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DEVELOPMENT AND INTERNATIONAL ECONOMIC COOPERATION: DEVELOPMENT OF THE ENERGY RESOURCES OF DEVELOPING COUNTRIES

Energy exploration and development trends in developing countries

Report of the Secretary-General

SUMMARY

In its resolution 45/209 of 21 December 1990, the General Assembly welcomed the report of the Secretary-General on energy exploration and development trends in developing countries and the outline of a programme of action for the acceleration of energy exploration and development in developing countries; called upon interested Member States, in cooperation with the appropriate organs, organizations and bodies of the United Nations system, to continue to explore ways and means to support the efforts of developing countries in the exploration and development of their energy resources; and requested the Secretary-General to submit a comprehensive report on the implementation of the resolution.

The present report analyses trends in energy consumption and production in the developing countries and focuses on problems and issues over the next 20 years, with particular reference to the energy-deficient developing countries.

* A/47/50.

Recent trends in energy consumption, particularly in the developing countries of Asia that have experienced considerable economic growth, have further demonstrated that development will be accompanied by higher energy intensities.

Oil and gas will continue to dominate energy balances in developing countries. High growth in electricity consumption will require a near doubling of installed production capacity by the year 2000. In order to meet the expected growth in energy demand, developing countries will face massive capital mobilization requirements, which may be exacerbated by environmental considerations.

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Abbreviations and symbols used

1.	b/d	barrels per day
2.	bmt	billion metric tons
3.	C.Eur.	Central Europe
4.	C.I.S.	Commonwealth of Independent States
5.	DCs	Developing Countries
6.	DMEs	Developed Market Economies
7.	E.Eur.	Eastern Europe
8.	GDP	Gross Domestic Product
9.	Lat.Amer.	Latin America
10.	mb/d	millions barrels per day
11.	Mid.East	Middle East
12.	mtoe	million metric tons of oil equivalent
13.	N.Amer.	North America
14.	OExDCs	Oil Exporting Developing Countries
15.	OIDC	Oil Importing Developing Countries
16.	OPEC	Organisation of Petroleum Exporting Countries
17.	U.S.A.	United States of America
18.	UAE	United Arab Emirates
19.	W.Eur.	Western Europe
20.	%	per cent

I. INTRODUCTION

1. Since the previous report of the Secretary-General which was submitted during the first half of 1990 (A/45/274-E/1990/73 and Corr.1), the crisis in the Persian Gulf and political developments in Central and Eastern European countries and the former USSR have had considerable direct and indirect impact on energy exploration and development in the developing world.

2. Following the invasion of Kuwait by Iraq on 2 August 1990, the trade embargo imposed by Security Council resolution 661 (1990) cut off more than 4 million barrels per day (mb/d) of exports from these two countries or 7 per cent of world consumption. This, and market speculation, resulted for a while in a doubling and tripling of oil prices with consequent shock effects on many oil importing developing countries.

3. In the message of the Secretary-General to the Ministerial Seminar of Petroleum Producers and Consumers, which was held in Paris on 1 and 2 July 1991 at the joint invitation of the Governments of France and Venezuela, it was stated 1/ that:

> "The recent crisis has brought to the fore, once again, the vulnerability of these countries, especially the least developed countries among them. The Security Council's decision to impose sanctions on Iraq has had a grave impact on the economies of the developing world, causing more than 20 countries to seek recourse under Article 50 of the Charter. The developed market economies had ample strategic oil reserves and commercial stockpiles. The developing world and the countries of Central and Eastern Europe had no adequate stocks of their own and had to bear the negative consequences."

4. The decision of member countries Organization of Petroleum Exporting Countries (OPEC) at their meeting in August 1990 to augment oil supplies by producing at full production capacity was taken with an explicit declaration that the objective was to meet the oil requirements of the developing world. 2/ While the loss of exports from Iraq and Kuwait was quickly made up with additional supplies from other member countries of OPEC, especially Saudi Arabia, many developing countries experienced shortages, with consequent losses of economic output. At the same time higher oil prices compounded the foreign exchange problem of these countries. It has been estimated that during the Persian Gulf crisis of August 1990 to January 1991 the incremental foreign exchange outlay for the oil imports of the developing countries amounted to as much as US$ 10 billion, or about a third more of their normal annual oil import bill. 3/ If these funds were to be invested in indigenous oil production they could augment supplies by 1 mb/d, or a doubling of current output. Scattered evidence suggests that special arrangements on a bilateral basis and loans from multilateral institutions cushioned the adverse impact in some developing countries. However, these measures fell short of requirements in view of the magnitude of the problem, especially in the least developed

countries and other developing countries, which suffered additional losses because of major trade relationships with Iraq and Kuwait.

5. Prior to the Persian Gulf crisis anticipation of continued economic growth and consequent increases in world oil demand had already led to the consideration of new arrangements between host oil exporting developing countries and international oil companies for new investments to expand production capacities. At the same time both oil exporting and importing developing countries, as well as the countries of Central and Eastern Europe and the former Soviet Union, had initiated measures for the reorganization and in some cases privatization of national oil enterprises and the provision of incentives for more direct foreign investments in their petroleum industries.

6. Much of this effort was stalled during the Persian Gulf crisis. Since then the deepening of economic recession in many of the developed market economies and depression in several of the formerly centrally planned economies of Central and Eastern Europe have led to only marginal increases in global oil demand and a drop in oil prices to their pre-Persian Gulf crisis levels. At the same time increasing environmental concerns, particularly with regard to the contribution of fossil fuels to carbon dioxide emissions and climate warming as well as intensive consideration of special taxes aimed at the reduction of fossil fuel consumption, have led to increasing uncertainties which have caused hesitations in commitments for large-scale capital intensive energy projects.

7. As emphasized in the previous report of the Secretary-General, analysis of trends on the demand side of the energy picture during the past two decades has clearly demonstrated that economic development in the developing world had been accompanied by higher energy intensities. In other words, more energy is needed now than previously for every US$ 1,000 of gross domestic product in the developing world (A/45/274-E/1990/73 and Corr.1, table 4). More recent trends in energy consumption, particularly in the fast growing developing economies of Asia have demonstrated further the validity of that conclusion.

8. Forecasts to the year 2010 prepared by the Secretariat indicate that energy demand in the developing countries will grow at an average annual rate of 4.4 per cent, which is much higher than the expected growth in the developed market economies of 1.8 per cent.

9. Half of the increase in world energy demand will be in the developing countries. The share of these countries in world energy consumption will increase to 35 per cent by the year 2010, as compared to 26 per cent in 1990. However, on a per capita basis, only marginal improvement can be expected in the current condition, where the level of energy consumption in the developing world is around 10 per cent of that in the developed market economies.

10. Oil will continue to dominate commercial energy consumption in the developing world. Coal will retain its overall position and it will be of great importance to a few countries, especially China and India. Natural gas

will strengthen its position as the third most important fuel and will be more widely used. The fast growth in electricity consumption, which is a worldwide phenomenon, will continue. In the absence of technological breakthroughs in new and renewable sources of energy, the contribution of such sources to the overall energy picture of the developing world will remain static, although the significance of biomass in rural areas and hydropower for overall electrification will continue. 4/

11. Massive capital investments and the application of modern technologies will be required in the energy sector of the developing countries in order to meet increasing domestic demand. Similar investments will be required in order to augment energy production capacities, particularly in oil and increasingly in natural gas for exports to the developed market economies and other net energy importing countries.

12. In view of the foreign indebtedness of so many of the developing countries, the magnitude of the scarcity of capital, which has extended even to the few traditionally capital-surplus oil exporting developing countries, reduced direct foreign investment and inadequate support from bilateral and multilateral financial sources, new arrangements will be required in order to promote international cooperation in this crucial field of the world economy.

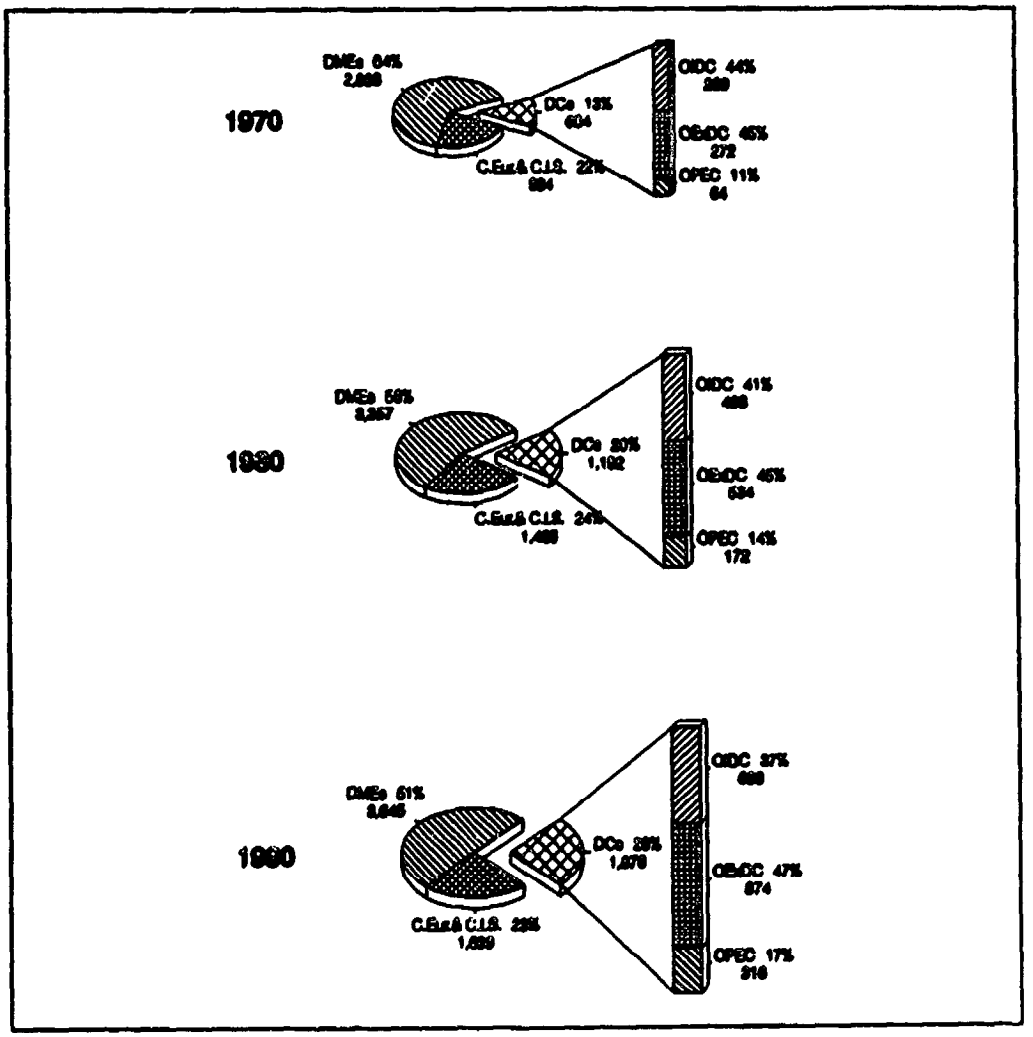
II. TRENDS IN ENERGY CONSUMPTION

13. The share of developing countries in the world commercial energy consumption has grown consistently over the past two decades, from 13 per cent in 1970 to 26 per cent in 1990, as shown in figure 1 and table 1, while the world commercial energy consumption increased by 60.3 per cent to a total of 7,189.8 million metric tons of oil equivalent (mtoe) in 1990.

