WORLD OIL OUTLOOK

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Why is petroleum used more than other energy resources? It is because petroleum is superior in economy. Economy of an energy is determined in terms of quality, quantity and price. Since the latter half of the 1950's when a large quantity of petroleum started to be produced in the Middle East, petroleum has decreased in price and come into top position among the energy resources in use. Hence, society changed toward mass petroleum consumption. The world had become unable to be kept up without cheap petroleum. Meanwhile the crisis situation developed in the Middle East and the price of petroleum soared, bringing about confusion in the world economy and the start of the energy crisis. In other words, the substance of our energy problems can be summarised as the petroleum resource problem. It resulted because the world economy depended too much on cheap petroleum. The energy crisis does not mean that energy resources ran dry suddenly, but it means oil consuming nations were no longer able to get oil at low prices.

CAUSES OF OIL CRISIS

Maldistribution of Petroleum.

a) 50% of the world's oil deposit is in the Middle East.
b) 67% of the world's oil export is from the Middle East.

Thus, oil producing areas and consuming areas are unevenly distributed, making the world's economy uneasy.

TABLE I

Production and Consumption of Oil in the World — 1978 (in million barrels per day)

Region	Production	Consumption	Difference
US and Canada	11.84	20.18	− 8.34
Latin America	4.965	4.19	+ 0.775
Western Europe	1.82	14.6	− 12.78
Middle East	21.29	1.655	+ 19.633
Africa	6.115	1.24	+ 4.875
Asia	2.41	2.0	− 0.41
Japan	0.01	5.42	− 5.41
Australasia	0.45	0.8	− 0.35
U.S.S.R.	11.705	8 385	+ 3.32
Eastern Europe	0.43	2.070	− 1.64
China	1.93	1.705	+ 0.225
TOTAL	62.965	62.245	
TOTAL OPEC MEMBERS:-	30.155		

The above Table I shows the production and consumption of oil in the world in million barrels per day.

Limited Oil Deposits

Knowing the deposit level of oil resources and the yearly amount of oil production/consumption is very important to achieve an understanding of the real energy crisis.

The following Table II gives comparative estimates of known total recovery of crude oil by region, based on surveys made in the past and a most recent survey conducted by the Rand Corporation. The figures in the two columns on the left are smaller in quantity because they are based on known resources, while the others include probable resources as well.

The figures for regions of the USSR and Asia-Oceania are small in the survey made by Rand Corporation. Among the studies represented in the tables, it appears that the Rand Corporation's survey is most valid.

(Estimated in part using data Moody and Esser and from D.A. Holmbren, J. D. Moody and H. H. Emmerich, "The Structural Settings for Giant Oil and Gas Fields" Proceedings, Ninth World Petroleum Congress, Vol. 3 (Exploration and Transportation), Applied Science Publishers, London 1975 — p.46).

TABLE II Comparative Estimates of Known Total Recovery of Crude Oil by Region (in billion barrels)

REGION	Internat. petroleum Encyclopedia as of 1.1.76	World Oil (as of 1.1.76)	Moody and Esser (as of 1.1.74)	Meyerhoff (as of 1.1.75)	Rand Corporation (as of 1.1.76)
US & Canada	156.4	155.7	168	171	163.2
Latin America	81.5	75.1	83	88	85.0
Western Europe	28.2	21.6	24	29	24.6 (+)
North Africa	53.5	52.9	46	47	52.9 (+)
USSR & East Europe	134.6	112.9	140*	143*	102.4 (+)
Central & South Africa	32.1	21.3	31	31*	22.7
Middle East	453.6	425.6	499	538	509.9 (+)
China	23.0	20.2	10*	20*	2.30 (+)
Asia-Oceania	29.9	28.9	36	38	27.8
WORLD	992.8	914.2	1,037	1,105	1,011.5 (+)
World Reserves end 1978	638.8	560.2	683	751	657.5

* Estimated

The estimated ultimate crude oil resources are consolidated by region in Table III. The total amount is (1700 — 2300) x 109 barrels, which is equivalent to 60-90 years based on the current world consumption of oil.

The total known deposits are given in the above Tables II and III and out of the known deposits about 35% has been consumed at end 1978. Hence, the proven reserve crude oil available at end 1978 is 657.5 billion barrels. This at present consumption rate would last for only about 29 years. The estimated ultimate crude oil resources of Table III are expected to last for 45 - 75 years at end 1978.

However, the most important point to note here is that world production of oil will start decreasing and economic confusions are inevitable in countries depending largely on imported petroleum, unless some measures are taken immediately. The consumption of crude oil did not decrease at all even with the steep price increases. Thus the economic value of this resource is higher than its selling price. Therefore, the price of crude oil would keep going up while production will decrease in extremely serious problem for non-producer oil consuming countries.

