C O N T E M P O R A R Y S U R V E Y
O F
I N T E R N A T I O N A L O I L I N D U S T R Y

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P R E F A C E

The present publication entitled "Contemporary Survey of International Oil Industry" - a compilation of selected articles and statistics is the second of the series brought out by Economics & Statistics Division. The first issue of this publication was brought out last year in September. This issue, apart from containing important articles and statistics on contemporary international oil situation, including on optimum rate of extraction of oil in North Seas, perspective on pricing of oil, energy conservation, development of alternative sources of energy, etc. also contains notes/papers contributed by E & S Division, viz. on (i) Pricing of oil in U.S.$ vis-a-vis SDRs; (ii) An analysis of India's trade with OPEC; and (iii) International comparison of prices of selected petroleum products and incidence of taxes/duties. In view of the growing importance of oil in world trade and international monetary transactions and the global need to conserve and optimally utilise exhaustible oil resources through various fiscal, financial and regulatory measures, it is hoped that articles and statistics contained in this publication would be useful to our Executives both in the public sector oil companies and in the Government.

2. While we have taken all possible care in precise and accurate presentation of various articles and statistics contained in this publication, we would welcome suggestions of our readers for any inadvertant error or omission that might have crept in this issue with a view to further improving it. In bringing out this issue, we have received valuable help from S/Shri B.K.Verma, H.R.Chopra, D.C.Garg and A.K.Chopra for which we express our grateful thanks. We are also grateful to S/Shri M.J.Kutty and S.K.Kapoor for stenciling this publication.

Jssinha

October, 1978.

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1. PRICING OF OIL

1.1 THE FUTURE PRICE OF ENERGY : SHOULD OIL PRICES BE PUSHED UPWARD?

by Pierre Desprairies

(The following article by Mr. Pierre Desprairies, President of the Institute Francais du Petrole, is a translation of the French-language original published in the June issue of the Revue de l'Institut Francais du Petrole. It was also presented by Mr. Desprairies as a paper at a meeting of the Oxford Energy Policy Club.)

For the energy exporting and purchasing countries, the future price of energy is a crucial factor in determining their economic growth rates and the direction their investments will take.

It is now more or less universally admitted that this price has an extremely good chance of rising*. Low-cost oil reserves, which are currently the main source of the world-wide energy supply, are no longer keeping pace with demand. We must make the transition from an economic system in which almost all oil is produced at between $ 0.30 and $ 4.00 per barrel to another system in which energy supplies will have increasingly to come from offshore oil at $7 or $ 8 per barrel, from liquefied natural gas at an FOB cost which is unlikely to be below $5 to $6 per barrel of oil equivalent (BOE), from coal produced at between $5 and $10 BOE, from nuclear energy at between $7 and $9 BOE, and from unconventional oil at between $8 and $15 BOE. Even if almost all these costs are less or even much less than the current selling price of oil ($13/barrel), and even if 80% of world oil supplies in 1990 are still produced at less than $5/barrel, a long-range upward movement of prices appears inevitable. A concerted effort will have to be made by both the exporting and consuming countries to make the required investments in time to spare the world population the risk of the economic calamity which would result from a physical shortage of energy.

Almost everybody agrees with the preceding analysis. In contrast, two essential questions evoke varying replies. When will it be necessary and desirable for the evolution towards a price rise to begin? Towards what future price level should this evolution be directed?

* The rise in prices under consideration in this article is expressed in constant (1973) US dollars. The problem of indexation - i.e. of maintaining the 1974 purchasing power of the proceeds from the sale of a barrel of oil - is not dealt with here.

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Various governmental or independent authorities consider that the upward movement must begin as soon as possible, and preferably now, if the world economy is to be protected from fearsome upheavals. Several proposals have been put forth in this field, by the Club of Rome in 1974, by several leaders of producing countries during 1977, and by James Akins, the former US Ambassador to Saudi Arabia. In the Western countries, various experts suggest that it would be wise to begin right away and to direct efforts towards a doubling of oil prices.

