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Telephone: (212) 867-0052

Petroleum Industry Research Foundation, Inc.

122 EAST 42nd STREET

New York, N. Y. 10168

OIL'S ROLE IN THE ENERGY FUTURE

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1. INTRODUCTION

A good starting point for a forecast of world energy supply and demand over the next 18 years may be a look at the last 18 years. We find that the period 1964-82 can be divided into two very different 9-year periods. Energy forecasts made during both periods tended to reflect these differences. In the 1960's and early 1970's it was generally assumed that energy supplies, particularly oil, would continue to be readily available in sufficient quantities to support the existing rapid world economic growth rates at least through the 1980's. In the period 1973-81, by contrast, the assumption underlying most forecasts was that oil and gas, which accounted for nearly 2/3 of total energy supplies, were becoming increasingly scarce for political, economic and resource reasons and would require substantial price increases which, in turn, would retard general economic growth. The appearance of considerable excess oil producing capacity since 1981 as a result of persistently falling demand and rising new supplies has recently caused a revision of the scarcity projections.

Most of these forecasts were simply modified extrapolations of prevailing trends and remained valid only while these trends continued. This was due in large part to the fact that the trend changes did not occur gradually but were triggered by

extraneous, unpredictable events. Another important reason was the economic Zeitgeist of the period. In the 1950's and, even more, the 1960's most economic thinking was growth oriented, domestically and internationally. By contrast, in the 1970's the underlying emphasis was on coming resource constraints and scarcity, starting with the "Club of Rome's" influential publication, Limits To Growth, nearly two years before the first oil crisis.

We do not know yet what the economic philosophy of the 1980's will be regarding resource availability. It may well be more pragmatic and less value oriented than the two previous ones. Certainly, our analysis aims to be pragmatic. What we propose to do is to develop one plausible future scenario. We will make certain reasonable assumptions and project energy demand on the basis of these assumptions to the year 2000. But we recognize that other reasonable assumptions would yield different but not necessarily less plausible results.

2. ASSUMPTIONS

Our first assumption concerns the economic growth rates of the three major regions analyzed in our forecast: the industrial market economies which belong to the OECD group; the less developed countries (LDCs); and the centrally planned economies (CPE's) which consist of the Soviet Union, Eastern Europe, the Republic of China and several other countries with similar economic systems. Our projections are shown in Table 1.

Table 1
ANNUAL REAL GNP GROWTH RATES
(% per year)

	1973-1981	1981-1990	1990-2000
U.S.	2.3	2.7	2.3
Other OECD	2.4	2.8	3.1
LDC's	4.9	4.3	4.2
CPE's	3.1	2.8	2.5
World	2.8	3.0	3.0

These rates are probably below the political aspirations of any of these regions but they are high enough to permit significant per capita growth rates in all of them. In the LDC's which will have the fastest population growth rates, the GNP rises about twice as fast as the population under our assumption.

Our second assumption concerns the price of oil which in turn affects the cost of all oil-competitive energy. Our price assumption is not a forecast but a tool of analysis. If the analysis shows the required amount of oil by 1990 or 2000 to be higher or lower, respectively, than is available under our initially assumed price, that price would have to be raised or lowered.

Our price assumption starts with the current (mid-March 1983) average world oil price of about $29/Bbl, assumes that this price will remain nominally unchanged for this year and next, will rise somewhat less than inflation in the principal importing countries until the late 1980's and will then rise approximately in line with inflation until 2000.

This price path assumes implicitly that OPEC, or some other form of inter-governmental price setting mechanism or arrangement, will continue to keep world oil prices substantially above the level which would prevail under conditions of

unconstrained competition. We recognize that this assumption is currently more open to challenge than at any time in the last 10 years and that the challenge has a valid base. Nevertheless, we consider a scenario of administered oil prices more plausible than one in which oil prices will over an extended period of time be determined solely by market forces. However, the policy, form and mechanism of the price administration could be quite different from that of the last 10 years.

A major factor underlying our view is that in almost all oil exporting countries prices are determined by political bodies whose basic orientation is towards price protection rather than market competition. Given their demonstrated historic success of administering oil prices, these bodies can be expected to retain or regain, as the case may be, some form of price control. This does not mean that the setters of future world oil prices can ignore market conditions but, rather, that they should be able to modify underlying market pressures to their advantage, but much less so than during the period 1973-82. In the last half of our forecast period, rising marginal production costs should reduce the gap between our assumed administered price and the price which would otherwise prevail.