TABLE III Estimated Ultimate Conventional World Crude Oil Resources by Region (in billion barrels)

Region	Known	Potential	Total
North America	179.8	100 - 200	280 - 380
South America	68.4	52 - 92	120 - 160
Western Europe	24.6	25 - 45	50 - 70
Eastern Europe/Soviet Union	102.4	63 - 123	165 - 225
Africa	75.6	45 - 94	120 - 120
Middle East	509.9	350 - 630	860 - 1140
Asia - Oceania	50.8	54 - 104	105 - 155
TOTAL	1011.5		

Oil Income

The maldistribution of oil has been turned to advantage by oil-producing countries, especially by the Arab nations, by resource nationalism. The price of oil started to rise rapidly after 1973, bringing forth large increases in the oil income of the OPEC nations. The considerable amount of dollars flowing into the oil-producing countries is a big problem to the world economy. The soaring price of crude oil fanned world-wide inflation and boosted commodity prices. The use of the oil dollar is the most difficult problem for the present and future economy of the world.

Further, due to the large increase in the oil income, the OPEC countries are in a comfortable position to reduce oil supplies and still meet the income requirements of their countries.

OIL PRICE INCREASES

Crude Oil Imports of Sri Lanka

Since the start-up of the oil refinery in 1969 crude oil has been imported by Sri Lanka for processing. The actual average price paid by Sri Lanka for import of crude oil and the trends of increase in prices are given in Table IV.

TABLE IV Average Price of Crude Oil Imported by Sri Lanka in U.S.$. per barrel

Date		F.O.B. Cost	Freight Cost	Total C&F Cost
1969		1.39	0.23	1.62
1970		1.39	0.25	1.64
1971		1.65	0.27	1.92
1972		1.79	0.32	2.11
1973		2.50	0.46	2.96
1974		10.73	0.64	11.37
1975		10.69	0.54	11.23
1976		11.11	0.57	11.68
1977		12.47	0.60	13.07
1978		12.67	0.68	13.35
1979	January	13.40	0.66	14.06
	February	14.15	0.71	14.86
	March	13.73	0.71	14.44
	April	14.78	0.51	15.29
	May	13.89	0.74	14.63
	June	17.10	1.16	18.26
	July	18.51	0.83	19.34
	August	19.69	0.99	20.68
	September	20.21	1.36	21.57
	October	20.53	1.41	21.94
	November	18.71	1.46	20.17
	December	23.36	1.46	24.82

The actual quantity of crude oil imported and the cost of same is given in Table V. (The quantity and value of refined products imported to meet shortfalls are not included).

TABLE V
Gross Imports of Crude Oil

	Quantity (min. barrels)	Value (min. US$)
1969	4.35	7.09
1970	13.35	21.89
1971	11.43	21.95
1972	13.43	28.47
1973	12.91	38.21
1974	12.84	147.27
1975	10.77	121.70
1976	10.70	129.68
1977	11.29	147.89
1978	10.60	141.82
1979	10.37	200.1

Based on the above data, a two to three-fold increase in the value of crude oil imported by Sri Lanka is expected to take place in 1980, in view of the sharp price increases during 1979 and expected increases in 1980.

PROBABLE SOLUTIONS TO OIL CRISIS

The energy substitutes for limited petroleum are the most practical solutions for the oil crisis. World nations are at present trying to develop various substitutes for oil energy.

With OPEC oil costing US.$.20-25 per barrel delivered to European or US refineries, the cost of some of the processes for generating energy from other non-oil "feedstocks" are examined in Table VI.

Since the estimate in Table VI was made, the crude oil price has further increased to U.S.$.35-40 per barrel delivered to European or US refineries. This is expected to encourage the development of substitutes for oil energy.

Coal

The known coal reserves of the world are about 750 billion metric tons hard coal equivalent, which is about 3,600 billion barrels of oil when converted to petroleum. The economically recoverable reserves are equivalent to more than 6,500 billion barrels of oil and the ultimate world coal reserves are estimated to be about ten times those of oil. Also coal is not so unevenly distributed as oil and with the high oil prices of today, consideration is now being given to coal. Besides the use as solid fuel, a great amount of coal will be used as material for synthetic gas or oil. The current world coal consumption is about 13.22 billion barrels of oil equivalent per year and could be considered the lowest cost substitute for oil energy.

