroleum exploration and in evaluating or updating existing petroleum survey data in LDCs. The Council took no action then, and the matter is not scheduled to be taken up again until 1981.

At the June 1980 session of the Governing Council, the UNDP Administrator cited his belief that there is an urgent need and considerable scope for additional funding for preinvestment petroleum surveys which would complement the World Bank lending program and focus on those low-income countries which may not be in a position to incur additional debts and those which are not members of the Bank. He recommended that the Council consider establishing within UNDP an energy fund for exploration and preinvestment surveys to finance preinvestment surveys, exploration, and demonstration projects which:

1. Have the potential to attract large-scale investment from public or private internal or external sources, or a combination of these, for further exploration, development, and/or exploitation of the resources concerned.
2. Have the potential to make a major contribution to a developing country's energy resources.
3. Cannot be financed from other sources, including the World Bank.

As proposed, this fund would have two components.

1. In the petroleum sector, exploration would produce survey data the LDC government could use to attract investment from public and private sources which have the technical and financial capacity to move into exploration drilling, development, and production. Costs of the exploration surveys would be reimbursed to the proposed fund by the LDC government from the sale of the survey data to interested investors.

2. In the case of alternative conventional and new and renewable energy resources, the proposed fund would undertake preinvestment survey, assessment, and demonstration activities up to and including the prefeasibility stage. The fund's expenditures on individual projects would be recovered as far as possible from the LDC government or other financial sources that invest in the exploitation of the resource discovered by a successful project.

## CHAPTER 6

### OBSTACLES TO FOREIGN PETROLEUM EXPLORATION

Despite the obvious incentive provided by the steep oil price increases since 1973, certain obstacles, or disincentives, must be overcome to accelerate petroleum exploration and production worldwide. Most of these obstacles were created by government actions and could be reduced or removed by government actions.

In the past, natural physical obstacles, such as deep water, arctic conditions, or remote continental interiors, have limited or prevented exploration in some promising areas. In recent years, however, the oil industry has made great technological advancements. Nearly any place in the world can now be reached by the explorer's drill, albeit at great expenditure of money, time, and effort in certain frontier areas that still lie at the outer limits of existing technology.

#### GOVERNMENT OBSTACLES

Economic disincentives or legal barriers have been created by government actions, and only government actions can remove or reduce these obstacles and thus accelerate petroleum production in non-OPEC, non-Middle East areas.

Three considerations, however, should be kept in mind in analyzing the constraints facing oil companies in foreign exploration.

1. Not all oil companies perceive the risks and/or impediments to exploration in a given country in the same way; what one company considers too risky may be acceptable to another.
2. The political and economic climate in a given country, particularly among many LDCs, is not static but dynamic. What was perceived to be an impediment to exploration yesterday may change tomorrow. Also, the steep oil price increases since 1973 have served as an incentive for some nonproducing or nonexporting countries to develop their oil and gas resources more rapidly.
3. The obstacles to exploration cited herein are viewed from the perspective of the United States and its oil companies. We did not assess these obstacles from the point of view of the host governments and, therefore, did not determine to what extent these obstacles have actually hindered any particular country from developing its resources at the rate it may have wished to.

The following enumeration of obstacles and disincentives to foreign exploration was assembled on the basis of our interviews with officials of 17 U.S. and 4 foreign oil companies,

professional literature and studies, and reports and views of experts from DOE and private organizations. Of particular value was a September 6, 1979, DOE report, "Accelerated Development of Oil and Gas Production in Non-OPEC Countries." This report includes a country-by-country assessment of obstacles for 30 developing countries that the World Bank views as having promising petroleum potential. (See app. I.)

### Political risk

Every oil company in our sample cited political risk as the major disincentive to foreign exploration. Most said the problem is getting worse as developing countries increasingly turn to nationalistic policies and nationalize company assets.

Although political instability is a common feature of many developing countries, it is also a matter of degree. An example is Lebanon, categorized by the World Bank and DOE as a country with high potential, whose longstanding civil war has made exploration virtually impossible. Chad, the Philippines, Vietnam, Afghanistan, Ghana, and the People's Democratic Republic of Yemen have all suffered from local wars, domestic insurgency, or violent changes of government in recent years. On the other hand, substantial activity has taken place in the Congo and Angola where domestic turmoil has been severe. The implications of instability for the sanctity of an exploration contract or the future profitability of an investment are difficult to predict in degree, but the general implication is always one of increased risk.

Although political instability and the increasing likelihood of nationalization and/or expropriation was one factor always cited during our interviews, each company assessed the degree of risk differently. Where some companies said they would not venture, others said they would or already had. For example, some companies have stayed out of Brazil and Argentina because of terrorism and political unrest, but Exxon, Shell, Deminex (a German company), and other companies have projects in those countries.