Next, we attempted to determine the relationship between economic growth and energy demand to find the total amount of energy required. We then estimated the amount of non-oil energy sources available to fill this requirement, with the balance being supplied by oil which, under our price assumption, would continue to be the swing fuel in world energy.

Our assumption regarding the energy/GNP relationship reflects the recent fairly significant decline in world oil prices which we believe will over time accelerate economic growth and energy demand from what both would have been if the 1981-1982 price level had been maintained. The lower price will also retard the development of some new energy supplies. However, it is our view that, notwithstanding the lower oil prices, energy demand will continue to grow at a significantly slower rate than GNP in all regions except the LDC's. One reason is that the move towards more energy efficiency which was triggered by the two oil price shocks of the 1970's has now taken on a life of its own, so to speak. New automobiles will continue to become more fuel efficient, new homes and other buildings will be designed to conserve energy and the same will be true of new industrial equipment. New electronic control technology will be an important tool in this development. Another reason is the ongoing structural change in industrial production. In the industrial countries the contribution to GNP of the so called "smoke stack" industries which are generally energy intensive is declining while that of high technology industries with relatively low energy requirements is increasing. We expect this trend to continue.

Table 2 shows our assumed energy efficiency per unit of GNP. We have limited the table and the following discussion to the OECD Countries and the LDC's, since the functional inter-relation between energy and economic activity is more direct in market oriented economies than in centrally planned economies where energy consumption tends to be determined primarily by

allocation. Energy developments in the CPE's will be discussed in a later section of this paper.

Table 2
ENERGY EFFICIENCY, 1973-2000

	Metric Tons of Oil Equivalent per Thousand 1975 $GNP				Rate of Change (% per yr.)		
	1973	1981	1990	2000	1973-1981	1981-1990	1990-2000
U.S.	1.16	0.96	0.82	0.72	-2.3	-1.7	-1.4
Other OECD	0.73	0.63	0.59	0.52	-2.0	-0.7	-1.3
LDCs	0.72	0.75	0.74	0.69	0.4	-0.2	-0.6
Average	0.87	0.75	0.69	0.62	-1.8	-0.9	-1.2
Million Joules per 1975 $GNP: Average	38.90	33.76	31.03	27.65			

Table 3 shows the total volume of energy required, based on the energy/GNP relationships developed in the previous table.

Table 3
OECD AND LDC ENERGY CONSUMPTION, 1973-2000

	Million Metric Tons Oil Equivalent (MTOE)				Growth Rates (% per year)		
	1973	1981	1990	2000	1973-1981	1981-1990	1990-2000
U.S.	1823	1808	1977	2152	-0.1	1.0	0.8
Other OECD	1817	1870	2255	2695	0.4	2.1	1.8
LDC's	626	951	1365	1944	5.4	4.1	3.6
Total	4266	4629	5597	6791	1.0	2.1	2.0
Total, Exajoules	189.5	207.6	251.0	304.5			

3. NON-OIL ENERGY IN THE OECD AND LDC COUNTRIES

Of the various non-oil energy sources we expect nuclear power to rise most rapidly: at least 11% annually to 1990 and then at about half that rate to 2000 as the backlog of plants currently under construction is completed and the absence of new orders in

the U.S. since the late 1970's begins to show up in the number of plant completions. In the LDC's nuclear power will grow sharply on a percentage basis but will remain a much smaller contributor to electric power generation than in the industrialized countries--6.7% vs. 20% by the year 2000. The reasons for the difference are capital constraints and an insufficient technological infrastructure in the LDC's.