These proposals include various hypotheses on the depreciation of the dollar and the dates when recourse to unconventional oil in commercial quantities will become inevitable. Mr. Akins proposes that oil prices should be indexed until about 1985, followed by a rise in prices (in constant dollars) to push their level up to that of unconventional oil in 10 years, i.e. by around 1995. He reminds us that the Arab countries would prefer to reduce this period by half, so that a price equivalent to unconventional oil would be reached by 1985. Others - the Club of Rome - would prefer to see this rise begin in 1975 at a rate of 3% per year in constant prices. In April 1978 the International Energy Agency (IEA) was thinking in terms of a rise equivalent to 2.5% per year in constant prices, beginning in 1985. Still others speak of doubling current selling prices, while failing to specify whether constant or current dollars are involved. The most radical among them propose immediate programmed rises ranging up to 15% per year in current terms, while emphasizing the fact that both oil and natural gas must be involved at the same time in order to achieve the objective in 1985.

In all these cases, the objective is the price of the most expensive category of unconventional oil (oil shale, coal-derived oil), which is also the most expensive fossil energy with an estimated cost of about $20 per barrel in 1977 dollars.* In constant money the price would therefore increase by about 50% between now and 1985.

These proposals will have to be carefully examined by both oil exporting and purchasing countries at the appropriate time. As things stand now, we can merely formulate a few comments of a very general nature.

1. In purely economic terms, a short-term rise in crude oil prices is difficult to conceive of as long as unused production capacity remains as large as it is now (25% to 30% in the OPEC countries alone).

*Should the cost of the most expensive unconventional oil be estimated at $20 or $25 (1977 dollars) per barrel? $25 is the figure most frequently mentioned nowadays. However, taking the long-term view, it may be presumed that improvements in production technology will permit a significant decrease in the 15% interest rate on invested capital employed in the calculations to date, with resulting costs in the $15 to $20 range. This is the rationale for the use of the latter cost figure here, but the figure itself does not materially affect the main argument.

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2. Is the most expensive unconventional oil the best price level to be used as a reference? By what date will it begin to be essential for world supplies, and when can it begin being produced in meaningful quantities in world market terms? Hardly before the end of the 1990s if we consider economic growth rates and the energy supply situation now considered to be the most probable. Before resorting to shale oil costing $ 20 per barrel, it is logical to hope that the highly productive investments in energy conservation, which have yet to be made, will be given priority. We can also hope that most of the conventional oil still remaining to be discovered will be exploited, especially in the developing countries, for which it will be an important source of economic progress. Likewise, we can anticipate that large-scale production of nuclear energy and coal will be undertaken as a substitute for oil. There are also several types of cheaper unconventional oil, such as deep offshore oil and enhanced-recovery oil, which should be produced long before shale oil and coal-derived oil.

3. Our reasoning must not be based on the assumption that oil will maintain its present position in the energy market, when about half of the needs it now meets can be covered by coal or nuclear fuel costing 25% to 50% less than oil in 1978. We must devote a top-priority effort to ensuring that the world's valuable oil resources last as long as possible, so that the segment of energy requirements that can be covered only by oil costing $15 to $20 per barrel occurs as late as possible and is as small as possible. We must see to it that the development of the energy situation is speeded up, so that by the end of this century the energy market will be divided into two separate parts :

- A fuel market based on nuclear electricity and coal, with prices governed by the cost of these sources of energy.

- A petroleum market for specific petroleum uses, approximately one-half the size of the present market for these purposes, so that a gradual reduction in supplies will allow this market to be supplied over a longer period with oil that is more and more expensive to produce. This covers land, air and sea transport, agricultural tractors, lubricants, petrochemicals, butane and propane, asphalt, a large portion of home heating for a fairly long time to come and general energy supplies for the majority of the developing countries.

4. There is no doubt that a rise in oil prices will help to curb demand and speed up the replacement of oil by alternative sources of energy, both of which are desirable developments. On the other hand, the stimulating effect