In its June 1978 report, "Exploration in Developing Countries," Exxon concluded that:

"\* \* \* there are very few countries where political risk is a totally insurmountable factor; however, during the past ten years [1969-1978], exploration has been severely restricted at times in such countries as Cambodia, Vietnam, Angola and Tanzania."

It appears that assessment and willingness to accept political risk varies among companies and is a judgement factor tempered by the financial strength of the company and the estimated geological attractiveness of an area.



On the other hand, there are more subtle problems of political instability. Exploration and development contracts are often subject to sudden unilateral revisions by the host government. The higher the risk of contract revision, the greater the rate of return companies will seek initially. In an address to a group of World Bank officials, an Occidental Petroleum Corporation official expressed the fear that host governments will unilaterally change contractual terms after a discovery is made. He stated:

"We are concerned in case we make a petroleum discovery that the host country will not recognize that prior to such discovery there was considerable geologic risk and that we based our economic projections on that risk. If the government considers the find to be a 'bonanza' and much larger than expected, they might use that as a reason to abrogate the contractual terms. When we enter into a venture for which we feel there is, say, a one-in-20 chance of finding commercial production, we must insist upon terms such that a successful venture would provide sufficient profit to pay for the 19 failed ventures \* \* \* that we expect to encounter enroute to this one discovery. If we are not allowed sufficient profits from the successes to pay for our failures, we will soon be out of the exploration business, and the world as well as our company will suffer as a result."

In many cases, the differing objectives of host governments and potential investors make agreement on contract terms inherently difficult and time consuming. Host governments often have strong political as well as commercial motivations and may want to avoid public appearances of weakness in dealing with foreign multinational companies. This problem appears to have been of particular importance in Peru, Brazil, Malaysia, and Chile. 1/

The terms of a country's laws and record of administering its laws are important preinvestment considerations. Although one major company we interviewed felt a need for bilateral treaties to protect private foreign investment and to provide procedures for resolving disputes arising under contracts and agreements covering such investments, others wanted no special help from the U.S. Government other than to simply refrain from creating new obstacles.

A number of companies also stated that the U.S. Government, specifically the State Department, had not been very helpful or supportive in the past when companies had been nationalized or otherwise came into confrontation with a foreign government. Social,

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1/See Accelerated Development of Oil and Gas Production in the Non-OPEC LDC's, DOE, Sept. 6, 1979.

on the other hand, said that it has had some good experiences with the State Department in recent years and feels that State has developed a more positive and effective attitude in dealing with U.S. companies overseas.

### Uncertainty of U.S. tax policies

Every U.S. oil company we visited also cited the uncertainty surrounding the U.S. foreign tax credit, and the potential loss of the credit altogether, as a major disincentive to foreign exploration. The past several years have brought a number of changes in U.S. tax laws and their interpretation concerning oil and gas extraction income. Currently, the primary issue involves whether payments to foreign governments are interpreted as being income taxes, which are creditable against U.S. income tax in order to prevent double taxation, or as being royalty payments, which are not creditable. Royalty payments are considered to be a business expense which, although they cannot be credited directly against U.S. taxes, can be deducted from revenue to reduce the company's net income subject to U.S. income tax. Treating a specific payment as a direct tax credit rather than a deductible business expense will result in a lower U.S. tax liability.

It is important that a company be able to project as accurately as possible its anticipated major cost elements when formulating a bid proposal or negotiating such matters as contract costs or terms with a government. Projected net profit, rate of return on investment, and discounted cash flow rate are all important to a company's decision whether or not to accept specific terms. Company spokesmen stressed the fact that these factors cannot be accurately projected when the U.S. Government keeps changing the rules. According to U.S. oil companies and various DOE studies, the uncertainty of U.S. foreign tax credit treatment complicated and delayed the negotiation and completion of exploration and development contracts by U.S. companies in many countries, including Peru, Bolivia, Guatemala, Indonesia, the Philippines, and Thailand.

A number of these countries, with the help of private U.S. consultants, had originally drawn up or revised their petroleum and/or mineral tax laws to conform with U.S. foreign tax credit requirements. Oil company officials said that many of these countries have expressed willingness to further revise their tax laws to conform with U.S. requirements if the U.S. Government would settle on what its requirements are going to be.

As uncertainty about U.S. foreign tax credit rules has delayed or otherwise affected U.S. company operations in the past, continued uncertainty or outright elimination of the credit may similarly affect future operations. Without complete access to corporate accounts, one cannot say for certain to what degree loss of the credit will change the petroleum industry's activities, but it is certain that profits from foreign operations would be reduced or the additional tax burden would be passed on to consumers.

To the extent that elimination of the foreign tax credit significantly reduces profits, it may be counterproductive to the goal of increasing petroleum exploration and production in non-OPEC LDCs where many economically marginal petroleum prospects are located and thus counterproductive to U.S. opportunities for future supply diversification.