Table 4
PROJECTED NUCLEAR POWER GENERATION IN OECD AND LDC REGIONS, 1981-2000

	MTOE			Growth Rates (% Per Yr.)	
	1981	1990	2000	1981-1990	1990-2000
U.S.	73	146	170	8.0	1.5
Other OECD	93	264	470	12.3	5.9
LDC's	5	30	75	22.0	9.6
Total	171	440	715	11.1	5.0
Total, Exajoules	7.7	19.7	32.0		

Next to nuclear power the fastest growing major energy source will be coal. Since both these fuels, as well as water power which will also grow faster than total energy, are primarily used to generate electric power, their growth rates are an indication of the increasing role of electricity in the world energy supply pattern between now and the end of the century. The conversion of coal into synthetic fuels will not require significant volumes of coal, except in South Africa. (This applies also to other synthetic fuels, most of which are not economically attractive at current or projected fuel prices. Hence, synfuels will not play a significant role in supplying world energy needs before the end of the century.)

Our projected growth in coal consumption is shown in Table 5.

Table 5
PROJECTED COAL CONSUMPTION IN OECD AND LDC REGIONS, 1981-2000

	MTOE			Growth Rate (% Per Yr.)	
	1981	1990	2000	1981-1990	1990-2000
U.S.	406	512	675	2.6	2.8
Other OECD	367	459	588	2.5	2.5
LDC's	200	289	415	4.2	3.7
Total	973	1260	1678	2.9	2.9
Total, Exajoules	43.6	56.5	75.2		

The growth in coal demand in the industrial countries other than the U.S. will have to come almost entirely from increased imports. Thus, the growth rate in international coal trade is likely to be more than twice that of world coal demand outside the CPE's.

Natural Gas in the U.S., which accounts for nearly 60% of total world consumption outside the CPE's, will move from demand constraint to domestic supply constraint between now and the late 1980's as a result of declining production. The gap will be filled by rising gas imports from adjacent countries. In the other OECD countries most of the increase in gas consumption will come from imports from OPEC members, other LDCs and the Soviet Union. In the LDC countries, by contrast, most of the increase will be supplied from domestic sources. The decline in the growth rate outside the U.S. from the 1980's to the 1990's will in part be due to the resource-constrained decline in West European gas production and in part to the cancellation, suspension or postponement of high cost LNG export projects.

Table 6

PROJECTED NATURAL GAS DEMAND IN OECD AND LDC REGIONS, 1981-2000

	MTOE			Growth Rate(% Per Yr.)	
	1981	1990	2000	1981-1990	1990-2000
U.S.	509	507	460	-	(0.1)
Other OECD	261	341	407	3.0	1.8
LDC's	123	249	358	8.2	3.7
Total	893	1097	1225	2.3	1.1
Total, Exajoules	40.0	49.2	54.9		

Hydro electricity which has been growing at a steady rate of 2.2-2.6% annually through both the last ten and the last five years is expected to grow at approximately the same rate over the next seventeen years. "Other" energy sources will grow rapidly to 1990 from a very small base in 1981, due to the commercialization of various forms of renewable energy.

We can now add up our various estimated forms of energy consumption to determine how much of the total energy requirements calculated earlier they will meet. The balance will have to come from the petroleum sector. Table 7 summarizes our energy consumption for the OECD and LDC regions, by type of fuel:

Table 7
PROJECTED ENERGY CONSUMPTION IN OECD AND LDC REGIONS BY SOURCE, 1981-2000

	MTOE			Growth Rates (% Per Yr.)	
	1981	1990	2000	1981-1990	1990-2000
Coal	973	1260	1678	2.9	2.9
Natural Gas	894	1097	1225	2.3	1.1
Nuclear Power	172	440	715	11.1	5.0
Hydro & Other	349	456	571	3.0	2.3
Total,Non-Oil	2388	3253	4189	3.5	2.6
Total Energy (See Table 3)	4629	5597	6791	2.1	2.0
Required Oil Supply	2241	2344	2602	0.5	1.0
Memo Items:					
Exajoules:					
Total, Non-Oil	106.9	145.7	187.7		
Total Energy	207.4	250.8	304.2		
Required Oil Supply	100.5	105.0	116.6		
Million B/D					
Required Oil Supply	47.0	49.4	54.7		

4. OIL IN THE OECD AND LDC COUNTRIES

Our calculation indicates that oil demand will increase only very slightly from 1981 to 1990. However, from 1982 to 1990 the increase should be faster, as is shown in Table 8. In both the 1980's and the 1990's, the growth will occur primarily in the LDC countries. In the U.S., oil consumption will remain about flat during the remainder of the century. This will be due to a combination of further oil conservation, particularly in the transportation sector, further reduction in oil sales to the residential/commercial heating markets, higher demand for petrochemical feedstock and diesel fuel and the end of the

displacement of fuel oil in the electric power and industrial markets. In the other industrial countries all growth will take place in the petrochemical and transportation sectors. In all industrial countries the historically unique drop in oil consumption which started in the U.S. in 1979 and in the other OECD countres in 1980 will probably end in 1983.