14. During the period 1980-1990, consumption of commercial energy in developing countries increased by 57.4 per cent for an annual growth rate of 4.2 per cent. In comparison, energy demand in the developed market economies during the same period grew by only 8.6 per cent for an annual growth rate of 0.8 per cent. This disparity in growth patterns of commercial energy consumption is the result of energy conservation and efficiency measures as well as structural changes in the economies of the developed market economies that have experienced considerable economic growth rates with lower energy intensities. In the developing world, however, structural changes in their economies have invariably led to higher energy intensities per unit of economic output. These trends may be expected to continue until certain levels of national income are achieved that may be followed by less energy intensive structures.

Figure 1. Commercial primary energy consumption a/

(Million tons of oil equivalent)



Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

a/ C.Eur = Central Europe
CIS = Commonwealth of Independent States
DCs = Developing countries
DMEs = Developed market economies
OExDCs = Oil exporting developing countries
OIDC = Oil importing developing countries
OPEC = Organization of Petroleum Exporting Countries

Table 1. Commercial primary energy consumption

(Million tons of oil equivalent)

		1970	1980	1985	1989	1990
Developed market economies	Oil	1 432.0	1 665.3	1 493.0	1 613.3	1 600.1
	Gas	659.6	765.2	741.8	804.3	813.8
	Coal	718.4	784.2	880.8	992.7	991.0
	Electricity	77.9	142.1	200.7	231.3	240.5
	Total	2 887.9	3 356.8	3 316.3	3 641.6	3 645.4
Central Europe and the Commonwealth of Independent States	Oil	271.1	465.7	437.0	457.0	440.3
	Gas	192.2	385.6	548.3	623.7	640.9
	Coal	518.1	589.2	600.3	596.0	541.1
	Electricity	12.1	25.0	38.2	46.1	46.1
	Total	993.5	1 465.5	1 623.8	1 722.8	1 668.4
All developing countries	Oil	267.1	554.5	611.5	717.0	742.5
	Gas	49.6	131.9	182.0	254.0	265.0
	Coal	270.5	463 2	644.7	782.0	794.0
	Electricity	16.8	42.4	60.5	71.0	74.5
	Total	604.0	1 192.0	1 498.7	1 824.0	1 876.0
Members countries of OPEC	Oil	37.6	110.6	150.0	170.4	171.1
	Gas	24.2	57.6	81.4	125.7	134.7
	Coal	1.0	1.6	2.6	4.5	4.8
	Electricity	0.8	2.4	3.6	5.2	5.3
	Total	63.6	172.2	237.6	305.8	315.9
Oil exporting developing countries	Oil	70.0	163.6	192.1	230.0	239.7
	Gas	16.8	50.0	59.6	67.5	69.7
	Coal	179.8	310.3	427.7	534.3	545.9
	Electricity	4.9	10.3	15.2	18.1	18.8
	Total	271.5	534.2	694.6	849.9	874.1
Oil importing developing countries	Oil	159.5	280.3	269.4	316.6	331.7
	Gas	8.6	24.3	41.0	60.8	60.6
	Coal	89.7	151.3	214.4	243.2	243.3
	Electricity	11.1	29.7	41.7	47.7	50.4
	Total	268.9	485.6	566.5	668.3	686.0
Total world	Oil	1 970.2	2 685.5	2 541.5	2 787.3	2 782.9
	Gas	901.4	1 282.7	1 472.1	1 682.0	1 719.7
	Coal	1 507.0	1 836.6	2 125.8	2 370.7	2 326.1
	Electricity	106.8	209.5	299.4	348.4	361.1
	Total	4 485.4	6 014.3	6 438.8	7 188.4	7 189.8

Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

15. The composition of world commercial primary energy consumption by source and consumption patterns in 1990 by groups of countries are shown in figures 2 and 3. There were marked differences in consumption patterns among the various groups of countries, and among the developing countries the pattern of consumption varied significantly. In the OPEC member countries, oil and gas accounted for practically all of the primary energy consumed. Although coal accounted for a significant proportion in the consumption pattern of the non-OPEC developing countries, it should be noted that its use was dominant mainly in China and India only.

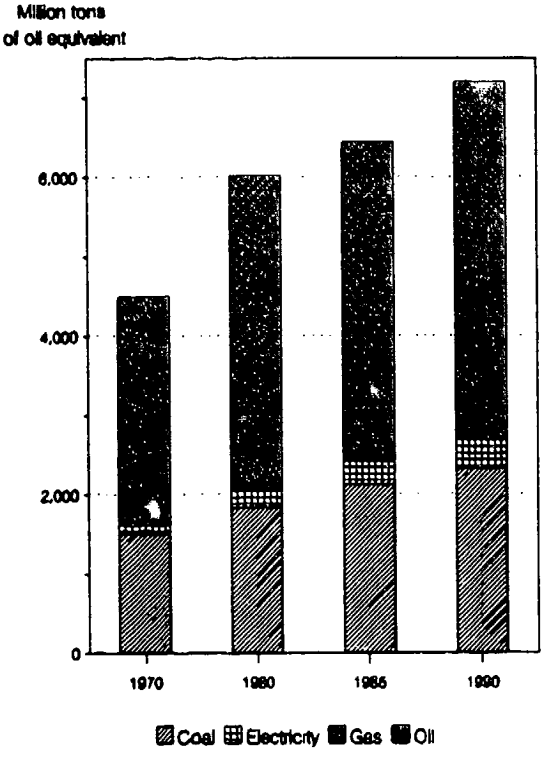
16. The per capita consumption of commercial energy in the developing countries continues to be very low, as shown in figure 4.

17. The level of commercial energy consumption in developing countries in 1990 as compared with 1985 increased by 377 mtoe, with coal contributing to this increase 149 mtoe, oil 131 mtoe, natural gas 83 mtoe and primary electricity 14 mtoe. These increases, except for electricity, were higher than in the developed market economies. Most of the developing countries continue to depend on oil as the major source for their commercial energy requirements: an increasing amount of oil has to be imported.

18. Historic oil demand data for the developing countries consuming more than 200,000 barrels per day of oil and ranked according to their levels of oil demand in 1990 are shown in table 2.

19. About 79 per cent of the oil demand of the developing countries in 1990 was accounted for by the 21 countries listed in table 2. During the period 1985-1990, much of the growth in oil demand was in the Asia and the Pacific region, with Malaysia, Pakistan and Taiwan Province of China registering annual growth rates of over 8 per cent, and the Republic of Korea and Thailand registering over 14 per cent. In China and India, oil demand rose by over 4 per cent annually in the period.

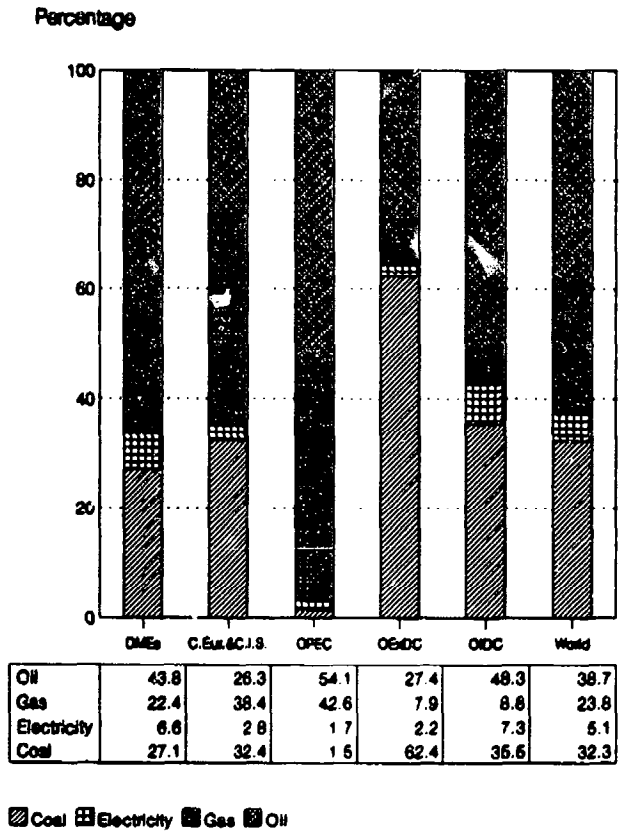
Figure 2. World consumption of commercial primary energy and its composition



	1970	1980	1985	1990	Change in primary energy source 1980 / 1970		1990 / 1980	
					mtoe	%	mtoe	%
Oil	1 970	2 686	2 542	2 783	716	36.3	97	3.6
Gas	901	1 283	1 472	1 720	382	42.4	437	34.1
Electricity	107	210	299	361	103	96.3	151	71.9
Coal	1 507	1 836	2 126	2 326	329	21.8	490	26.7

Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

Figure 3. Commercial energy consumption patterns 1990, by group of countries a/



	DMEs	C.Eur.&C.I.S.	OPEC	OExDC	OIDC	World
Oil	43.8	26.3	54.1	27.4	48.3	38.7
Gas	22.4	38.4	42.6	7.9	8.8	23.8
Electricity	6.6	2 8	1 7	2.2	7.3	5.1
Coal	27.1	32.4	1 5	62.4	36.6	32.3

Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

a/ C.Eur = Central Europe
CIS = Commonwealth of Independent States
DMEs = Developed market economies
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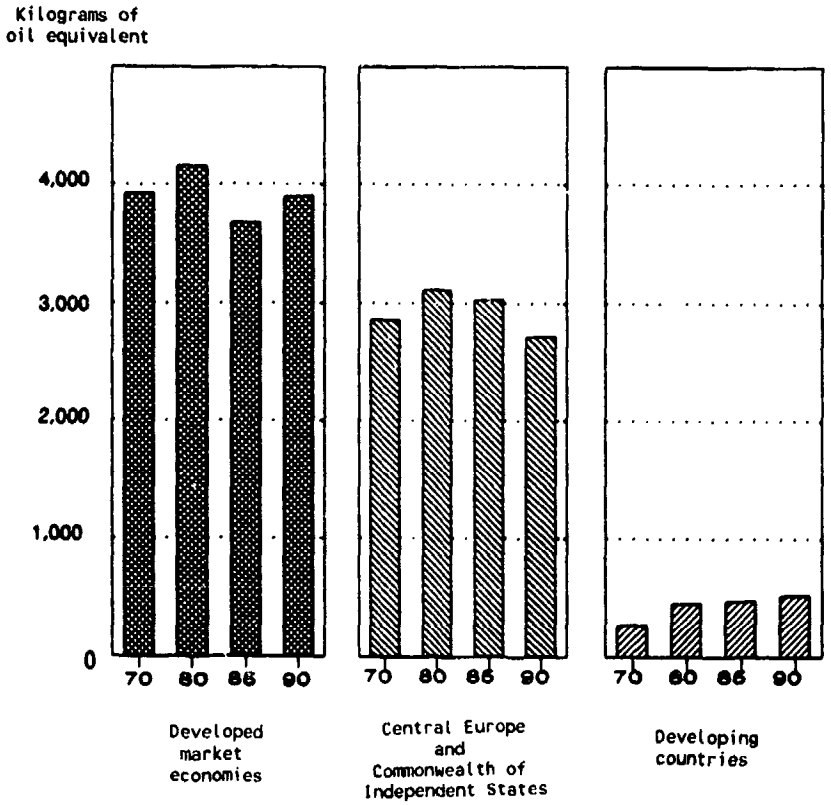
Figure 4. Per capita consumption of primary commercial energy



Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

Table 2. Oil demand in selected developing countries

	Thousands of barrels per day				Growth rates (percentage)		
	1980	1985	1989	1990	1980-1985	1985-1990	1989-1990
China	1 221	1 436	1 780	1 803	2.9	4.3	1.3
Mexico	1 083	1 258	1 458	1 524	2.7	3.5	4.5
Brazil	948	793	967	961	-2.7	3.5	-0.6
India	508	710	912	912	6.6	4.8	0.0
Republic of Korea	454	445	665	824	-0.4	14.2	24.0
Iran (Islamic Republic of)	493	602	786	807	3.7	5.7	2.7
Saudi Arabia	331	713	713	739	19.2	0.6	3.6
Indonesia	421	487	493	503	2.6	0.5	1.9
Taiwan Province of China a/	369	321	472	480 b/	-2.2	9.4	...
Thailand	230	215	333	400	-1.1	14.3	20.2
Egypt	237	316	379	390	5.6	3.9	2.8
Argentina	452	361	370	345	-3.4	-0.7	-6.9
Venezuela	354	406	345	342	2.4	-2.6	-0.8
Malaysia	153	181	227	275	3.0	8.7	21.4
Philippines	206	140	205	213	-5.3	8.7	4.1
Nigeria	136	148	220	212	1.5	7.2	-3.6
Singapore	167	152	187	211	-1.5	6.5	12.5
Cuba	189	194	221	210	0.5	1.4	-5.0
Iraq	124	132	246	209	1.1	9.7	-15.0
Pakistan	87	136	187	205	9.3	8.5	9.9
Total	8 164	9 146	11 166	11 565	2.0	3.7	3.5

Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

a/ Data from Annual oil market report, 1990, International Energy Agency.

b/ Estimate.

III. TRENDS IN ENERGY EXPLORATION, DEVELOPMENT AND PRODUCTION

A. Crude oil

20. Although oil supplies have become geographically more diversified over the past 20 years, with commercial deposits found in around 80 countries, the world's remaining oil is very unevenly distributed, with most of it located primarily in the Persian Gulf area. In terms of proved reserves, the Middle East, in particular in the Persian Gulf area, holds about two thirds of the world's reserves (see fig. 5). 5/ The large Arabian-Iranian downwarp sedimentary basin is the most petroliferous geological province in the world.

21. As shown in table 3 and figure 6, oil supplies from the developing countries have increased substantially over the past 20 years. Among the non-OPEC oil exporting developing countries, production has more than tripled (from 0.972 to 3.789 billion barrels per year between 1970 and 1991), improving their share of the total world's oil production from 5.9 per cent to 17.3 per cent. In the energy deficient developing countries, oil production has almost doubled, to over 0.764 billion barrels a year. 6/

22. Current total annual oil production from OPEC is about the same level as in 1970, but its share of the world total production has declined from a high of 51.2 per cent to 38.5 per cent. Nevertheless, the share of OPEC countries is expected to increase because of the magnitude of their proved reserves.

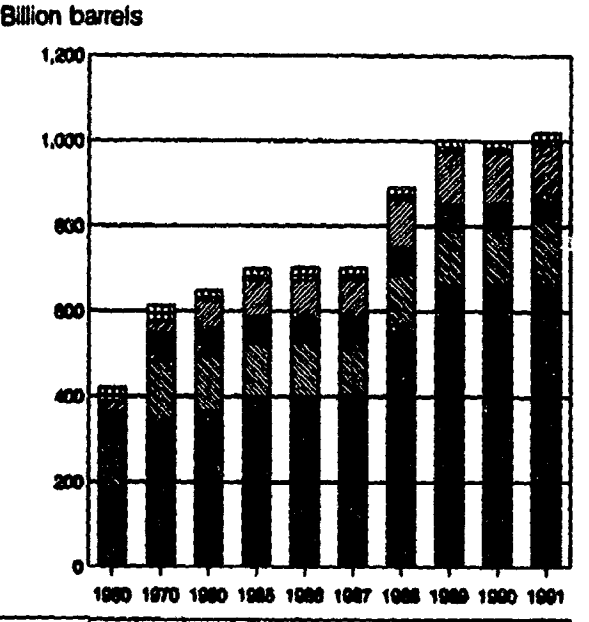
23. Increased production from non-OPEC countries between the mid-1970s and mid-1980s was based largely on substantial discoveries in four major areas, the North Sea, Mexico, Alaska and the Commonwealth of Independent States.

24. Most of the world's oil production comes from super giant fields containing in excess of 5 billion barrels of recoverable oil each. World wide only 38 of these super giant fields have been discovered but they contain over half of all the oil discovered to date. Although these 38 oil fields produced much the same in 1991 as in 1975, there is clear evidence that a number of those fields are already in decline. For example, Prudhoe Bay in Alaska and Samatlor in Russia have entered their decline phase, as has the developed part of the Ghawar field in Saudi Arabia. Also, some of the fields in the Islamic Republic of Iran have reportedly encountered problems with gas handling and water breakthrough. 7/

25. Another 300 or so giant oil fields contributed 30 per cent of the world proved reserves. The remaining 15 per cent or so of the world's reserves are contained in much smaller fields and the large majority of those fields do not significantly impact on world oil production.

Figure 5. World proved oil reserves

(At year end)



	1960	1970	1980	1985	1986	1987	1988	1989	1990	1991
USA	32	39	20	27	27	25	27	25	26	26
Latin America	25	28	69	83	84	89	114	125	121	120
Commonwealth of Independent States	63	63	63	63	61	59	59	58	57	57
Rest of the world	118	141	134	127	130	125	124	132	132	153
Middle East	185	344	362	396	398	402	564	660	663	692

Source: United Nations, Department of Economic and Social Development, based on the Oil and Gas Journal Energy Database.

Table 3. World crude oil production

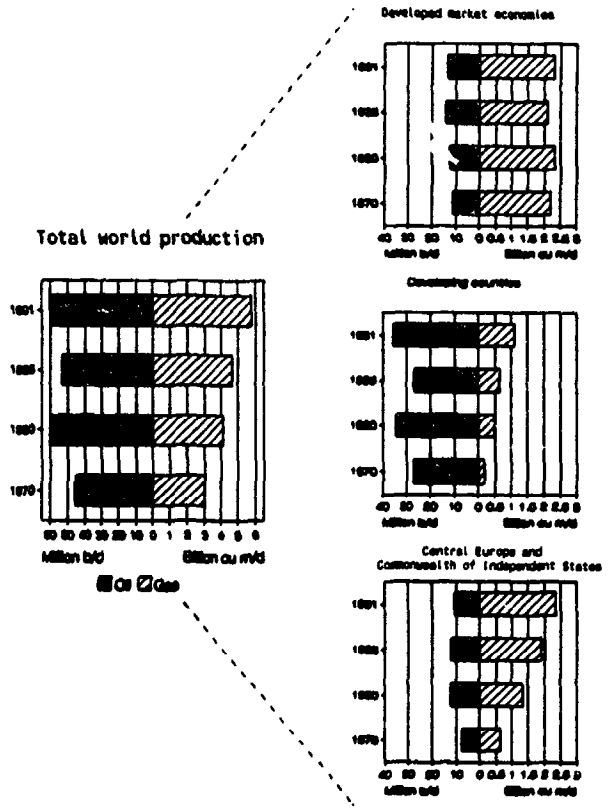
(Thousands of barrels)

Country	1970	1980	1985	1989	1990	1991
OPEC countries	8 508 939	9 781 765	5 869 571	7 922 802	8 476 760	8 521 574
Share of world total a/	51.2	45.0	30.2	36.6	38.5	39.0
Oil exporting developing countries	972 463	2 438 974	3 135 439	3 540 503	3 646 058	3 789 138
Share of world total a/	5.9	11.2	16.1	16.3	16.6	17.3
Energy-deficient developing countries	318 944	401 639	704 959	706 350	763 288	764 383
Share of world total a/	1.9	1.8	3.6	3.3	3.5	3.5
Developed market economies	4 102 900	4 598 943	5 242 650	4 926 110	4 844 572	4 973 673
Share of world total a/	24.7	21.1	27.0	22.7	22.0	22.7
Central Europe and Commonwealth of Independent States	2 707 504	4 525 270	4 466 163	4 577 465	4 285 465	3 820 820
Share of world total a/	16.3	20.8	23.0	21.1	19.5	17.5
World total	16 610 750	21 746 591	19 418 782	21 673 230	22 016 143	21 869 887

Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues, and Oil and Gas Journal, 30 December 1991.

a/ Percentage.