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of a price rise on the increase of world-wide energy resources appears slight at first glance compared to the sums the consumers would have to pay. In most exporting countries the amounts paid by purchasers would not in the main go to increase energy production, except in the very few countries which have already embarked upon a program to develop their energy resources, such as Iran and Algeria. There is no question of contesting the priority nature of development needs for most such countries which such additional revenues would in many cases help to satisfy. We will come back to this. Let us simply mention here that this is a different problem from that of energy resources. In the sparsely populated countries which are the leading producers, an increase in prices would further increase world credit inflation. In fact, the development of energy resources throughout the world depends much more on political decisions by governments than on any rise in prices - decisions concerning taxation and regulations to ensure the future of nuclear power and coal, for which the new generations of electric power stations between now and 1990 will be the main customers. Nuclear energy and coal are already much less expensive than oil, but if coal-fired or nuclear power plants are not built, the tendency of the consumers to change fuels in reaction to the rising cost of oil will be frustrated. It is also a political decision to set margins that will enable private and state petroleum companies to explore for and produce new and more expensive conventional oil and, in the developing countries, to set up a system of guarantees which will undoubtedly be required if petroleum and energy investments are to be stepped up. As for the production of unconventional oil, it is primarily dependent on the development of technologies which are still too expensive and which will, for many years to come and no matter what the price of oil may be, require a combination of government subsidies and private sector efforts.

It is not realistic to speak purely in economic terms. We must not forget that half of the crude oil consumed in the world is sold by developing countries to industrialized countries. In addition to the cost, which has been the only aspect dealt with here, and which is more often than not only a small portion of the selling price, this price includes taxes which go toward the development of the selling country. Current production costs and selling prices enable the countries in the Middle East to make $10-$12 per barrel sold. If production costs increase, and if competition from coal and nuclear energy limits income from taxes on oil production in the foreseeable future, we must not conclude that these taxes will have to be reduced by a corresponding amount. Oil must remain one of the raw materials which has a lasting contribution to make to the gradual transfer of a share of the rate of growth from the industrialized countries to the developing exporters which is necessary for the long-range economic progress of both groups of countries. A hard look at the future suggests that in the next 10 or 15 years the

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cost of the most expensive unconventional oil ($20 BOE in 1978 dollars) will hardly be more than a sort of ceiling price or an objective to be achieved at the end of this century.

What, in actual fact, will take place, considering the possibility of far-reaching political or military upheavals in the Middle East? The time will come when the worldwide surplus in production capacity will irrevocably begin to diminish and the exporting countries will begin to gain the upper hand in the market. At present rates of consumption and production of petroleum and other energy sources, this situation should come to pass within the next decade, at a date which is difficult to specify and in circumstances which will cause considerable tension with regard to supplies. It is probable that the exporting countries will then demand, in addition to $12/bbl in royalties, a sum equivalent to the actual or anticipated increase in costs attributable to secondary recovery programs (water and gas injection) which will initially serve to maintain or significantly increase production - say, probably in the range of $ 2-3/barrel. To this may be added a further price increment designed to augment the financial resources earmarked for purposes of development with a view also to slowing down the rate of depletion of reserves.

What might be the price resulting from the sum of these three factors? First of all it will depend on the extent of the industrialized countries' capacity to pay out without appreciably reducing the amounts they purchase - as was the case in 1975. The stronger the economic recovery is, the higher the price increase could be. Another factor will be the capacity to pay of petroleum-purchasing and non-oil producing developing countries, over and above that part of the increases which the exporting countries refund to them. Similarly, present and future developments in nuclear energy and coal must be taken into consideration. It will be difficult for the price to rise from $13/barrel to $20/barrel if the half of the energy market in question can be supplied by an alternative source of energy costing less than, or even much less than, $ 10/barrel. The $20/barrel cost of unconventional oil appears to be the long-range limiting factor for price increases.

Things could turn out differently, and the increases might be much greater, if the crisis were to occur later after a lengthy economic recovery and a period of insufficient energy investment in the industrialized countries, and/or if the Arabian Peninsula were to cut back its deliveries sharply and permanently. This would cause a physical shortage of resources which would have serious consequences and result in oil becoming an auction commodity which would be so expensive that only the richest buyers could afford to pay for it. It would cost perhaps two to three times the present market price of $13/barrel until such time as demand once again diminished to the same level

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as supply. Such a rise would probably be accompanied by a sharp and lasting economic recession - that is to say by a considerable decrease in oil sales. Such a situation would be harmful to both the selling and the purchasing countries.

This is a fascinating and difficult topic which it would be very useful to include in the North-South Dialogue. The time was not ripe when France took the initiative of setting up the Paris Conference in 1975. Is it any more so today? Will the inevitable need for a dialogue be accepted without having to go through the ordeal of a crisis which, on both sides, would open the eyes of the general public and enable the governments to begin to discuss their common future? One would certainly hope so; but the outcome is still very doubtful.