Table 8
PROJECTED OIL CONSUMPTION IN OECD AND LDC REGIONS, 1981-2000

	Million Barrels Per Day				Growth Rates (% Per Yr.)	
	1981	1982 (prelim.)	1990	2000	1982-1990	1990-2000
U.S.	16.0	15.2	15.3	15.3	0.1	0.0
Other OECD	19.9	19.1	20.1	20.6	0.6	0.2
LDC's	11.1	10.8	14.0	18.8	3.3	3.0
Total	47.0	45.1	49.4	54.7	1.1	1.0

Now let us consider whether our calculated oil volumes are likely to be available at our assumed price. It does not require much analysis to determine that the 49.4 million B/D requirement for 1990 should be readily available. In 1979 oil production in these regions was nearly 3 million B/D higher than our projected level, and in 1982 when crude and NGL production amounted to 42.4 million B/D there was enough available spare capacity to produce about 49 million B/D despite the temporary production constraints imposed by the Iranian-Iraqi war. This together with the 1.4 million B/D net CPE exports would have been adequate to meet the 1990 level last year, although with little spare capacity left. What a 49.4 million B/D requirement will do to the industry's

spare capacity by 1990 will largely determine the price of oil at that time.

In our view, oil production will increase sufficiently to supply that requirement and still retain a significant volume of spare capacity, although considerably less than at present. We estimate conservatively that crude oil and NGL production outside OPEC will rise by about 2.5 million B/D between 1982 and 1990 or less than half the growth of the previous eight years. This will be partially offset by the decline in net CPE exports. The supply balances for both these years and also for 2000 are shown in Table 9.

Table 9
OECD & LDC OIL SUPPLY AND DEMAND
1982-2000
(Million Barrels Per Day)

	1982 (Prelim)	1990	2000
Oil Demand	45.1	49.4	54.7
Inventory Changes	-1.3	00.0	00.0
New Supply Requirements	43.8	49.4	54.7
Oil Supplies			
U.S.*	10.8	10.1	
Canada	1.2	1.3	
Mexico	3.0	4.0	
North Sea	2.7	3.2	
Other*	5.3	7.0	
Subtotal	23.0	25.6	
Net CPE Oil Exports	1.4	0.1	
Total Non-OPEC Supplies	24.4	25.7	25.7-27.7
Required OPEC Oil Production	19.4	23.7	29.0-27.0
Of Which:Crude	18.5	22.0	27.0-25.0

*Includes processing gains and minor quantities synthetics.

Estimates of OPEC's commercially available crude producing capacity as well as its "preferred" production level vary among experts. But there is general agreement that both are substantially in excess of the 22 million B/D required for 1990. Consequently, absent a major physical interruption, the price pressure is likely to be downward until then. At the same time, the projected 1990 level represents a substantial improvement from this year's expected extremely depressed level of 17.5 million B/D. Thus our initial assumption that the real world oil price in 1990 will be moderately below the actual price of 1983 appears realistic, even if one were to assume a somewhat higher OPEC production level because of inventory build-up and restraints in production increases by some non-OPEC exporters.

For the year 2000 our 1% oil demand growth rate for the 1990's results in a demand level of 54.7 million B/D. If oil production outside OPEC does not increase during that period OPEC would have to supply 29 million B/D in the year 2000, including nearly 27 million B/D of crude oil. The possibility of such a development cannot be dismissed, particularly if real oil prices should decline more during the 1980's than we have assumed. In that case the mega-projects to explore and develop the offshore and arctic areas would be curtailed because of their long lead times and very large capital expenditures. Yet, most of the world's remaining reserves outside the Middle East are probably located in those areas.

It is important to recall in this connection that we have assumed that production outside OPEC will remain at capacity, as

it has since the early 1970's, so that non-OPEC reserves are likely to be drained at a much faster rate than those of OPEC, particularly the group's Middle East (Arabian Gulf) producers. Since these producers already hold the world's largest reserves with the highest reserve/production ratio, exploration activities have increasingly moved away from the Middle East.