Figure 6. World oil and gas production a/



Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

a/ b/d = barrels per day
cu m/d = cubic metres per day

26. Oil production is distributed widely, as shown in table 4, where the countries are ranked in order of their projected ultimate recovery of 5 billion barrels and more. The oil contained in proved reserves at present could lead to a perception of an enormous resource base. However, if there are no additions to these reserves from new discoveries, maintaining and increasing production would come from additions that are incremental to existing production. Production from an oil field cannot be sustained indefinitely as production will reach a natural plateau and then decline. Even the largest of oilfields cannot sustain plateau production indefinitely.

27. In the short term production capacity can be increased through over-production, an accelerated rate of depletion of developed reserves, and by bringing back onstream shut-in production capacities, especially those in the OPEC Persian Gulf countries. This was the case in making up the shortfall in supply from the loss of production of about 4.3 mb/d from Kuwait and Iraq during the Persian Gulf crisis. Shut-in production capacity was rushed into service in the latter part of 1990 and early 1991. The need to make up the supply deficit allowed Saudi Arabia, the United Arab Emirates and other countries like Nigeria and Venezuela to produce at or near capacity. Saudi Arabia increased its production to 8.5 mb/d in the second half of 1990, and to an average daily production of 8.2 mb/d in 1991 from an average daily production of only 5.13 mb/d in 1989. With the loss of production from Kuwait and Iraq replaced and oil demand stalling for economic reasons, the oil market in 1991 was almost in balance, moderating the volatility of crude oil prices, which reached a peak of US$ 41/barrel not long after the Iraqi invasion but dropped to US$ 20/barrel through the end of 1991. The replacement production capacity has remained on stream since, albeit with little to spare.

28. Although the magnitude of world proved oil reserves has increased considerably during the past 30 years (see figure 6), most of the increases, especially during the second half of the 1980s, were due to revisions of estimates rather than the discovery of new oilfields. In fact new oil found has been much lower than total production during the period.

29. The primary reasons for the decline in the level of new field discoveries are the substantial decrease in exploration spending and the location of exploration activity. During the period 1985-1990, it is estimated that exploration spending by the largest 30 oil companies fell by 25 per cent. Major oil companies have been replacing their production in recent years mainly through acquisition of reserves. 8/

30. The location of exploration activity is also crucial. During the past decade exploration activity has been concentrated in and around known areas, in many cases mature areas where the largest fields had already been found. New oil and gas reserves will not be found unless new areas are explored or oil companies have sufficient incentives to explore the more costly or technically complex possibilities in known provinces.

Table 4. World oil distribution

(Billion barrels)

Country	Cumulative production	1991 production	Proved reserves	Reserves: production ratio	Probable a/ reserves addition	Remaining oil	Total oil
Saudi Arabia b/	62.4	3.03	257.8	86:1	42	299.8	362.20
Commonwealth of Independent States	112.2	3.74	57.0	15:1	124	181.0	293.20
United States of America	158.0	2.69	26.3	10:1	71	97.3	255.30
Iran, Islamic Republic of b/	39.1	1.22	92.9	76:1	52	144.9	184.00
Iraq b/	22.4	1.03 c/	100.0	100:1	45	145.0	167.40
Venezuela b/	44.7	0.85	59.0	69:1	38	97.0	141.70
Kuwait b/	26.5	0.64 c/	94.0	147:1	4	98.0	124.50
United Arab Emirates b/	12.6	0.88	98.1	111:1	49	147.1	159.70
Mexico	17.5	1.01	52.0	51:1	52	104.0	121.50
China	15.7	1.02	24.0	24:1	48	72.0	87.70
Canada	14.3	0.56	5.6	10:1	33	38.6	52.90
Libyan Arab Jamahiriya b/	17.4	0.55	22.8	41:1	8	30.8	48.20
Nigeria b/	13.4	0.68	17.9	26:1	9	26.9	40.30
Indonesia b/	13.7	0.52	6.6	13:1	10	16.6	30.30

Table 4 (continued)

Country	Cumulative production	1991 production	Proved reserves	Reserves: production ratio	Probable a/ reserves addition	Remaining oil	Total oil
Norway	4.0	0.68	7.6	11:1	22	29.6	33.60
United Kingdom of Great Britain and Northern Ireland	10.3	0.65	4.0	6:1	13	17.0	27.30
Algeria b/	8.3	0.29	9.2	32:1	2	11.2	19.50
Egypt	5.2	0.32	4.5	14:1	5	9.5	14.70
India	3.0	0.24	6.1	25:1	3	9.1	12.10
Brazil	2.9	0.23	2.8	12:1	8	10.8	13.70
Australia	3.3	0.20	1.5	8:1	5	6.5	9.80
Oman	3.3	0.26	4.3	17:1	2	6.3	9.60
Argentina	5.3	0.17	1.1	19:1	2	3.1	8.40
Malaysia	2.2	0.23	3.1	13:1	4	7.1	9.30
Qatar b/	4.4	0.14	3.7	26:1	2	5.7	10.10
Colombia	3.1	0.16	2.0	12:1	2	4.0	7.10
Tunisia	0.8	0.04	1.7	43:1	4	5.7	6.50
Romania	4.7	0.05	1.2	24:1	1	2.2	6.90
Yemen	0.2	0.07	4.0	57:1	2	6.0	6.20
Ecuador b/	1.7	0.11	1.6	14:1	3	4.6	6.30
Angola	1.7	0.18	1.8	10:1	2	3.8	5.50

Table 4 (continued)

Country	Cumulative production	1991 production	Proved reserves	Reserves: production ratio	Probable a/ reserves addition	Remaining oil	Total oil
Brunei Darussalam	2.0	0.05	1.4	28:1	2	3.4	5.40
Peru	1.8	0.04	0.4	10:1	3	3.4	5.20
Trinidad and Tobago	2.6	0.05	0.5	10:1	2	2.5	5.10

Source: United Nations, Department of Economic and Social Development, based on the report, "Dominant Middle East oil reserves critically important to world supply", by J. P. Riva Jr., Oil and Gas Journal, 23 September 1991.

Note: Some countries, like Gabon and Cameroon, are not mentioned in the table owing to lack of information on probable reserves addition.

a/ Probable reserves addition are comprised of estimated field growth and undiscovered recoverable resources.

b/ OPEC member country.

c/ Annual oil productions of Iraq and Kuwait shown are for 1989, that is, prior to the Gulf War, for more realistic levels.

31. The geology of almost all of the world's sedimentary basins is at least partially known. Although substantial new oil remains to be discovered, geological inferences indicate that it is likely to be in smaller accumulations and widely scattered.

32. Many sedimentary basins in the developing world remain under-explored. This is due to several factors, including geological prospectivity with probability of smaller deposits, political instability, jurisdictional disputes with neighbouring States, pricing policies for domestic marketing and comparatively inadequate incentives for direct foreign investment in this sector. Yet for many oil importing developing countries even small oil discoveries could make all the difference in meeting their energy requirements without intolerable foreign exchange problems.

1. Member countries of OPEC

33. During the second half of the 1980s, large increases in oil reserves were announced in some member countries of OPEC: Saudi Arabia, Venezuela, Islamic Republic of Iran, Iraq, Libyan Arab Jamahiriya and United Arab Emirates. In most cases these large increases in the reserves were not related to new field discoveries. They were based mainly on increasing recovery factors in existing fields. Production capacities in several OPEC countries, especially those in the Persian Gulf, are not limited by the physical constraints of reserves. In most of these countries oil output is limited only by voluntary ceilings based on world demand for OPEC oil.

34. Prior to the Gulf War, OPEC countries had planned to boost their oil output capacity in anticipation of an expected upturn in world oil demand, which would be met largely from OPEC supplies. Plans by the OPEC Persian Gulf countries were to add some 6.05 mb/d of new capacity by 1995 and a further 1.9 mb/d by the year 2000. 9/ Many of these projects, especially in Saudi Arabia, are now being implemented. Table 5 reflects some of these trends.

35. During the period 1982-1990, seismic activity was at a record level in 1990, with about 160,078 line-kilometres surveyed, almost double the level of 1986. Similarly, exploratory wells completed, 310 wells in 1990, represented a gain of 28 per cent compared with the level in 1986. Development wells completed also rose sharply to 1,178 wells in 1990, largely from increased drilling in Indonesia and Venezuela. The rising trend in exploration and development activities in OPEC countries is expected to continue in order to maximize sustainable crude oil production to meet the projected growth in world demand, coupled with declining production from the Commonwealth of Independent States and the United States of America. Clearly, OPEC alone has the capacity for expansion to meet any significant growth in world oil demand. Moreover, OPEC has control of the lowest cost oil, which, together with its surplus supply situation, would imply that OPEC production capacity and capacity utilization remain the major determinants of the price of oil.

Table 5. Exploration and development indicators of OPEC member countries, (1982-1990)

Year	Licensed area (thousand sq km)	Seismic activity (line-km)	Exploratory drilling (number of wells)	Development drilling (number of wells)
1982	2 707	137 670	606 a/	2 705 a/
1983	2 565	128 554	474	2 031
1984	2 414	116 186	454	1 577
1985	2 178	101 923	358	1 224
1986	2 312	86 971	242	946
1987	4 202	91 367	258	803
1988	4 384	113 346	267	960
1989	4 530	143 228	285	969
1990	3 716	160 078	310	1 178

Source: World Petroleum Trends 1991, Petroconsultants (United Kingdom) Ltd.

a/ Includes unusually high level of drilling in Venezuela in the Orinoco tar belt for heavy oil.