A tandem concern is that the loss of the foreign tax credit might reduce the ability of U.S. companies to compete overseas, particularly against the enhanced competitive positions of the major oil companies of France, Germany, and Japan. The larger industrial powers have moved consistently over the last decade to provide direct incentives and eliminate disincentives for foreign exploration by their own oil companies. For example, France, Germany, and Japan either specifically or through a variety of special regulations and administrative practices effectively exempt their firms' foreign source petroleum income from any domestic taxes, irrespective of the form or rate of host-country taxation. 1/

Germany and Japan allow full deductions against domestic-source taxable income for overseas exploration outlays and provide loans for exploration which are forgiven if the venture is unsuccessful. Both countries also offer loan guarantees and some interest subsidies on the large sums involved in developing successful ventures. This permits much higher debt-equity ratios than prevail in the U.S. industry and, accordingly, significantly reduces the cost of capital to those firms. 1/

Some companies said they would abandon some current exploration projects if the foreign tax credit becomes unavailable. One major company said it would have to seriously consider withdrawing from foreign exploration altogether.

A more detailed analysis of the issues relating to the foreign tax credit and the proposed changes may be found in our report to the Congress, "The Foreign Tax Credit and U.S. Energy Policy" (EMD-80-86, Sept. 10, 1980).

#### Excessive taxation by host governments

Company officials also cited excessive local taxation as a major disincentive to petroleum exploration. Some stated that their companies had avoided seeking opportunities in several countries because of high local taxes. Examples cited were Nigeria's 85-percent income tax rate and India's 63-percent rate. Usually, the high tax rate was not the sole reason cited for avoiding a specific

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1/See "International Taxation of Oil Production: Some Current Issues," Exploration and Economics of the Petroleum Industry, T. R. Stauffer, 1978.

country; other disincentives were also present, but taxes were a factor in the equation. Other countries mentioned in this regard were the United Kingdom and Canada, both of which in the past had increased their taxes and toughened the financial terms of their concession contracts to the point that private investment and the exploration and discovery rates began to decline. Exploration by foreign companies had virtually stopped in Canada before the Canadian Government reversed itself and put together a program of incentives designed to increase exploration, especially in the frontier areas. The Province of Alberta also offered an incentive package. These programs were very successful in increasing exploration and discoveries.

#### Limited access to prospective areas

Another reason a number of major prospective areas have not been explored or have not been fully explored is that private oil companies have been denied access to the areas. Several different causes have contributed to this situation.

#### Exclusionary policies

Several major prospective oil producing countries have chosen to rely exclusively or almost exclusively on their own national oil companies for all petroleum exploration, production, and sales. Mexico is the primary example of this approach; its government nationalized private oil holdings in 1938 and all domestic oil operations since then have been managed by PEMEX, the state oil company. Private firms are occasionally used as service contractors but do not participate in any major way in investment decisions.

Although U.S. oil professionals are fairly unanimous in their respect for PEMEX's present capabilities, some pointed out that it has taken PEMEX a long time to reach its current level of proficiency. During its long learning period, petroleum exploration, discovery, and development in Mexico lagged far behind those countries where the major oil companies were permitted to operate.

But these policies are not always static. For example, Brazil, Argentina, and Chile followed a policy of total exclusion of foreign companies after the early 1950s. After world oil prices rose drastically in 1973-74, all three countries reversed these policies and tried to encourage foreign investment in order to accelerate the production of domestic oil resources. Their success in attracting private companies has been mixed, partly because of geological uncertainties, particularly in Chile, but also because of residual mistrust over the change in government policies and the need to establish new government/industry relationships.

A less severe form of exclusion is the restriction of acreage available to foreign companies or the reservation of the best

acreage for the state oil companies. The purpose of such policies is generally to give state oil companies an advantage over the competition in order to allow domestic oil industries to develop. Such exclusionary policies appear to be in effect in Argentina, Bolivia, Brazil, Chile, Bangladesh, Vietnam, the Philippines, Pakistan, and Italy and in the United Kingdom's North Sea. The effectiveness of these policies depends on the capabilities of the host countries' national oil companies, which, all too often, are limited.

#### Boundary or territorial disputes

A number of promising areas have not been available for exploration because of territorial and/or boundary disputes. The prospect of commercial oil production often raises the value of the disputed area and thus complicates resolution of such problems. These problems have been particularly intractable to international resolution.

DOE 1/ and other sources identified the following major problem areas.