Excluding the CPE's, non-Middle East reserves account for 39% of world reserves but last year supplied 71% of production, compared to a 55% average in the 1970's. As a consequence substantial excess producing capacity has developed in the Middle East which has the world's lowest production cost while most high cost areas around the world are producing near capacity. An eventual return to the Middle East must therefore be expected. The speed of this development will be inversely related to the price of oil. But under any realistic assumption the production of Middle East oil will increase substantially during the remainder of this century from last year's level of 12 million B/D and so will its share of world production.

If we assume as a more probable alternative to our no-increase scenario that non-OPEC crude production will increase by 2 million B/D in the 1990's , OPEC crude oil production by the year 2000 would have to be 25 million B/D. Neither this volume nor the 27 million B/D required under our other scenario would put any resource or technical constraint on the group's collective produceability by the year 2000. However, since most of the 3-5 million B/D increase from 1990 would come from Middle East suppliers, the 25-27 million B/D requirement for OPEC oil could exceed some of these suppliers' politically or economically

desirable production levels. In that case real world oil prices would rise again, regardless of whether there is still an effective price administering organization by then.

The probability of such a development depends in part on the world oil buyers' degree of confidence in the political and commercial availability of the Middle East's excess producing capacity when needed. A high degree of confidence could act as a disincentive to oil explorations and development in other areas, all of which are higher-cost. A low degree of confidence would have the opposite effect. A related aspect is the future stake of foreign companies in Middle East oil. To the extent to which these companies are, or remain, excluded from participating in the economic rent generated by the low cost of Middle East oil through equity ownership or preferential access, they will seek their own economic rent by continuing looking for oil elsewhere at prevailing administered prices. This would tend to increase the volume of non-Middle East oil, and probably total non-OPEC oil, available in the 1990's.

OPEC members and other exporters may counteract such loss of crude market outlets by forward integration into refining, just as private oil companies did historically. This development which is already underway is likely to diminish the effectiveness of the direct administration of crude prices but not necessarily that of OPEC's indirect price administration tool--country production quotas.

5. THE CENTRALLY PLANNED ECONOMIES

We now turn to the Centrally Planned Economies (CPE's) whose

energy problems are rather different from those of the two other groups of countries we have studied. The two largest CPE's, the Soviet Union and China, are both net energy exporters. The other principal members of the CPEs, the East European countries, are all net energy importers with most of their supplies coming from the Soviet Union. The same is true of Yugoslavia, Cuba, North Korea, Kampuchea, Laos and Vietnam, which, under our definition, are also included among the CPE's.

The net export position of the Soviet Union and China does not mean that these countries have energy surpluses over and above their unconstrained domestic requirements. They appear to have given priority to the exportation of part of their energy production to OECD countries in order to earn the necessary foreign exchange to purchase goods and services from these countries. But these exports are not surplus to domestic requirements such as U.K. oil exports or U.S. coal exports. They represent a trade-off between the need for additional domestic energy and the need for imports of other goods and services. In the case of the Soviet Union there is also a political and contractual obligation to export fuel to the six East European members of the Council for Mutual Economic Assistance (MEA) as well as to Cuba.

The USSR

The USSR is rich in all major fuel supplies. It is the world's largest producer of oil and is projected to become the largest producer of gas by 1990. Despite its favorable position, the growth rate of total energy production in the USSR has slowed considerably since the 1970's and is expected to grow only about

2.2% yearly, for the rest of the century, as shown in Table 10:

Table 10
USSR ENERGY PRODUCTION
1981-2000

	MTOE			Growth Rates (% Per Yr.)	
	1981	1990	2000	1981-1990	1990-2000
Oil*	610	595	575-600	-.3	-0.3 to 0.1
Gas	380	580	800-825	4.8	3.3 to 3.6
Coal	325	380	450-475	1.8	1.7 to 2.3
Nuclear	20	65	125-175	14.0	6.8 to 10.4
Hydro	45	60	75	3.2	2.3
Total	1380	1680	2025-2150	2.2	1.9 to 2.5
Total, Exajoules	61.9	75.3	90.8-96.4		
*(Million B/D)	(12.2)	(11.9)	(11.5-12.0)		

Oil Production is levelling off and is expected to stay in the 11.5-12.0 MB/D range out to 2000. Proven oil reserves (65 Billion Bbls.)are estimated at 9% of world total and additions to reserves are slowing down. Output in several of the older European producing fields is declining and most of the small yearly increases in overall production is from Samotlor, the super-giant field in West Siberian Tiumen which is expected to peak in 1986. In 1981, West Siberia supplied 55% of total USSR production and is believed to reach 75% of total oil output by 2000.