36. Production expansion projects remain the focus among the OPEC countries and in some countries exploration and production sectors have been opened to foreign participation. Venezuela has announced plans to open development of marginal fields to both private and overseas interests for the first time since nationalization of its oil industry in 1976.

37. The Islamic Republic of Iran continued to restore its production capacity to about the level prior to the Iran-Iraq war, when peak output was about 5 mb/d; however, drilling has remained at a low level. Restoration of offshore production was being emphasized. Several new drilling rigs have been purchased from Canada and the United States, which would lead to an acceleration of the programme for capacity expansion. In addition protocols have been signed with foreign oil companies for offshore development.

38. The potential production levels of the OPEC member countries can be many and varied in relation to future patterns of supply and demand, prices and political and economic acceptability. Table 6 shows estimates of effective production capacities for 1990 and the year 2000.

Table 6. Estimated effective and potential oil production capacity of OPEC member countries

(Million b/d)

Country	Estimated effective capacity	Possible capacity in 2000
Algeria	1	1
Ecuador	0.5	0.5
Gabon	0.3	0.3
Indonesia	1.5	1.5
Iran, Islamic Republic of	3	4
Iraq	3.5	5
Kuwait	2	3
Libyan Arab Jamahiriya	1.5	2
Nigeria	2	2
Qatar	0.5	0.5
Saudi Arabia	10	12
United Arab Emirates	2	2.5
Venezuela	2.5	3

Source: United Nations, Department of Economic and Social Development, based on the report, "Oil export capacity in OPEC countries: constraints and prospects", by N. Abi-Aad, Petroleum Review, March 1991.

2. Non-OPEC oil exporting developing countries

39. The share of world oil production of 19 non-OPEC oil exporting developing countries has increased markedly in the past 20 years.

40. Exploration and development activities in these oil exporting developing countries have been on the rise during the second half of the 1980s. Since 1986 licensed acreage increased by 80 per cent and seismic activity by 71 per cent. However, exploration and development drilling has remained static (see table 7).

41. Exploratory and development well completions have increased substantially in China since 1987 when such information and data were first made available. In 1990, combined total well completions in China were estimated at 7,627 wells, by far the largest number of wells drilled in any developing country. China has opened discussions with foreign companies covering participation in exploration and development in the Xinjiang Region in the far western part of the country, a significant development, as previously foreign participation was limited mainly to offshore activities. The Tarim, Turpan and Junggar basins in the Region are expected to provide significant new reserves for the next century. Several discoveries have been announced in the Tarim basin and an oil discovery was made in the Turpan basin in early 1991.

42. Oil output from Malaysia has been increasing substantially, having risen by about 138 per cent over the last decade. Peak production at the present time can be as high as 650,000 b/d, as demonstrated in 1990 when output was raised to meet the shortfall caused by the Persian Gulf crisis.

43. The Syrian Arab Republic has also made considerable gains in oil output, which has increased continuously in the past decade.

44. Mexico, despite its substantial proved reserves, had been unable in recent years to expand production because of deep indebtedness and lack of foreign exchange. This was at the time of resumption of economic growth and consequent increases in domestic oil demand. It has been reported that Pemex, the national oil company of Mexico with exclusive operations in the country, was able to invest only about US$ 1 billion annually during the late 1980s as compared with US$ 6 billion in 1981. In 1991 Pemex secured a US$ 1.3 billion loan guarantee from the Export-Import Bank of the United States to call in companies from the United States for four big new exploration projects. Pemex was ultimately looking to secure as much as US$ 5.0 billion in guarantees for 16 projects from the same source. Similar arrangements with 25 other national export-import banks were contemplated. 10/

Table 7. Exploration and development indicators in non-OPEC oil exporting developing countries, 1982-1990

Year	Licensed area (thousand sq km)	Seismic activity (line-km)	Exploratory drilling (number of wells)	Development drilling (number of wells)
1982	1 324	146 402	455	1 485
1983	1 222	121 461	369	1 310
1984	1 222	111 368	381	1 389
1985	1 106	127 528	406	1 128
1986	1 046	111 693	350	1 039
1987	1 330	112 314	354 (1 525) a/	850 (5 706) a/
1988	1 523	157 584	352 (1 642) a/	954 (5 809) a/
1989	1 716	230 481	339 (1 665) a/	884 (5 860) a/
1990	1 872	191 028	370 (1 697) a/	750 (5 930) a/

Source: World Petroleum Trends 1991, Petroconsultants (United Kingdom) Ltd.

a/ Figures in parentheses are exploratory and concern development wells completed in China, which data were not available prior to 1987. These data are presented separately to avoid an anomalous increase in the number of wells completed.

45. Viet Nam, a recent entry into the ranks of oil exporters, has made substantial gains in its oil output, with an average of about 65,000 b/d in 1991. Production is from offshore fields operated by Vietsovpetro, the only company producing oil currently. Production is expected to reach 120,000 b/d by 1995. Many foreign oil companies, including national oil companies from developing countries, Petronas of Malaysia, Pertamina of Indonesia and so on, have expressed interest in the offshore areas. Significant increases in Viet Nam's production capacity are to be expected in the near future.

46. There has been a wide degree of variation in the replacement of reserves in the last few years among the major non-OPEC oil exporting developing countries. The greatest successes were registered in the Syrian Arab Republic and Yemen, where exploration intensity has been very high recently. Less successful efforts have been registered in Angola, Egypt and Malaysia.

3. Energy-deficient developing countries

47. Other than the 32 oil exporting developing countries - 13 OPEC member countries and 19 non-OPEC oil exporting countries - the remainder of the developing countries and territories, over 100 of them, are net importers of oil. The estimated total import of oil of the energy-deficient developing countries was about 1.7 billion barrels in 1990 (4.5 mb/d), and by far the largest part of the supply was from OPEC Persian Gulf countries.

48. Of this large number of energy-deficient developing countries only 19 have any oil production capacity, ranging in size from world class producers to producers of a few hundred barrels a day or less. The share of total world oil production of this group of oil producing/importing developing countries was about 3.5 per cent in 1991, having retained this share more or less since 1985.

49. Among the large group of non-oil producing developing countries, only 20 had any petroleum exploration activities in recent years.

(a) Oil producing/importing developing countries

50. The total production of this group of oil producing/importing developing countries increased by about 140 per cent since 1970 and reached a level of about 0.764 billion barrels (2.09 mb/d) in 1991. However, almost all of this gain was attributable to the three largest producers, Argentina, Brazil and India. In 1991, production from these three countries, 0.646 billion barrels (1.77 mb/d), amounted to about 85 per cent of the total production of the group of oil producing/importing countries.

51. As shown in table 8, seismic activity has increased considerably in these countries since 1985. However, both exploration and development drilling has declined, mainly because of financing difficulties, especially in Brazil and India.

Table 8. Exploration and development indicators in oil producing/importing developing countries, 1982-1990

Year	Licensed area (thousand sq km)	Seismic activity (line-km)	Exploratory drilling (number of wells)	Development drilling (number of wells)
1982	3 397	196 873	705	1 748
1983	3 077	169 092	823	2 002
1984	3 869	168 786	699	2 115
1985	3 543	171 239	712	2 448
1986	3 578	194 852	570	2 270
1987	3 268	250 682	594	2 327
1988	2 804	297 403	703	2 173
1989	3 346	295 696	646	1 898
1990	4 457	261 608	648	1 627

Source: World Petroleum Trends, 1991, Petroconsultants (United Kingdom) Ltd.

52. Oil production in India, after showing steady gains during the past decade, declined by 4.7 per cent in 1991. This decline was due more to ageing equipment and poor storage and transport facilities than to constraints in production capacity. India's oil output is expected to increase to about 870,000 b/d by the end of fiscal year 1995/96. However, India's oil consumption is expected to reach 1.73 mb/d by then. 11/ In 1990, oil imports cost about US$ 5.5 billion, or about a third of India's foreign exchange outlay. In order to offset the rise in oil import volume, India has to accelerate expansion of its domestic production capacity and to that end plans are being made to intensify exploration and development activities and to extend the search to deepwater, difficult and remote areas with increased foreign participation.

53. In Argentina, the oil and gas industry, particularly the upstream sector, has been deregulated. A large number of the state oil company fields have been privatized, including producing fields with significant proved reserves. It is estimated that 40 per cent of Argentina's oil industry is now in private hands. Much of the properties sold are under explored and/or underdeveloped and thus there is high potential for increased exploration and production spending. Furthermore, under draft legislation that is being submitted for congressional approval, the state oil company itself will be partially privatized. Oil production in Argentina has increased continuously over the past five to six years. In 1991 total output was about 0.178 billion barrels

(487,300 b/d), which was, however, still below the level of 0.185 billion barrels (505,600 b/d) in 1980. Yet in 1990 Argentina became a net exporter of oil.

54. Oil production in Brazil had increased annually since 1980, having reached a historically high level of about 0.232 billion barrels in 1991 (635,800 b/d). The national oil company, Petrobras, an acknowledged leader in deepwater technology, brought onstream part of the giant Marlin deepwater field in 1991. In 1991, exploration risk contracts came to an end and Petrobras once again has sole responsibility for exploration and production activities in Brazil.

55. Pakistan, Thailand and Turkey also registered substantial gains in their outputs in 1991. Pakistan's output of about 69,500 b/d in 1991 represented a gain of about 16 per cent over the previous year and Thailand's average daily production in 1991 increased 13.7 per cent to about 46,600 b/d and a significant gain of about 24 per cent was registered in Turkey's oil output in 1991 for a daily average of 86,700 b/d.