- The offshore areas extending from the Yellow Sea to the South China Sea is a patchwork of overlapping claims and concessions involving Japan, Korea, the People's Republic of China, Vietnam, the Philippines, Taiwan, and Malaysia. The State Department has warned companies that the United States will not protect operations in these disputed areas.
- The Gulf of Suez: Although Egypt and Israel have reached agreement on the Sinai oil fields, both countries claim sovereignty over the offshore areas in the southern part of the Gulf of Suez; both countries have exploration agreements with private companies for this area, but little exploration has been possible because of the dispute.
- The Falkland Islands, currently under United Kingdom sovereignty, are claimed by Argentina. Despite good geological potential, no activity can be expected until the dispute has been resolved.
- Libya and Tunisia have a border dispute in a potentially productive offshore area.
- Greece and Turkey have a dispute over the Northern Aegean Sea, another promising area.
- Italy has unresolved boundary issues with France, Spain, Libya, Tunisia, Algeria, Yugoslavia, Albania, and Greece covering the major portion of the Mediterranean Sea.

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1/See footnote 1 on p. 65 .

Italy has delayed seeking resolution of most of these problems awaiting the outcome of the Law of the Sea Conference. Lack of resolution of legal jurisdiction over the Mediterranean continental shelf has undoubtedly retarded exploration there.

--The Barents Sea is disputed between the Soviet Union and Norway.

--Malta and Libya have a boundary dispute in the Mediterranean Sea.

On the other hand, recent settlement of boundary disputes has opened for exploration (1) a large area west of Kyushu Island off Southwest Japan that had been subject to conflicting claims of South Korea and Japan and (2) the British side of the western approaches to the English Channel.

#### Home government foreign policy

According to DOE, U.S. companies are precluded from returning to offshore exploration in Vietnam for foreign policy reasons. Before the war, several companies had been exploring there with some success. The United States has also embargoed the sale of U.S. equipment for use in Vietnam. Given the dominance of U.S. suppliers in the petroleum equipment industry, the embargo has hampered efforts of foreign companies, such as Bow Valley (Australia), AGIP (Italy), and Deminex (Germany), in Vietnam.

#### LACK OF EXPORT POTENTIAL

The major oil companies generally seek access to crude oil supplies for their own markets, and lack of export prospects is a disincentive. This constraint is a major factor in some countries, particularly those which lack infrastructure (i.e., suitable roads, supply points, pipelines, and trained manpower). Small discoveries located far from ports, mines, or other good sites for export terminals may be considered uneconomical by the companies because of the higher costs of operations in these difficult environments.

Despite the lack of export potential, smaller finds might still have the potential of supplying a significant share of local oil needs. Such domestic oil production might displace a comparable volume of imported oil and thus have the same net beneficial impact on world oil balances as would additional export production.

Chad, the Congo Basin of Zaire, and the interior of Sudan are examples of LDCs that may have potential for significant production but whose export potential might not justify development because of difficult terrain and distances from possible export terminals.

Several South American countries, notably Brazil, Argentina, and Chile, are seeking oil development primarily for domestic consumption. Even attractive financial terms may be insufficient for companies seeking crude supplies rather than contract work.

#### OBSERVATION

Diversification of foreign supply sources has been suggested as a possible means of reducing the adverse effects of foreign oil dependency. In our opinion, however, it is not a viable short-range strategy. On the other hand, there is potential for source diversification in the mid- to long-term (beyond 5 to 7 years from now), provided that new sources can be developed in countries that are currently nonproducers or low producers and that current producers outside the Middle East and North Africa, such as Mexico and the North Sea countries, continue to increase their export capacities.

The key to discovering and developing new oil production sources is the aggressive acceleration of worldwide petroleum exploration. This can be achieved only if obstacles to such exploration which have been raised by governments are removed or reduced. These obstacles include the expropriation of private assets when exploration is successful, excessive rates of taxation by host governments, an uncertain U.S. tax policy, and exclusionary host-government policies.

The executive and legislative branches will need to consider U.S. oil company operations in foreign countries as an issue to be factored into relationships with these countries. The United States should seek better understanding of the needs and concerns of both the companies and their potential host governments (especially LDCs). It should then seek through both bilateral and multilateral channels to favorably influence LDC government attitudes and policies concerning private investment in petroleum exploration and development. The United States should also explore ways of helping LDCs to increase the commercial viability for private development of small oil fields with little or no export potential--perhaps through such means as risk-sharing arrangements that could reduce the threshold of economic viability or through reciprocal tax agreements with the LDC government that would enable it to reduce its tax demands and again lower the breakeven point for the company.