Gas Production has a bright outlook. Almost 40% of total world proven reserves are located in the USSR. Production of gas has more than doubled in the last ten years and is projected to increase about 5% yearly to 1990 and 3-4% yearly to 2000, depending on Soviet capability to complete the pipeline construction program now under way.

Coal Production has actually declined in the last three years and only in 1982 has a turn-around taken place. While the USSR holds some 25% of world coal reserves, technical and transportation problems will permit only a modest growth to 1990.

Energy consumption in the USSR is determined by availability of domestic supplies. Adjustments in the use of the various fuels within this availability presumably depend not only on economic, but also political considerations, such as hard currency earnings and East Bloc energy requirements. USSR energy consumption projections are shown in Table 11.

Table 11
USSR ENERGY CONSUMPTION
1981-2000

	MTOE			Growth Rates (% Per Yr.)	
	1981	1990	2000	1981-1990	1990-2000
Oil*	470	485	475-500	.3	-.2 to +.3
Gas	340	505	700-725	4.5	3.3 to 3.7
Coal	310	365	435-460	1.8	1.8 to 2.3
Other	65	125	200-250	7.5	4.8 to 7.2
Total	1185	1480	1810-1935	2.5	2.0 to 2.7
Total, Exajoules	53.1	66.4	81.2-86.8		
*(Million B/D)	(9.4)	(9.7)	(9.5-10.0)		

Gas will become the largest contributor to energy, gradually substituting for oil in many sectors. Oil will stay flat and lose share, except in the transportation sector. Coal will increase in volume, but account for about 25% of total consumption throughout the years. Sectoral demand of energy in the USSR is very different from other industrial countries. Residential/commercial and transportation use is small, while

industrial and electricity needs account for over 70% of total fuel consumption.

USSR energy exports is projected to remain the major source, 70-75%, of Soviet hard currency earnings. Table 12 shows the volumes of these exports.

Table 12
USSR NET ENERGY EXPORTS
1981-2000
(MTOE)

	1981	1990	2000
Oil*	140	110	100
of which to non-CPE's	(50)	(30)	(20)
Gas	40	75	100
of which to non-CPE's	(15)	(45)	(45)
Coal	15	15	15
of which to non-CPE's	(5)	(5)	(5)
Total	195	200	215
of which to non-CPE's	(70)	(80)	(70)
Total, Exajoules	8.7	9.0	9.6
*(Million B/D)	(2.8)	(2.2)	(2.0)
of which to non-CPE's (MMB/D)	(1.0)	(0.6)	(0.4)

PEOPLE'S REPUBLIC OF CHINA (PRC)

Growth in energy production has levelled off compared to better than 10% yearly in the 1965-75 period. The problems in the energy sector are old technology, poor infrastructure and very low mechanization of coal mines.

The shift in Chinese policy from self-reliance to increasing cooperation with the West and the measures taken for reorienting

the economy, now under way, are expected to reverse the stagnation in energy output, as shown in the following table:

Table 13
PRC ENERGY PRODUCTION
1981-2000

	MTOE			Growth Rates (% Per Yr.)	
	1981	1990	2000	1981-1990	1990-2000
Oil*	100	125	175-200	2.5	3.4 to 4.8
Gas	10	20	25	8	2.3
Coal	290	385	500-550	3.2	2.6 to 3.6
Hydro & Other	15	25	50	5.8	7.2
Total	415	555	750-825	3.3	3.1 to 4.0
Total, Exajoules	18.6	24.9	33.6-37.0		
*(Million B/D)	(2.0)	(2.5)	(3.5-4.0)		

The PRC's economy remains based on coal, which supplies about 70% of total energy. Negotiations with western firms for the development of new coal mines (from reportedly large deposits) are now under way. Railroad and port facilities construction, higher mechanization of mines and other improvements are planned to accelerate coal production in the next decade.