56. Pakistan continues to attach very high priority to the development of its energy sector, particularly oil and gas exploration and development to reduce oil imports. Recently, Pakistan has negotiated loans and co-financing arrangements with the Asian Development Bank and the World Bank for development of oil and gas fields and the related infrastructure. In Turkey, a new exploration programme in the Black Sea has started and the development of oilfields in the southeastern part of the country discovered in 1989 could lead to further additions to its production capacity. In Thailand, new concessions, both on land and offshore, continue to be opened for exploration and development. Meanwhile, a number of oil companies have applied for permission to start production from their recent onshore discoveries that would lead to a significant increase in total oil output.

57. In most of the other countries of this group, concessions are being awarded increasingly to foreign oil companies and in a number of those countries either discoveries or encouraging oil and gas shows have prompted an increase in exploration activity. 12/

(b) Non-oil producing developing countries

58. Exploration activity in this group of countries continued at a comparatively low level, other than in Papua New Guinea where oil production and export are expected to start during the latter half of 1992.

59. As shown in table 9, licensed acreage and seismic activity continued to decline in the past few years and the trend is likely to continue. The sudden increase in exploratory drilling completions in 1989 and 1990 was attributable in the main to the high number of wells completed in Papua New Guinea, where exploration intensity has been at high levels.

Table 9. Exploration and development indicators in non-oil producing developing countries, 1982-1990

Year	Licensed area (thousand sq km)	Seismic activity (line-km)	Exploratory drilling (number of wells)	Development drilling (number of wells)
1982	2 278	41 239	44	0
1983	1 809	50 402	33	0
1984	2 057	33 095	23	4 a/
1985	1 986	24 784	34	13 b/
1986	1 842	30 148	18	24 b/
1987	1 977	41 032	13	0
1988	1 844	24 032	23	0
1989	1 873	20 901	41	1 c/
1990	1 611	21 887	38	2 c/

Source: World Petroleum Trends 1991, Petroconsultants (United Kingdom) Ltd.

a/ Development wells completed in the Sudan, although no production was scheduled.

b/ Development wells completed in Yemen, which became an oil exporter in 1987.

c/ Development wells completed in Mozambique, although no production was scheduled.

B. Natural gas

60. World recoverable reserves of natural gas, in the long term, are of an equal magnitude to oil reserves and it is generally believed that much more gas will be found as exploration for it becomes as profitable as it is for oil. Proved recoverable reserves of natural gas are estimated at 112 trillion cubic metres, or 734 billion barrels of oil equivalent.

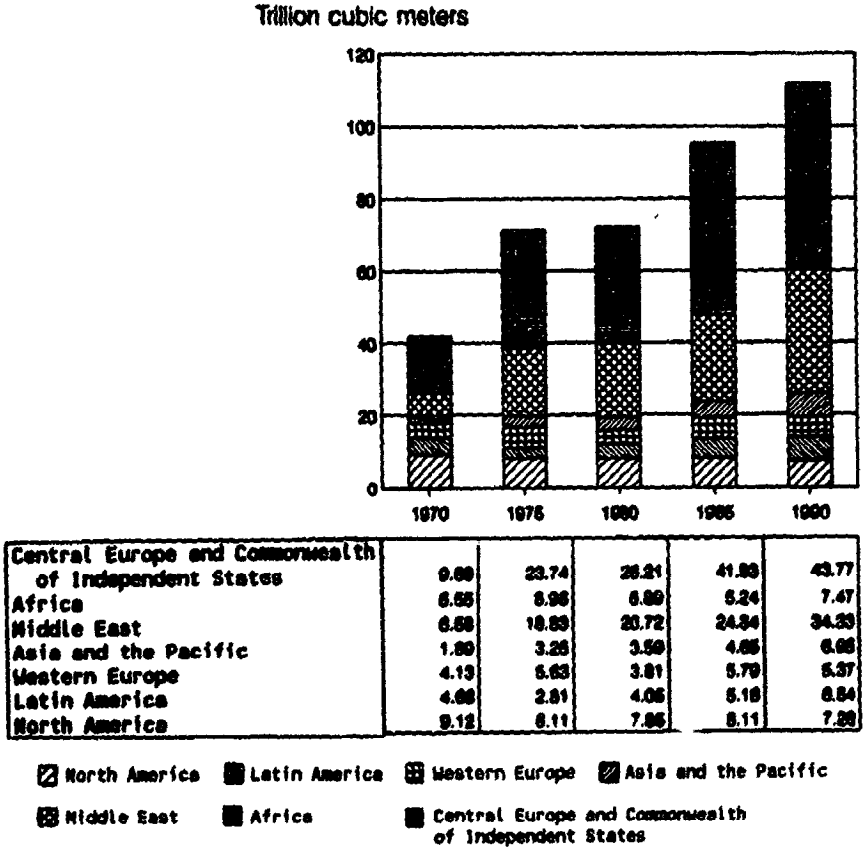
61. A growing number of developing countries have proved gas reserves that have not been developed, especially in Africa. Others, as in the Middle East, have barely begun to exploit their considerable reserves. Many developing countries face major obstacles in developing their gas reserves because of lack of markets and/or requirements for heavy front-end investments in the necessary infrastructure.

62. The magnitude of natural gas reserves has risen steadily during the past two decades, as shown in figure 7. This growth is particularly marked in the Commonwealth of Independent States and the Middle East; these two regions account for two thirds of the world natural gas reserves. Almost 37 per cent of the total proved recoverable reserves of natural gas in the world is located in the Commonwealth of Independent States, primarily in Russia, with about 41 trillion cubic metres. The Commonwealth of Independent States continues to lead in production, consumption and export of natural gas and it is unlikely to reach its peak until well into the next century. Among the developing countries, the Islamic Republic of Iran has the largest proved reserves of natural gas, at about 13.8 trillion cubic metres, or 12.5 per cent of the world's total. The Islamic Republic of Iran has resumed its export of gas to the Commonwealth of Independent States and has been exploring the possibility of pipeline exports to Central Europe via Turkey and to Asia through Pakistan. Gas production in the Islamic Republic will increase significantly with the rise in domestic consumption as a huge gasification programme is under way. Domestic pipelines have been laid and a gas processing plant with a rated capacity of 85 billion cubic metres a year has been inaugurated.

63. In Africa, Algeria has embarked on a renovation and expansion of its gas production facilities, including natural gas liquefaction, and has directed the main thrust of its marketing to the western pipeline to Spain via Morocco and Gibraltar, while increasing the capacity of the Trans Med pipeline to Italy to 16 billion cubic metres a year. Elsewhere in Africa, Nigeria has begun building industrial and domestic markets, having started construction of a pipeline from the fields in the delta to Lagos, towards a target market of 15 billion cubic metres a year. A major liquefied natural gas (LNG) project for export to Europe is under consideration. Many of the central and southern African countries have natural gas reserves that are not being exploited as yet, although small projects involving use of natural gas are being implemented.

Figure 7. World proved natural gas reserves

(At year end)



Central Europe and Commonwealth of Independent States	9.69	23.74	26.21	41.93	43.77
Africa	6.65	5.96	6.89	5.24	7.47
Middle East	6.58	18.83	20.72	24.34	34.33
Asia and the Pacific	1.89	3.26	3.59	4.66	6.66
Western Europe	4.13	5.63	3.81	5.79	5.37
Latin America	4.66	2.81	4.06	5.16	6.84
North America	9.12	8.11	7.85	8.11	7.26

Source: United Nations, Department of Economic and Social Development, based on the Oil and Gas Journal Energy Database.

64. In the Asia and Pacific region, natural gas production continues to rise, especially from offshore fields in Brunei Darussalam, India, Indonesia, Malaysia and from Australia's North-West Shelf. Gas is marketed mainly as LNG rather than pipeline gas; LNG has a virtual monopoly of the trade in the region, with Japan as the world's largest LNG consumer. Indonesia, Malaysia and Brunei Darussalam are the leading suppliers of LNG in the region, to be joined by Australia's North-West Shelf, and there is more than sufficient capacity in those countries to meet considerable increases in LNG demand. A trans-ASEAN (Association of South-East Asian Nations) pipeline, connecting Thailand, Malaysia, Singapore, Indonesia and the Philippines, linking the five countries into a single gas grid capable of transporting up to 20 billion cubic metres of gas a year, is being studied.

65. In Latin America, several countries have increased their natural gas reserves substantially and production has increased by 43 per cent during the past decade with significant gains in production in Argentina, Bolivia, Brazil, Colombia and Mexico. In a number of countries a large part of the gas was re-injected for reservoir pressure maintenance.

66. In Argentina the State-owned Gas del Estado (GDE) is being privatized and contract negotiations and transfer of business units could be complete by the end of 1992. The natural gas pipeline system consists of 7,900 miles of main line delivering 67.9 million cubic metres (2.4 billion cubic feet) a day.

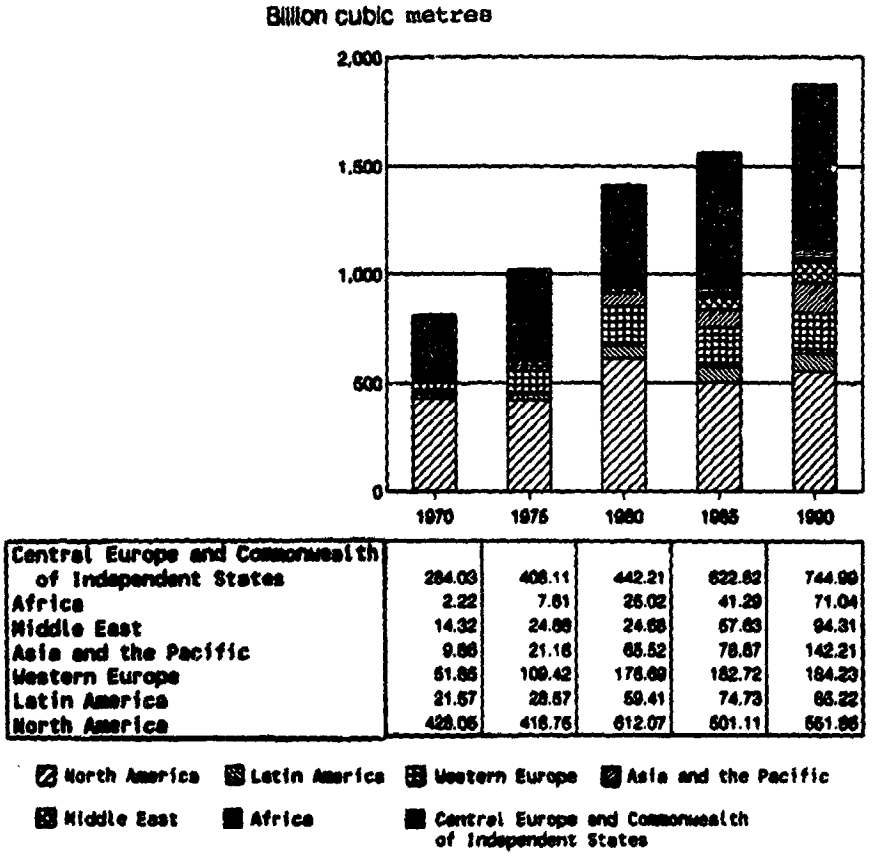
67. In Venezuela, three international companies will be forming a consortium with Lagoven, a subsidiary of Petroleos de Venezuela, the national oil company, to develop the natural gas resources on the Paria peninsula on the north-western coast. The project is expected to involve an overall investment of around US$ 3 billion for export of 4.4 million tons of LNG annually beginning in 1996.