COUNTRY-BY-COUNTRY ASSESSMENT OF OBSTACLES TO  
ACCELERATED OIL PRODUCTION, AND ESSENTIAL INDICATORS<sup>1</sup>

Country	Active rigs, March 1979	Active companies	Investment obstacles	Comments
<b>I. Net oil exporters:</b>				
Mexico.....	196	None.....	Exclusionary policies.....	Despite the ban on foreign investment in oil and gas, Mexican capabilities are good, and exploration and production are proceeding rapidly.
Egypt.....	20	Amoco, Exxon, Deminex, Shell, Mobil, others.....	Boundary disputes.....	Egypt has consistently offered attractive terms to investors, and with the exception of the Gulf of Suez dispute, production is rising rapidly.
Trinidad.....	17	Amoco, Texaco, Tesoro.....	None.....	Trinidad has consistently offered attractive terms to investors and is one of the most densely drilled countries in the world.
Malaysia/Brunei.....	21	Exxon, Shell, others.....	U.S. tax law, contract disagreements, boundary disputes.....	Exxon activity in Malaysia was disrupted in 1975 when the Government converted to production-sharing. Agreement was reached in 1976 and the difficult period appears over.
Angola.....	6	Gulf, Texaco.....	Political instability.....	Production declined drastically during the 1975/76 civil war, but oil operations have now resumed.
Tunisia.....	5	Shell, Elf/Aquitaine, others.....	Boundary disputes.....	No significant problems other than the dispute with Libya.
Bolivia.....	6	Occidental, Tesoro.....	Political instability, exclusionary policies, contract disagreements, lack of export potential.....	Basic government/industry disagreements persist, severely restricting the rate of exploration and development of new structures.
Congo.....	0	Elf, AGIP, Getty, others.....		Despite an extreme government, the primary limitation on new production will be geology.
Syria.....	14	Mobil, Marathon, others.....	Restrictive policies, political instability.....	The Government opened a substantial acreage to foreign investment in 1975, and some activity is underway. Geological prospects, however, appear limited.
Zaire.....	0	Gulf, Shell, Amoco.....	Political instability, lack of export potential.....	Continued political and security problems in Zaire, combined with the substantial uncertainties of future potential have limited investor interest.
<b>II. Oil importers with very high potential:</b>				
Argentina.....	57	CEP, Deminex.....	Exclusionary policies, boundary disputes, lack of export potential, political instability.....	Although geological prospects are favorable, Argentina has restricted foreign investment to a secondary role, offering only limited acreage and strict terms.
Brazil.....	59	BP, Shell, Exxon, Elf, others.....	Exclusionary policies, lack of export potential.....	Brazil has also restricted the role of foreign investment, offering limited acreage and strict terms.
Chile.....	5	Phillips, Arco, Amerada Hess.....	Exclusionary policies, lack of export potential.....	Chile has also restricted the role of foreign investment, offering limited acreage and strict terms.
Colombia.....	12	Exxon, Occidental, Mobil, Texaco, others.....	Contract disagreements, lack of export potential.....	Colombia's investment climate has been subject to frequent change based on internal political considerations. Prospects for identifying new structures are limited.
India.....	40	None.....	Exclusionary policies.....	India has elected to forego the higher development rates possible through foreign investment and has chosen instead to rely on indigenous capabilities.
Peru.....	22	Occidental, others.....	Political instability, U.S. tax law, contract disagreements.....	Exploration and development have proceeded slowly as a result of strained industry/government relations.
Chad.....	1	Conoco.....	Political instability, lack of export potential.....	Discoveries in the interior may not be economical for export, but might be used for domestic needs. The country faces civil strife in the capital and insurrection in the north.
Philippines.....	13	Cities Service, Amoco, Shell, others.....	Political instability, lack of export potential, boundary disputes, contract disagreements.....	Exploration and development are proceeding slowly as a government/industry relationship is developed.
Thailand.....	2	Shell, Exxon, others.....		Activity is significant, but exploration in the Gulf of Thailand has yielded primarily gas.
Vietnam.....	2	AGIP, Deminex, others.....	Political instability, boundary disputes, U.S. foreign policy.....	Exploration in offshore areas has resumed, but is severely hampered by local warfare and U.S. restrictions.
Niger.....	5	Exxon, Texaco, Elf/Aquitaine, others.....		Exploration activity is high, and prospects are good.
<b>III. Net Oil Importers with High Potential:</b>				
Afghanistan.....	0	None.....	Exclusionary policies, political instability.....	The recent advent of a pro-Soviet government and continued civil strife limit the potential for new exploration. At least one U.S. company is holding discussions with the Government, and future activity cannot be ruled out. The Soviets have an active gas operation in the north.
Bangladesh.....	2	Union, others.....		Seismic exploration is underway with a recent large gas discovery.
Turkey.....	13	Mobil, Shell, others.....	Political instability, boundary disputes.....	Significant exploration is underway. Some promising areas in the Aegean are under dispute with Greece.
Cameroon.....	3	Mobil, Shell, Gulf, CFP, others.....		Substantial activity is now underway, and prospects are good.
Guatemala.....	0	Elf/Aquitaine, Texaco, Amoco, Getty, others.....		
Ghana.....	0	Phillips, AGIP, Getty, others.....	Political instability.....	The civil war precludes activity.
Lebanon.....	0	None.....	Political instability.....	
Sudan.....	2	Socal.....	Lack of export potential.....	Sudan has consistently offered attractive terms to investors. Resource potential in the interior may not be economical for export.
Yemen, Peoples' Democratic Republic.....	0	None.....	Exclusionary policies, political instability.....	No foreign investment has yet been permitted.