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Source: Middle East Economic Survey, Vol. XXI, No.41, 31 July 1978.

1.2 PRESSURE FOR OPEC'S ACTION ON DOLLAR

Determined pressure, spearheaded by Kuwait, is mounting within the OPEC ranks to do something to compensate member countries for the seemingly inexorable weakness of the US dollar. So far, this momentum has not reached the point of general agreement on the holding of an extraordinary ministerial conference to review prices in the light of the dollar crisis. (An informal OPEC ministerial gathering, scheduled for 3 April in Geneva, is mandated to discuss long-term energy strategy only, not current prices or the dollar crisis - see page 10.) It may yet do so, but the likelihood is perhaps not very great owing to the known coolness of Saudi Arabia towards the idea of holding an extraordinary conference to reopen the price issue, even if specifically restricted to the dollar fall-out, before the next regular conference in Geneva in mid-June.

The Saudis are, of course, deeply committed both to supporting the dollar (in which the bulk of their enormous foreign-asset holdings are denominated) and to maintaining the oil price freeze at least till the end of 1978. However, they too recognize that some adjustment to the dollar price quotation may have to be introduced at mid-year to compensate for OPEC's dollar losses if the decline for the US currency persists until then. This, they stress, would not be a breach of the price freeze, merely an inevitable compensation for a world monetary disequilibrium. In such a case, the Saudis might well go along with a dollar price increase effective 1 July 1978 in line with an appropriate currency indexation formula with a base point at 1 January 1978. However, the general hope in Saudi Arabia seems to be that the dollar will recover sufficiently by then to render such action necessary.

The majority of OPEC would like to go farther and faster on the dollar question than the two price-freeze leaders, Saudi Arabia and Iran, are prepared for (though the latter has shown some signs of weakening). But the danger of introducing any currency indexation formula - as OPEC knows from previous experience - is that one may be caught uncomfortably short by the dollar's upswing if and when it comes. This is no doubt why some in OPEC would much prefer to have a one-shot increase in prices to compensate for past losses and leave it at that.

However, if formula there has to be there are now three candidates for the post: the SDR (with its heavy dollar weighting tending to blunt the fluctuations both upward and downward); the 11-currency Geneva II basket (which excludes the dollar); and the three-tier basket, including currencies of both industrialized and OPEC countries as well as gold, now proposed by the UAE Oil Minister, Dr. Mana al-Otaiba.

Statements on the Dollar Question

The following is a round-up of position statements by leading officials in various OPEC countries regarding the dollar problem.

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Kuwait: No Longer Bound by Caracas Price Freeze

Kuwait's mounting concern over the continuing decline in the value of the US dollar was underlined by the unscheduled visit which its Finance Minister, Mr. 'abd al-Rahman al-'Atiqi, made to Riyadh on 7 March where he conferred with his Saudi opposite number, Shaikh Muhammad Aba al-Khail.

Earlier, on 3 March, Mr. 'Atiqi, in a statement to the Kuwait daily al-Watan, declared that OPEC "is now absolved of its commitment to freeze oil prices," and stressed that the US and the other industrial countries should have done something about shoring up the dollar and curtailing the rise in the price of their exports following OPEC's decision to freeze oil prices last December.

"The time has come to lay down the criteria through which it would be possible to compensate for the sharp decline in the value of the dollar," he said, adding that in his view an oil price increase should be introduced with retroactive effect to 1 January 1978 "to enable the oil producing countries to obtain the real price of their oil by compensating them for the decline in the dollar."

Asked whether he supported the idea of determining oil prices on the basis of a basket of currencies, or alternatively adjusting oil prices upward or downward to reflect fluctuations in the value of the dollar, he replied that either method would safeguard the oil producers' rights, and that choice of approach should be left to the Oil Ministers of OPEC.

Mr. 'Atiqi stressed the need for the adoption of a unified stand by the OPEC member countries on this issue in order to safeguard their rights. "Solidarity between the member countries on this issue is of paramount importance, particularly between the big producers such as Saudi Arabia and Iran. Unity of approach by these two countries would be of particular significance since they have contributed to the stability of the world economy and should be shown some respect for the position they took at the most recent OPEC conference.