Coal-based processes, of course, have disadvantages that are not directly measurable in dollar terms. Coal mining is a dirty, unsightly business and large quantities of coal are vastly more difficult to handle and store than oil. More importantly, the conversion processes are large potential polluters. In a typical Fischer-Tropsch plant, the ratio of coal import to fuels, feedstocks and chemical output is nearly 3:1. This means that nearly two-thirds of the coal mined goes to waste in one way or other. Because of these very considerable disadvantages, coal has to be sold at a substantial discount to oil in terms of equivalent thermal values to compete with it as a feedstock. The Sasol 2 Complex now under construction in South Africa, for example, will take coal at $ 5-7/ton, yet will only compete with oil at $25 per barrel.

Although the more exotic coal conversion techniques have yet to be proven industrially, there are three processes capable of producing synthetic gas already in commercial operation; Koppers-Totzek dust gasification, the Winkler fluidized-bed process and Lurgi's fixed-bed high pressure gasification.

Liquified Natural Gas

The proven resources of natural gas deposits in the world are about 450 billion barrels of oil equivalent. The current world natural gas consumption rate is about 9 billion barrels of oil equivalent per year. Natural gas is a clear fuel and an ideal substitute for light petroleum oil. But additional investment is required for production, storage and transport facilities. However, this could be considered as an important substitute fuel by countries importing petroleum or coal.

Shale Oil and Oil Sand

The oil contained in shale is obtained by dry distillation of shale. The oil contained in oil sand is of high viscostity. Both energy sources are distributed world-wide and the deposits are considerable.

British Petroleum, in a briefing paper published last year, quantified these petroleum resources. The Company estimated that shale oil resources totalled 3,000 to 4,000 billion barrels of which perhaps six per cent could be considered recoverable. Tar sands and heavy oil accounted for another 3,000 to 5,000 billion barrels of which about 10% might be recovered.

Even taking these modest recovery factors into consideration, it is possible to foresee unconventional oil reserves contributing some 600 billion barrels to future oil supplies, almost as much as the present proven reserves of conventional oil.

Improving Recovery of Conventional Oil

Rising prices and improving technology also have a bearing on the way more conventional oil reserves are exploited. Here, too, there is a strong possibility that the amount of recoverable oil will be stretched as time passes. At present, some 70% of the oil in commercial fields is being left in the ground because it is either too difficult or too costly to extract. Given the right conditions and encouragement, the oil industry should be able to improve that recovery factor, at least to 40 or 45%. In many oil fields the industry could do even better.

TABLE VI **Energy Production Costs**
(Excluding taxation, refining, storage, transmission and distribution costs)

	US.$.per barell of oil equivalent
Indigenous coal (US)	3 - 5
Imported coal (NW Europe)	8 - 14
Indigenous coal (NW Europe)	10 - 15
Nuclear fuel	7 - 11
Low BTU gas from indigenous coal (US)	20 - 25
Liquified Natural gas imports	10 - 25
Synthetic Natural gas from indigenous coal (US)	20 - 25
Liquids from indigenous coal (US)	30 - 40
Liquids from imported coal (NW Europe)	30 - 45
Liquids from oil sands	15 - 25
Liquids from oil shale	15 - 35
Biomass liquids	30 - 60
Solar hot water (35° latitude)	50 - 130

Source: Shell "World Energy Prospects" October 1977, updated by Major energy Corporations spring 1979.

To do this, companies need to apply far more exotic and commercially more risky production techniques than are generally used at present. With only a few exceptions, the oil that is currently produced flows to the surface either as a result of natural reservoir pressures or by means of injected water or natural gas. The oil that is left behind is vast in quantity but it presents the industry with one of the biggest technological challenges. Some of the oil will remain untouched for ever, isolated from the producing wells by geological conditions. The rest of the residue is the hard to get oil that may form a film on the walls of the rock pores or it may be locked in the reservoir by droplets of water.

There is no ready-made key to unlock this store of oil, each reservoir is unique and the quality of oil can vary greatly from being thinner than water, on the one hand, to being thicker than cold molasses on the other. To tease this oil out of the ground, production engineers may have to inject steam, encourage a fire in the reservoir, pump in chemicals or mix the trapped oil with a gas. Latest estimates of the U.S. Department of energy show that the minimum price of oil required to justify the use of such methods is as follows.

	1979 US $ per barrel
Steam drive	11 - 16
In-site combustion	13 - 20
Co 2 flooding	13 - 23.50
Surfactant/polymer flooding	20 - 32

Again, it is clear that at least some of these methods are beginning to look economically feasible. In recent years, major oil companies have developed a closer liaison between their research and production teams so that they are in a better position to judge which of their natural oil fields could benefit from the introduction of such new technology.

Shell, in a report published in March, 1979 estimated that the national reserves that could be made available by the application of enhanced recovery techniques could be as much as 400 billion barrels, coincidnetally, the cumulative amount of oil produced to date in the world.

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