<sup>1</sup> From Department of Energy Sept. 6, 1979, report: Accelerated Development of Oil and Gas Production in Non-OPEC Countries.



OPEC MEMBERS

<u>Country</u>	<u>Date of membership</u>
Algeria	1969
Ecuador	1973
Gabon	1973 (Associate)
	1975 (Full membership)
Indonesia	1962
Iran	1960
Iraq	1960
Kuwait	1960
Libya	1962
Nigeria	1971
Qatar	1961
Saudi Arabia	1960
United Arab Emirates	1974
Venezuela	1960
(Abu Dhabi)	1967 (Membership transferred to United Arab Emirates in 1974)

OAPEC MEMBERS  
(note a)

Algeria  
 Bahrain  
 Egypt (note b)  
 Iraq  
 Kuwait  
 Libya  
 Qatar  
 Saudi Arabia  
 Syria  
 United Arab Emirates

a/OAPEC was established in 1968 by these countries.

b/Egypt was a member until Apr. 1979.

U.S. CRUDE IMPORTS BY COUNTRY OF ORIGIN  
1978

<u>Country</u>	<u>(Thousands of barrels ranked in order)</u>	<u>Percent</u>
+*1. Saudi Arabia	414,474	18.22
*2. Nigeria	326,656	14.36
+*3. Libya	229,363	10.10
+*4. Algeria	225,188	9.90
*5. Iran	198,500	8.72
*6. Indonesia	181,837	7.99
+*7. United Arab Emirates	138,100	6.07
8. Mexico	115,428	5.07
9. Canada	89,875	3.95
*10. Venezuela	64,185	2.82
11. United Kingdom	60,554	2.66
12. Trinidad	51,509	2.26
13. Norway	38,327	1.68
+*14. Qatar	22,806	1.00
+*15. Iraq	22,211	0.98
16. Oman	21,640	0.95
*17. Ecuador	14,015	0.62
*18. Gabon	13,841	0.61
19. Malaysia	13,113	0.58
+ 20. Egypt	7,395	0.33
21. Peru	6,584	0.29
22. Tunisia	4,338	0.19
23. Congo (Brazzaville)	3,454	0.15
+ 24. Syria	2,530	0.11
25. Angola	2,290	0.10
26. Brunei	2,058	0.09
+*27. Kuwait	1,718	0.08
28. Cameroon	885	0.04
29. Chile	584	0.03
30. Netherlands	478	0.02
31. Bolivia	308	0.01
32. U.S.S.R.	276	0.01
33. Zaire	263	0.01
TOTAL	<u>2,274,783</u>	<u>100.00</u>

+ OAPEC Countries

\* OPEC Countries

Source: Department of Energy

PETROLEUM PRODUCING COUNTRIES AS OF 1978

<u>Country</u>	<u>Major fields</u>	<u>Total wells (note a)</u>	<u>Discovery dates</u>	
			<u>First</u>	<u>Last</u>
Abu Dhabi	9	240	1960	1971
Algeria	43	1,282	1956	1974
Angola	11	248	1966	1975
Argentina	10	6,020	1907	1969
Australia	7	407	1961	1969
Austria	14	1,531	1938	1976
Bahrain	1	260	1932	-
Barbados	2	23	1966	-
Bolivia	12	286	1927	1976
Brazil	21	2,230	1941	1973
Brunei	6	792	1929	1970
Burma	5	439	1902	1970
Cameroon	1	13	1974	-
Canada	24	25,800	1913	1965
Chile	11	670	1950	1962
Colombia	27	2,370	1918	1976
Congo	3	151	1957	1972
Denmark	1	18	1971	-
Divided Zone	7	455	1953	1969
Dubai	2	80	1966	1970
Ecuador	7	1,028	1921	1970
Egypt	25	502	1938	1977
France	12	409	1949	1974
Gabon	19	310	1956	1973
Ghana	1	6	1977	1977
Guatemala	3	4	1972	1977
India	19	1,600	1890	1974
Indonesia	111	8,112	1893	1976
Iran	37	752	1908	1974
Israel	3	26	1963	1977
Iraq	14	250+	1909	1973
Italy	5	204	1954	1973
Japan	5	743	1958	1972
Kuwait	8	586	1938	1963
Libya	38	1,492	1959	1978
Malaysia	11	188	1911	1975
Mexico	84	3,507	1901	1978
Morocco	1	23	1957	-
The Netherlands	5	648	1943	1957
New Zealand	1	11	1959	-