Mr. 'Atiqi went on to enumerate the factors that necessitate a reassessment by the OPEC countries of their stand at Caracas: "I, for once, accepted the price freeze last December, but during the past two months there have been great changes, and no one can blame me if I have reconsidered my position."

The Kuwaiti Finance Minister explained that he was not calling for compensation for the dollar drop and imported inflation in respect of the year 1977. "But if, by closing ranks, we in OPEC succeed in getting compensated for the losses of the past two months, the world will not blame us."

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Mr. 'Atiqi said that there was no doubt that the decision to freeze oil prices last December was based on the expectation that the value of the dollar would be stablized and imported inflation would be curtailed. "But this did not happen and for this reason Kuwait is cont-acting the other member countries with a view to convening an extraordinary meeting to discuss these problems," he said.

More recently, on 7 March, Kuwait's Oil Minister, Shaikh 'Ali al-Khalifah al-Sabah, hinted that a big increase in oil prices was unavoidable if Kuwait and the other oil producers were to be compensated for the losses they had sustained as a result of the continuing fall in the value of the US dollar. Speaking in the course of an interview with the Arab Times of Kuwait, Shaikh 'Ali said that the real losses sustained by Kuwait amount to substantially more than the $1 million-a-day figure mentioned earlier in the week, and added that the only way to compensate for these losses was "to raise prices and raise them by a not inconsiderable amount." He said losses had been heavy and dated back to the Doha OPEC conference in 1976: "Such big losses call for quick decisions to stop the side."

Shaikh 'Ali spoke about another aspect of this monetary crisis namely the fall in the purchasing power of the Kuwaiti dinar in international markets and said that the losses resulting from this should also be compensated for. "The question of how to compensate for our losses is now our prime concern", he said, but affirmed that Kuwait was hoping to reach agreement with other OPEC countries on an oil pricing policy for the future.

Asked if Kuwait planned to call an extraordinary conference of OPEC to discuss these problems, he replied that the mechanics of convening such a conference was straightforward in that it required the agreement of only seven members for it to be held.

The same day, 7 March, the Kuwaiti Foreign Minister, Shaikh Sabah al-Ahmad, announced that his government had begun a series of consultations with other OPEC member countries to agree on a unified approach to the problem of the declining dollar.

Saudi Arabia: Full Backing for the Dollar

On 6 March 1978, in a statement to the daily al-Riyadh, Mr. 'Abd al-Aziz Turki, the Deputy Minister of Petroleum and Mineral Resources, stressed that whereas it was conceivable that oil producers might raise their oil prices which are quoted in dollars, there was no question of abandoning the dollar as the currency of payment for oil. He said that the OPEC countries were studying the possibility of convening an extraordinary conference of OPEC to discuss the effects of the dollar's decline on the purchasing power of their revenues.

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However, he pointed out that the OPEC countries were still studying the reasons for the dollar's decline and had not yet been called to meet on this issue. "If the causes of the decline appeard to indicate a continuing fall in dollar values, then OPEC will no doubt take appropriate action to protect the interests of its member states as it has done in the past," he said.

He noted that OPEC was studying the relationship between the US currency and the International Monetary Fund's Special Drawing Rights and added that "the important thing is to discover the causes of the dollar's decline and determine whether it is a short or a long term phenomenon."

"We should not take any precipitate action which might have harmful effects," he cautioned.

On 4 March, the Saudi Minister of Finance, Shaikh Muhammad Aba al-Khail, affirmed that "it is in the interest of Saudi Arabia and the Gulf countries to support the US dollar." Saudi Arabia and the Gulf countries should avoid anything that might lead to the continued instability of the US currency, he was quoted as saying.

He emphasized the status of the dollar as the appropriate currency for big financnail transactions. It is the monetary unit of the international trade exchanges, and as an international reserve currency has practically replaced gold since mid-1972.

The Minister noted that the actual value of the dollar derived its strength from the US economy, the biggest in the world, and added that the Kingdom and many other countries using the dollar as a reserve and commercial exchange currency had suffered from its present depressed condition which was attributable to competition in world trade between the US, West Germany and Japan.

Shaikh Muhammad pointed to the limited role of other international currencies as compared with the dollar and the fact that the host countries of those currencies were reluctant to permit the building up of large foreign holdings in their currencies and were enacting legislation to prevent this.

He affirmed that oil revenues would continue to be paid in US dollars because there was no other currency that could serve in this role.