Oil production has flattened. Joint exploration with western firms in the Yellow Sea and in the South China Sea is expected to start in 1984 and, if successful, could double oil production by 2000.

Hydropower has a bright outlook, since only a very small share of hydro resources is now being used and a joint development agreement with the U.S. should show results within the next decade.

Despite reported domestic energy shortages, the PRC is continuing exports of energy for hard currency earnings. While

this is practiced currently on a modest scale (350,000 B/D of oil exports in 1981), it is expected that the joint ventures for oil and probably coal production will raise energy exports substantially by the end of the century.

Meanwhile better planning for the utilization of available energy supplies, measures now being implemented for energy conservation, particularly oil, should ease the current energy shortages and permit the PRC's energy consumption to increase about 3% per year, as shown on Table 14. Coal will remain the basic fuel, accounting for over two-thirds of total consumption.

Table 14
PRC ENERGY CONSUMPTION
1981-2000

	MTOE			Growth Rates (% Per Yr.)	
	1981	1990	2000	1981-1990	1990-2000
Oil*	85	110	145-160	2.9	2.8 to 3.8
Gas	10	20	25	8	2.3
Coal	290	380	470-520	3.0	2.2 to 3.2
Other	15	25	50	5.8	7.2
Total	400	535	690-755	3.3	2.6 to 3.5
Total, Exajoules	17.9	24.0	30.9-33.9		
*(Million B/D)	(1.7)	(2.2)	(2.8-3.0)		

Total CPE Energy Balance

To arrive at an energy supply and demand balance for all CPE's we must also include the six East European MEA members as well as the six other CPE's. The resulting totals are shown in Table 15.

Table 15
TOTAL CPE PRODUCTION AND CONSUMPTION
1981-2000
(MTOE)

	1981		1990		2000	
By Fuel	Prod.	Consump.	Prod.	Consump.	Prod.*	Consump.*
Oil	735	680	740	735	793	797
Gas	430	420	640	605	855	823
Coal	910	900	1140	1110	1370	1348
Other	105	105	210	210	355	375
Total	2180	2105	2730	2660	3373	3343
Total, Exajoules	97.7	94.4	122.4	119.3	151.2	149.9

*Midpoint of ranges indicated in previous tables.

6. WORLD ENERGY CONSUMPTION

We can now construct a world energy outlook by bringing together our projections for the market economies (OECD and LDCs) and the CPE's. The result is shown in Table 16. We are only showing projections for consumption. However, for oil this is very similar to production since we expect both the CPE's and market economies to be nearly self-sufficient from the late 1980's on.

Table 16
PROJECTED GLOBAL ENERGY CONSUMPTION BY
MARKET ECONOMIES(ME) AND
CENTRALLY PLANNED ECONOMIES (CPE), 1981-2000

	1981			1990			2000		
	ME	CPE	TOT.	ME	CPE	TOT.	ME	CPE	TOT.
Oil*	2241	680	2921	2344	735	3079	2602	797	3399
Coal	973	900	1873	1260	1110	2370	1678	1348	3026
Nat.Gas	894	420	1314	1097	605	1702	1225	823	2048
Other	521	105	626	896	210	1106	1286	375	1661
Total	4629	2105	6734	5597	2660	8257	6791	3343	10134
Total, Exajoules	207.6	94.4	301.9	251.0	119.3	370.2	304.5	149.9	454.4
*(Million B/D)	47.0	13.6	60.6	49.4	14.7	64.1	54.7	15.9	70.6

The table shows that energy consumption will rise faster in the CPE's than in the market economies. This is because the amount of energy required per unit of GNP will remain larger in the CPE's than in the OECD countries. In both groups of countries oil consumption will grow considerably slower than total energy consumption throughout the period. Nevertheless by the year 2000 we expect world oil demand to be 10 million B/D higher than in 1981. Thus, the oil age will not end with the century. But oil's relative importance in the energy market appears to be on a long term, perhaps irreversible, decline. In the CPE's this may be due primarily to supply constraints. In the market economies the principal causes are structural changes in demand.