## APPENDIX IV

<u>Country</u>	<u>Major fields</u>	<u>Total wells</u>	<u>Discovery dates</u>	
			<u>First</u>	<u>Last</u>
Nigeria	125	1,627	1958	1976
Norway	4	51	1968	1970
Oman	10	312	1963	1975
Pakistan	5	17	1937	1968
Peru	17	7,103	1869	1977
Philippines	1	5	1977	1977
Qatar	4	105	1940	1970
Republic of China	3	91	1959	1971
Saudi Arabia	15	1,228	1938	1971
Sharjah	1	4	1972	-
Spain	3	32	1964	1972
Syria	5	476	1956	1974
Thailand	1	18	1963	-
Trinidad - Tobago	20	8,301	1903	1974
Tunisia	5	107	1964	1972
Turkey	21	496	1940	1974
United Kingdom	10	180	1955	1974
United States	195	b/508,340	1859	1978
U.S.S.R.	17	21,790	1948	1973
Venezuela	64	21,774	1914	1963
West Germany	35	2,993	1899	1969
Zaire	2	13	1970	1973

a/ Includes shut-in wells.

b/ Only producing wells.

Source: World Petroleum Encyclopedia  
Oil and Gas Journal, Dec. 31. 1979

WORLD ESTIMATED PROVED OIL RESERVES  
IN DESCENDING ORDER

<u>Country or area</u>	<u>Estimated proved reserves</u> <u>Jan. 1, 1980</u> (1,000 bbl)	<u>Producing wells</u> <u>July 1, 1979</u>	<u>Estimated 1979 production</u> (1,000 bpd)	<u>Percent change from 1978</u>
Saudi Arabia	163,350,000	725	9,250.0	+14.8
U.S.S.R.	67,000,000	NA	11,670.0	+ 2.1
Kuwait	65,400,000	590	2,210.0	+18.6
Iran	58,000,000	547	2,900.0	-44.3
Mexico	31,250,000	4,200	1,490.0	+23.4
Iraq	31,000,000	250	3,370.0	+28.2
Abu Dhabi	28,000,000	250	1,450.0	-
United States	26,500,000	508,000	8,650.0	- 0.2
Libya	23,500,000	896	2,050.0	+ 2.9
China	20,000,000	NA	2,100.0	+ 7.2
Venezuela	17,870,000	12,486	2,330.0	+ 7.7
Nigeria	17,400,000	1,457	2,370.0	+24.1
United Kingdom	15,400,000	240	1,570.0	+21.4
Indonesia	9,600,000	3,823	1,600.0	- 2.4
Algeria	8,440,000	970	1,240.0	+ 1.2
Canada	6,800,000	18,323	1,480.0	+11.8
Neutral Zone	6,260,000	423	560.0	+20.2
Norway	5,750,000	50	390.0	+11.2
Qatar	3,760,000	95	480.0	+ 2.4
Egypt	3,100,000	432	500.0	+ 3.3
Other communist*	3,000,000	NA	370.0	- 2.6
Malaysia	2,800,000	227	270.0	+22.7
India	2,600,000	1,600	240.0	+ 6.7
Argentina	2,400,000	6,424	470.0	+ 2.6
Oman	2,400,000	254	290.0	- 7.9
Tunisia	2,250,000	63	105.0	+ 5.0
Australia	2,130,000	370	440.0	+ 1.9
Syria	2,000,000	513	165.0	- 2.9
Brunei	1,800,000	592	255.0	+13.6
Dubai	1,400,000	79	360.0	-
Brazil	1,220,000	1,605	165.0	+ 3.1
Angola-Cabinda	1,200,000	176	143.0	+ 9.2
Ecuador	1,100,000	472	220.0	+ 8.9
Colombia	710,000	2,111	125.0	- 4.6
Trinidad & Tobago	700,000	3,323	215.0	- 7.3
Peru	655,000	2,766	195.0	+27.5
Italy	645,000	121	33.0	+10.0
Gabon	500,000	218	192.0	-14.7
West Germany	480,000	2,945	95.0	- 4.0
Chile	400,000	431	18.0	-
Congo Republic	400,000	113	57.0	+72.7
Denmark	375,000	18	12.0	+20.0
Yugoslavia	275,000	NA	70.0	-12.5
Bahrain	240,000	233	50.0	- 5.7