Shaikh Muhammad noted that the present dollar crisis was due to the large US trade deficit during 1977 and the failure of the US Congress to ratify President Carter's energy bill, as well as other aspects of international economic co-mpetition. He said that it would be in the interest of the

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whole world for the US, West Germany and Japan to resolve their differences and to agree on specific limits for the exchange rates of their currencies. The present state of affairs could not continue indefinitely, especially with the continuous US purchase of dollars on international markets and the eventual Congressional ratification of the energy bill.

The Saudi Finance Minister denied that the value of the Saudi riyal was directly linked to the dollar. He said the Saudi Arabian Monetary Agency determines the exchange value of the riyal against the dollar according to the riyal's parity with the SDR but explained that SAMA has a certain leeway in determining this parity in order to ensure the continuing stability of the riyal which is a requisite of orderly development.

The Saudi dilemma concerning the US dollar was the subject of a comment made by Mr. Farouk al-Akhdar, the Secretary General of the Royal Commission for Jubail and Yanbu, in the Saudi daily al-Jazirah, 8 March. He said that the fact that a large part of Saudi monetary reserves are held in US dollars makes it incumbent upon Saudi Arabia to support the dollar in order to safeguard the value of its own assets. He dismissed suggestions that payments for oil should be collected in Saudi riyals as harmful to the interests of the Saudi national economy because it would mean that the riyal would soon become an international currency no longer subject to national control, and would subject the Saudi consumer to decision falling outside the realm of Saudi Arabia's national economic administration.

Mr. Akhdar also explained the reasons why the Saudi riyal had not risen in value by the same ratio as the decline in the US dollar. He said that the Saudi monetary authorities decided not to respond to the increase in the value of the SDR, to which the riyal is tied, because that would have harmed the national economy. "Any sudden and sizeable increase in the value of the riyal would have led to the flight of a su-bstantial part of the country's oil wealth abroad and caused losses to the Saudi Treasury to the advantage of foreign firms who do business in Saudi Arabia since their contracts are expressed in riyals".

UAE: Oil Minister Otaiba Proposes New Currency Basket for Calculating Oil Prices

The UAE Minister of Petroleum and Mineral Resources, Dr. Mana' Saeed al-Otaiba, has called for the adoption of a new basket of currencies to be used as a basis for calculating oil prices. In a lecture delivered in Abu Dhabi on 7 March to a group of senior UAE diplomats, Dr. Otaiba proposed a three-tier basket composed of currencies of the industrialized countries and the oil producers as well as gold, as follows :

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- First tier representing 70% of the total basket and composed of currencies of the industrialized countries in the following proportions: US Dollar, 15%; Deutsche Mark, 12%; Pound Sterling, 10%; Swiss Franc, 10%; Japanese Yen, 10%; Canadian Dollar, 7%; French Franc, 6%.

- Second tier representing 20% of the total basket and composed of strong currencies of the oil exporting countries, as follows: Saudi Arabian Riyal, 10%, Kuwaiti Dinar, 5%; UAE Dirham, 5%.

- Third tier representing 10% of the total basket and composed of gold.

Iraq: Purchasing Power Must Be Safeguarded

The Iraqi Oil Minister, Mr. Tayeh Abdul-Karim, told the Iraqi News Agency on 8 March that the problem of the decline in the US dollar "cannot be solved except by developing an alternative to the system of pricing oil in US dollars." He said Iraq supported any solution which would safeguard the purchasing power of oil revenues, whether by switching to SDRs or to a Geneva II type formula.

Earlier on 6 March, the semi-official daily al-Thawrah urged that oil prices should be increased to compensate for the fall in the value of the US dollar, and inflation in the industrialized countries. In an allusion to Saudi Arabia and Iran, the paper attacked "those forces which have thwarted a decision on adjusting oil prices at the Caracas conference of OPEC," and blamed them for continuing to exert pressure to maintain a freeze in oil prices through to the end of the year.

Qatar: Minister Calls for Creation of OPEC Dollar

Qatar's Minister of Finance and Oil on 6 March called for the creation of a new unit of currency - an OPEC dollar - which would be used to determine oil prices, thereby stemming the losses of the oil producers resulting from the fall in the value of the US dollar. He said OPEC has sustained losses totaling $ 14 billion as a result of the dollar's decline.