68. The United States of America and the Commonwealth of Independent States are the main natural gas producers in the world. While the production in the United States has increased during the past 20 years, reserves replacement has lagged significantly, as shown in figures 7 and 8. During the same period, in the Commonwealth of Independent States, gas production has more than tripled and the proved reserves increased by more than fourfold.

69. Worldwide, natural gas production has more than doubled since 1970 and new discoveries and increased estimates of existing reserves continued to outpace production, leaving total world reserves at the end of 1990 at 112 trillion cubic metres.

70. As shown in figure 9, gas consumption has increased steadily in all areas over the past two decades and currently natural gas provides about 24 per cent of all commercial energy. Gas utilization includes direct supply as fuel, electricity power generation and chemical feedstock for ammonia, methanol and petrochemicals.

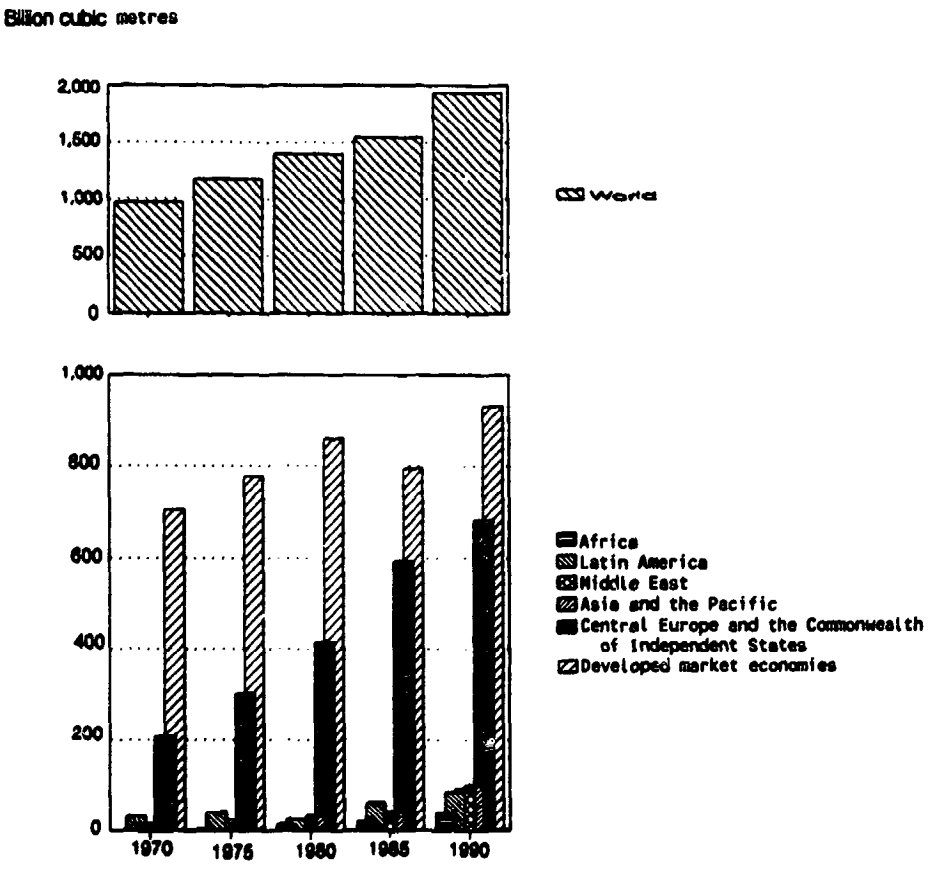
Figure 8. World natural gas production



	1970	1975	1980	1985	1990
Central Europe and Commonwealth of Independent States	284.03	406.11	442.21	622.82	744.99
Africa	2.22	7.61	25.02	41.29	71.04
Middle East	14.32	24.89	24.68	57.63	94.31
Asia and the Pacific	9.86	21.16	65.52	78.87	142.21
Western Europe	51.85	109.42	176.69	182.72	184.23
Latin America	21.57	28.57	59.41	74.73	85.22
North America	428.06	416.76	612.07	601.11	561.86

Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

Figure 9. World natural gas consumption



Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

71. A new phase of natural gas utilization is materializing as technical progress is making it economically available as a transport fuel with comparatively less environmental impacts. Motor vehicles generate more pollution than any other single human activity and an ever-expanding number of motor vehicles will exacerbate global and local environmental problems. A mitigative option will be the use of an alternative fuel. Compressed natural gas (CNG) and methanol produced from natural gas are technically viable alternatives and are being introduced experimentally in various markets.

C. Coal

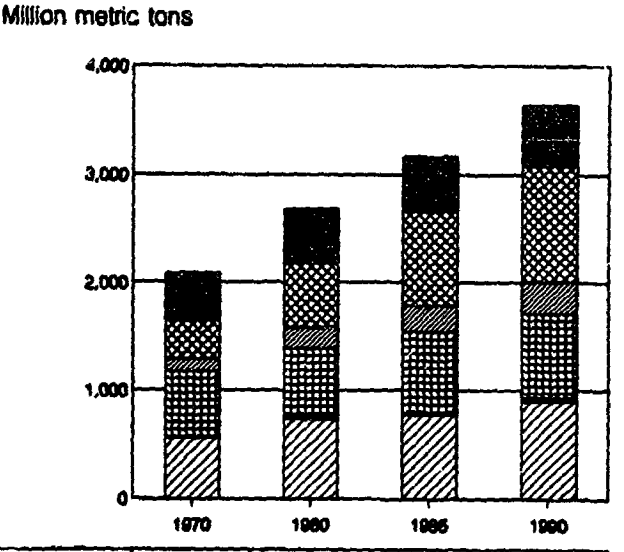
72. Coal is the world's most widely available fossil energy source, with proved recoverable reserves of about 1,075 billion metric tons (bmt) of hard coal (bituminous, including anthracite), 130 bmt of sub-bituminous coal and 391 bmt of lignite, for a total of about 1,596 bmt. 13/ At the present world-wide rate of consumption and with existing technology, and even if consumption should increase substantially, the economically recoverable reserves of coal would last several hundred years.

73. Being the most abundant and widely dispersed fossil fuel and currently the second most important source with which the world meets its energy needs, coal will increase in both absolute and relative importance. However, some 75 per cent of total proved recoverable reserves of hard coal occur in just three countries, China (610 bmt), the United States (113 bmt) and the Commonwealth of Independent States (104 bmt). At present these countries produce about two thirds of the world's hard coal. Also, in the case of lignite, some 60 per cent of the proved recoverable reserves are concentrated in the same three countries. Among the developing countries other than China, the distribution of the proved recoverable reserves is again concentrated in a few of the countries, about 50 per cent in India alone.

74. Some 50 developing countries have identified coal resources and 32 of these countries have some production. However, a very large part of the production comes from a few of the developing countries: China, Democratic People's Republic of Korea, India, Republic of Korea and Turkey. As shown in figure 10, total mine production of hard coal of the developing countries in 1990 was about 1,229.3 million metric tons, a share of about 33.8 per cent of the world total coal production of 3,639.5 million tons.

75. Most of the incremental production is expected from the traditional major producers, China, the United States, the Commonwealth of Independent States, South Africa, Australia, Canada, India and Poland. In view of the anticipated substantial increase in energy demand in the developing countries, other smaller producer countries will also play a role. However, there is considerable uncertainty as to the level of demand and production capacities in the developing countries. Large capital investments in extractive, consuming and transport facilities will be required for this purpose.

Figure 10. World hard coal production



Commonwealth of Independent States	432.72	492.92	494.41	543.01
Africa	5.11	5.11	4.76	6.17
China	354.01	598.01	872.28	1,080.01
Asia and the Pacific	116.41	194.02	243.88	289.29
Europe	611.55	642.56	745.68	784.13
Latin America	8.41	17.68	28.39	37.79
North America	559.43	730.66	770.23	899.11

Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

D. Electric power

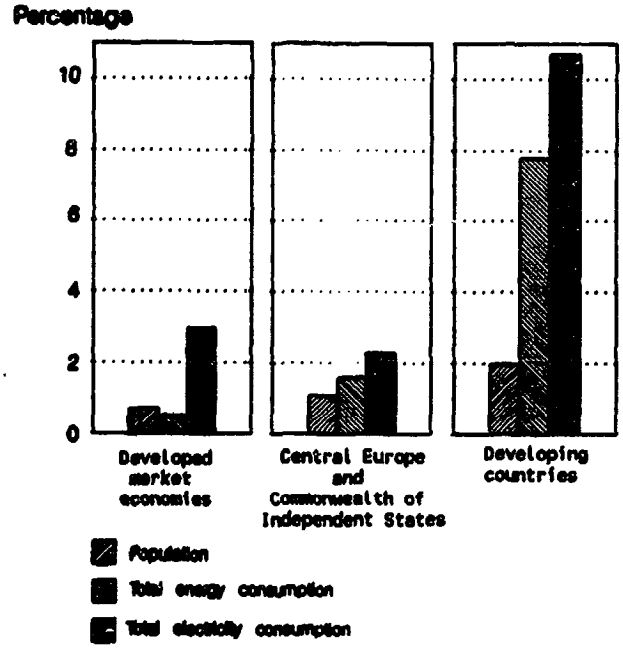
76. World-wide electricity consumption increased to 11,753 terawatt hours (TWH) in 1990, a gain of about 2.5 per cent over 1989, a growth rate lower than the average annual rate of 3.9 per cent for 1980-1990. In the developing countries as a group, despite great differences among them, electricity consumption has grown much faster than in the developed market economies, the Central European countries and the Commonwealth of Independent States. The rate of growth in the developing countries averaged over 10 per cent annually in the period, as shown in figure 11, from a total consumption of about 1,223 TWH in 1980 to about 2,661 TWH in 1990. 14/

77. Despite the high annual growth rate mentioned above, the per capita electricity consumption of the developing countries remains very low compared with the developed market economies, as shown in figure 12.