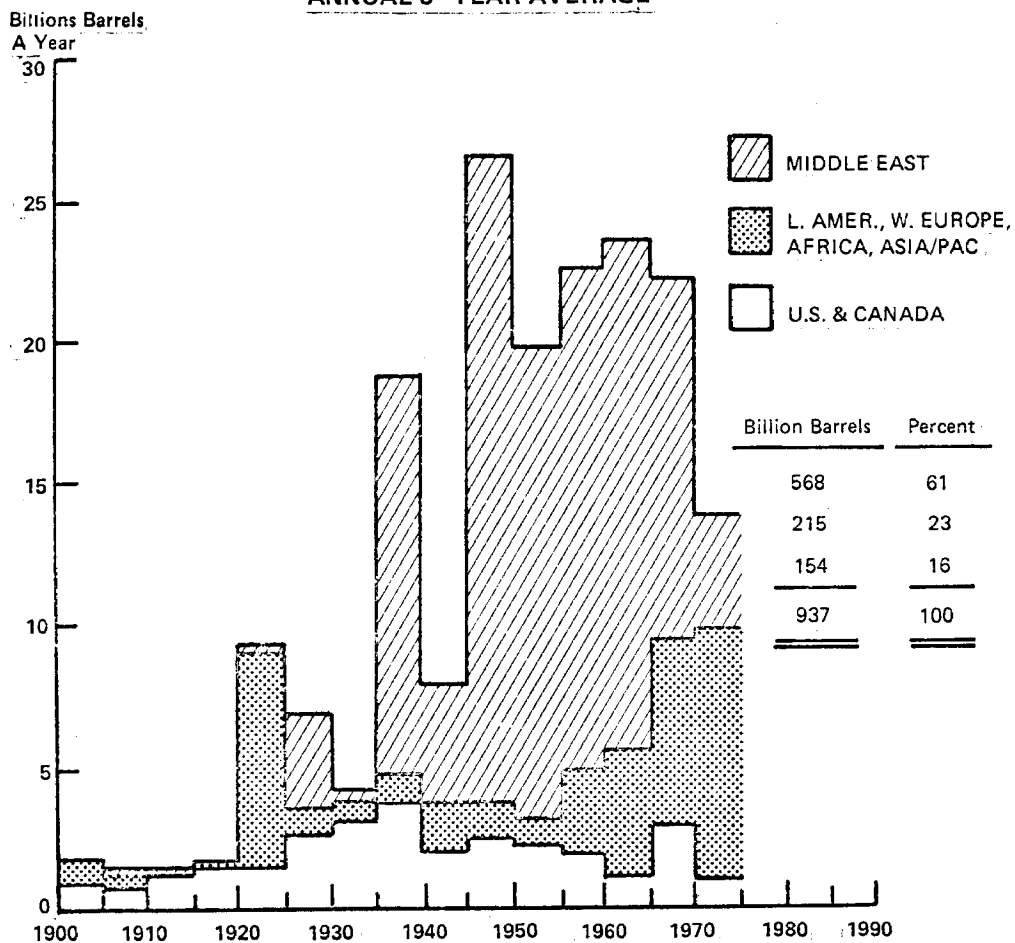
## APPENDIX V

<u>Country</u>	<u>Estimated proved reserves Jan. 1, 1980 (1,000 bbl)</u>	<u>Producing wells July 1, 1979</u>	<u>Estimated 1979 production (1,000 bpd)</u>	<u>Percent change from 1978</u>
Pakistan	200,000	18	11.0	+10.0
Bolivia	150,000	180	30.0	- 9.1
Greece	150,000	-	-	-
Spain	150,000	27	15.0	-16.7
Austria	141,400	1,254	36.0	+ 2.9
Cameroon	140,000	29	32.0	+200.0
Zaire	135,000	11	21.0	+ 5.0
Turkey	125,000	402	56.0	+12.0
New Zealand	110,000	17	16.0	+23.1
Netherlands	60,000	473	25.0	-16.7
Japan	55,000	507	10.0	-
France	50,000	293	20.0	-
Burma	25,000	445	30.0	+20.0
Philippines	25,000	5	15.0	-
Guatemala	16,000	1	1.6	-
Sharjah	11,300	4	15.0	-31.8
Taiwan	10,200	80	5.0	-
Ghana	7,000	6	3.5	-
Barbados	1,500	31	0.8	-
Israel (note a)	1,000	16	30.0	+172.7
Morocco	<u>100</u>	<u>1</u>	<u>0.5</u>	-
<b>TOTAL</b>	<b><u>641,623,500</u></b>	<b><u>582,211</u> +</b>	<b><u>62,588.4</u></b>	<b>+ 3.6</b>
Total Asia	19,355,200	7,684	2,892.0	+ 2.8
West Europe	23,476,400	5,421	2,266.0	+29.6
Middle East	361,947,300	4,381	21,186.0	+ 0.2
Africa	57,072,100	4,372	6,714.0	+ 9.5
Latin America & Carribean	56,472,500	34,030	5,260.4	
w/U.S. & Can.	89,772,500	560,353	15,390.4	+ 4.3
Communist	90,000,000	NA	14,140.0	+ 2.5

a/Includes Sinai fields returned to Egypt in late 1979.

Source: Oil and Gas Journal, Dec. 31, 1979.

**FREE WORLD OIL DISCOVERY HISTORY**  
**ANNUAL 5-YEAR AVERAGE**



SOURCE: EXXON

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