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Source: Middle East Economic Survey, Vol. XXI, No. 21, 13 March 1978.

1.3 OPEC STAYS WITH DOLLAR

Ever since its inception eighteen years ago, the Organisation of Petroleum Exporting Countries has had one dominant aim - to maximise government revenues from the export of crude oil. This is the cement that has bound the structure together. In many other respects - as with most international bodies - the 13 member governments are disunited. They differ greatly in the size of their crude oil reserves and therefore in their attitude towards production: Saudi Arabia is reckoned to have over 110 billion barrels of proved reserves, whereas Qatar has under 6 billion and Ecuador less than 2 billion. Their revenue needs vary widely, a few of them being unable to spend all their vast incomes. And their political affiliations are poles apart: Saudi Arabia has close links with the West, whereas Iraq leans towards the Soviet Union.

These differences, economic and political, have become more evident of late and have been brought into sharper focus by the events of the recent past. They were reflected in the inconclusive meeting of oil ministers held in Saudi Arabia in May 1978. The unexpected decision to hold such an informal get-together was taken at last December's Caracas conference. The meeting was intended to provide the opportunity for the kind of forward-looking discussion for which there is no time at the regular semi-annual conferences. So it was said that there would be no agenda and no decision making.

Cause for concern

But recent events made it certain that two subjects would be uppermost in the oil ministers' minds when the meeting was finally held. They were the continued slack demand for OPEC exports and the prolonged weakness of the dollar on the foreign exchange markets. These factors were eroding the OPEC governments' revenues. So it is not surprising that in March and April loud voices were heard proclaiming that urgent consideration must be given to these problems.

At their previous gathering in Caracas last December, failure to reach a unanimous decision on pricing - largely because Iran joined Saudi Arabia and the UAE in resisting an increase - resulted in a continued freeze. The marker crude, Arabian Light, remained at the figure of $ 12.70 a barrel to which it had been raised six months earlier. For the majority of OPEC members, however, prices remained at the level fixed at the beginning of 1977. Since then the stagnation of Western economies and the rise of non-OPEC production has resulted in a slack demand for OPEC exports. As a result, crude oil production in OPEC countries during the first quarter of this year (under 28.2 million b/d) was 10 per cent below the previous year's level and price discounting was common on spot markets.

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The effect of the buyer's market on government oil revenues was aggravated by the continued weakness of the dollar, the currency in which oil prices are denominated. The answer to the questi-on how much the dollar has depreciated depends partly on the basis of the calculation. But OPEC reckons that between the beginning of 1977 and April 1978 the depreciation was 18 per cent. And accordi-ng to Dr.Hassan Ali Mekran, deputy chairman of the National Iranian Oil Co and former governor of Iran's Central Bank, this decline meant for OPEC countries some $ 20 billion a year in lost revenues. (Their revenues in 1976 are estimated to have totalled $ 117 billion). OPEC economists more cautiously put the loss at between $12 and $20 billion a year.

Governments with the greatest need of revenue (e.g. Algeria and Nigeria) were naturally most conscious of the loss. But the difference in the impact as between one country and another was due to other factors also. Iraq for instance makes most of its payments for Soviet arms in dollars and thus suffered a direct loss of purchasing power as the dollar declined. Venezueala, on the other hand, was less severely affected because much of its trade is with the USA. Again, some countries with surplus revenues had diversified their liquid assets out of dollars and derived some benefit from the strength (eg.) of the Swiss franc and the German mark. However, the fall in the dollar was a legitimate concern of all OPEC governments. It meant that the real price of oil had not been steady but had declined; some of the governments naturally wanted to ventilate their grievance at the May meeting.

Saudi Arabia, however, was reluctant to agree to any action that would aggravate the dollar's decline. Apparently in the hope - or perhaps the assurance from Washington - that recovery of the dollar was just round the corner, the Riyadh government insisted that the much-heralded meeting should be postponed from 4th April to 6th May. (An OPEC spokesman explained that 'more time was needed to study the issues involved'). In addition, the venue was changed from Geneva to the Saudi summer capital Taif, where the delegates would be less in the limelight.