78. There is a constant and critical need to install new electricity generation capacity in the developing countries, not only because of the continuing high growth in demand, but also because of the imperative to replace output from ageing and inefficient power plants. At the current rate of demand growth the developing countries will require a near doubling of installed capacity, from about 590.2 gigawatts in 1990, by the year 2000. This would require an investment of over US$ 1 trillion (in 1989 dollars). 15/ Furthermore, fuel supply, transportation and other infrastructure investments will require considerable additional outlays annually.

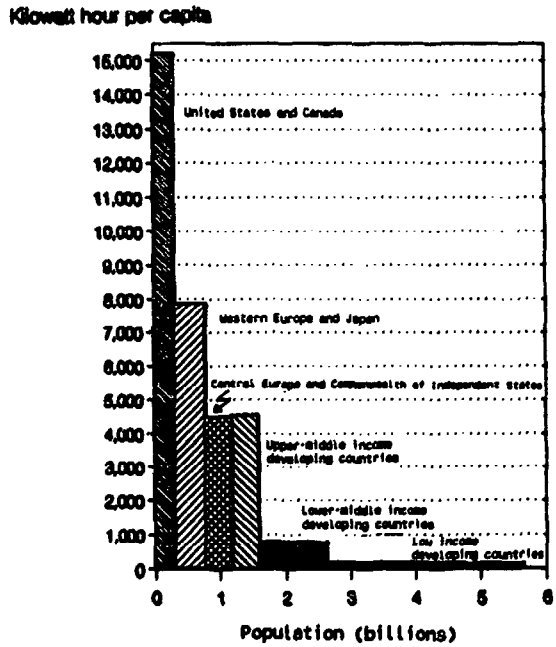
79. In the developing countries fossil fuels continue to be the dominant primary energy source for electricity generation, as shown in figure 13, having steadily increased from 775 TWH in 1980 to 1,632 TWH in 1990, with their share of total electricity generated increasing from 61.3 per cent in 1980 to 65.8 per cent in 1990. Hydropower has made significant gains, especially in a number of the developing countries, having increased by 60 per cent during 1980-1990.

Figure 11. Electricity consumption: average annual growth rate, 1980-1990



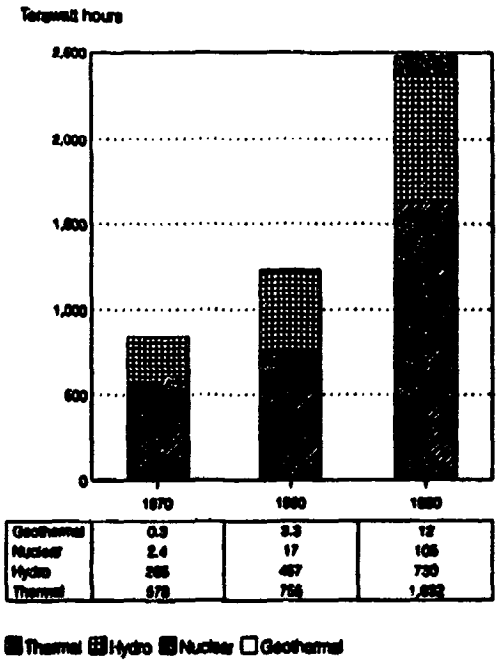
Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues, and United Nations World Population Chart 1990 (revised).

Figure 12. World electricity consumption, 1990



Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues, and the World Development Report, 1991, the World Bank.

Figure 13. Electricity generation by fuel source in the developing countries



Source: United Nations, Department of Economic and Social Development, based on the Energy Statistics Yearbook, various issues.

IV. FINANCIAL REQUIREMENTS AND INVESTMENTS

80. In view of the expected growth in energy production and consumption in the developing world during the 1990s investment requirements will be considerable. For oil production alone, in the member countries of OPEC it has been estimated that US$ 120 billion will be needed by the year 2000. 16/ Another estimate of investment requirements for the oil industry as a whole has been put as high as US$ 1,020 billion, of which US$ 250 billion is for exploration and development, US$ 250 billion for refining, US$ 180 billion for ocean transportation and pipelines, and US$ 340 billion for storage, distribution and marketing. 17/

81. In comparison much more investment will be needed for electric power. As stated previously, about US$ 1 trillion will be needed in the developing countries alone for electric power generating plants. According to a recent study by the World Bank in energy-deficient developing countries and based on plans for electricity capacity expansion from 236,718 MW in 1989 to 442,907 MW in 1999, cumulative capital investments are estimated at US$ 448.6 billion, of which US$ 150 billion would be in foreign exchange. 18/

82. With capital scarcities even in the traditionally capital surplus oil exporting developing countries it is doubtful that the required petroleum investment will be made without new arrangements between host countries and transnational oil corporations. In oil importing developing countries the problem is likely to be even more pronounced, particularly in exploration, since more countries, including the new republics of the former Soviet Union, will be competing for risk capital. Under these circumstances it becomes even more urgent to consider special and expanded assistance programmes by the international community.

V. CONCLUSION

83. The current situation of surplus energy capacities may provide a false sense of energy supply security. A resumption of economic growth, particularly in the developing world, could lead to yet another energy crisis, which can be prevented if precautionary measures are taken by the international community. Such measures have already been initiated in the context of the Ministerial Seminar of Petroleum Producers and Consumers and the European Energy Charter. 19/

84. In this context the Secretary-General wishes to note that the General Assembly in its resolution 45/209 welcomed the outline of a programme of action for the acceleration of energy exploration and development in the developing countries contained in his report (A/45/274-E/1990/73 and Corr.1) and stressed the need for comprehensive national, bilateral and multilateral measures, particularly with regard to financing, investment and technology, as well as training of national technical personnel, to accelerate the exploration and development of energy resources in developing countries, including new and renewable sources of energy.

85. As analysed in the current and previous reports of the Secretary-General on this subject, very few of the above objectives, which have been endorsed repeatedly by the General Assembly during the past 10 years, have been achieved. With a view to mobilizing the international community to increase efforts for comprehensive national, bilateral and multilateral measures to accelerate the exploration and development of energy resources in developing countries, it is recommended that the Assembly consider the preparation of an expanded programme of action in this regard.

Notes

1/ United Nations press release SG/SM/1218, 1 July 1991.

2/ World Economic Survey 1991, (United Nations publication, Sales No. E.91.II.C.1), table V.1, p. 99.

3/ Ibid.

4/ For more information on the contribution of new and renewable sources of energy to the world energy balance, see (a) the report of the Intergovernmental Group of Experts on New and Renewable Sources of Energy (A/AC.218/1992/9); (b) the report of the Secretary-General on solar energy: a strategy in support of environment and development (A/AC.218/1992/5); and (c) the report of the Committee on the Development and Utilization of New and Renewable Sources of Energy, Official Records of the General Assembly, Forty-seventh Session, Supplement No. 36 (A/47/36).

5/ The OPEC Persian Gulf States, Saudi Arabia, Kuwait, the Islamic Republic of Iran, Iraq, the United Arab Emirates and Qatar, together hold reserves of about 647.5 billion barrels, against a world total of about 999.1 billion barrels.

6/ All crude oil production, trade and consumption data are from the Energy Statistics Yearbook (United Nations publication), various issues, and Oil and Gas Journal, various last issues of the year containing the "World Prodution Report".

7/ The number of oil fields mentioned is based on the report entitled "Size and distribution of known and undiscovered petroleum resources in the world, with an estimate of future exploration", by Marcello Colitti, OPEC Review, vol. 5, No. 3, 1981.

8/ World Economic Survey 1990 and 1991 (United Nations publication, Sales Nos. E.90.II.C.1 and E.91.II.C.1), chap. V.

9/ Petroleum Review, March 1991, p. 125.

10/ "Mexico President Opens its Oil Industry", The New York Times, 25 September 1991, p. D1.

Notes (continued)

11/ Petroleum Intelligence Weekly, 6 January 1992.

12/ World Oil, August 1991.

13/ World Energy Conference 1989, "Survey of Energy Resources".

14/ All electricity production and consumption data in the section are based on the Energy Statistics Yearbook (United Nations publication), various issues.

15/ See "Report on the Stockholm Initiative on Energy, Environment and Sustainable Development (SEED): Strategies for Implementing Power Sector Efficiency, Stockholm, 13-15 November 1991", key issues papers.

16/ Dr. Subroto, Secretary-General, Organization of Petroleum Exporting Countries, has stated at several forums that some US$ 120 billion will be required in OPEC countries for oil exploration and development during the present decade.

17/ Petroleum Intelligence Weekly, 13 January 1992, p. 7. See "Oil industry investment needs in the 1990s: Will US$ 1 trillion be enough? Will it be available?", by Walter L. Newton.

18/ "Capital Expenditures for Electric Power in Developing Countries in the 1990s", World Bank, Energy and Industry Working Paper, Energy Series Paper 21, February 1990.

19/ See the Declaration on International Economic Cooperation, in particular the Revitalization of Economic Growth and Development of the Developing Countries, contained in the annex to General Assembly resolution S-18/3 of 1 May 1990; the International Development Strategy for the Fourth United Nations Development Decade annexed to resolution 45/199 of 21 December 1990; and resolutions 40/208 of 17 December 1985, 43/193 of 20 December 1988 and 45/209 of 21 December 1990 on the development of the energy resources of developing countries.