Whether or not the Saudis had any clear understanding with Washington on this issue, the special relationship between the two countries is evident to all. Saudi Arabia is the biggest foreign source of oil for the USA, supplying over 18 per cent of last year's total imports; and production of this oil is in the hands of Aramco - owned by four US majors in partnership with the state. Since the Riyadh government receives more oil revenue than it can spend, it will need incentives of a different kind if the envisaged expansion of oil production facilities to 14 million b/d is to take place. On the other hand, Saudi Arabia took a quarter of its merchandise imports from the USA last year and now has a big investment stake in that country. It thus has a keen interest in the stability of the dollar.

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Politically Washington regards the Saudi government as a stabilising influence in a strategically important area of the world. Saudi money is used to pack moderate Arab regimes and to combat Soviet infiltration. To fulfil its role the government believes that it must have modern armaments and, in particular, American F-15 jet fighters. Recent statements by top-ranking Saudis, including the foreign minister and the oil minister, demonstrate the depth of feeling in Riyadh on this issue. If Congress refused to sanction the sale of F-15 aircraft then, said Shaikh Ahmed Saki Yamani (the oil minister) last month, "we will have the feeling that you are not concerned with our security and do not appreciate our friendship". Had the Senate not voted its agreement on 15th May, Saudi enthusiasm for the dollar might have faded away.

Alternatives to the dollar

What then? The majority of the delegates at last month's (May 1978) meeting were not proposing to abandon the dollar as the unit of payment in the international oil trade. They were looking for some feasible method of adjusting the dollar price to compensate for the depreciation of the US currency against the D-mark, the Swiss franc, the yen, etc. A paper prepared for them by OPEC's economics departments suggested a number of possibilities.

The changing value of the dollar could be calculated in relation to :(a) the group of 11 currencies * that were listed in the Geneva-II agreement of June 1973; (b) the group of 16 currencies which is in future to be used by the IMF in calculating the value of its special drawing rights (SDR) - but excluding the dollar, the Saudi riyal and the Iranian rial; (c) the four or five leading world currencies - again excluding the dollar. Using these tools, and adopting three different weighting systems, the OPEC study yielded a range of results. It showed that, according to the basis of calculation chosen, the price of the marker crude would need to be raised (on 1st March 1978) from the official figure of $ 12.70 to between $13.39 and $15.09 a barrel to compensate for the depreciation of the dollar.

The OPEC economists did not commit themselves to any one of these methods. But it is interesting to note their conclusion that the calculation of oil prices in terms of SDRs - formally agreed by OPEC at its Gabon Conference in June 1975 but not implemented - would have resulted in a loss of oil revenues of from $19.5 to $27.6 billion, according to the method of calculation. This is a reminder that the dollar has had

* The 11 currencies are: Australian and Canadian dollars, Belgian, French and Swiss francs, the D-mark, lira, yen, Dutch guilder, Swedish krone and the pound sterling.

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previous bouts of depression from which it has made a good recovery - and in recent weeks there has been evidence that the decline in the dollar may have been arrested, in accordance with Washington's promise. At all events, the OPEC governments will stay with the dollar for the time being.

Price prospects now

The alternative to some form of indexation to compensate for currency depreciation is a straight increase in the price of the market crude. In the present state of the market, however, this would tend to reduce the demand for OPEC oil while doing nothing to promote that recovery of the world economy on which the growth of demand ultimately depends.

Prices were not within the province of last month's meeting, but it is significant that OPEC's secretary-general forecast in Taif that one result of the conference scheduled for 15th June would be a freezing of prices till the end of this year. Shaikh Yamani went further, arguing that because the oil surplus is unlikely to pass away until 1981 or 1982, prices should remain stable for three or four years. Some of his colleagues may not welcome this prognosis, though it may indeed turn out that the next few years are characterised by the price stability he envisages.

The longer-term prospect is quite different. If and when demand for OPEC oil once again forges ahead, and the existing surplus producing capacity is absorbed, the divisions between the governments will lose some of their relevance and the price hawks may come into their own. To formulate appropriate policies for the medium and longer-term - and to make recommendations for action - is the task assigned last month to a new six-man committee of oil ministers. Including the representatives of Iran, Iraq, Saudi Arabia, Kuwait, Algeria and Venezueala, it covers a broad spectrum of viewpoints and interests. If the committee takes its remit seriously it will have some tricky problems to discuss. The rest of the world will have a keen interest in the policies it formulates and the recommendations it puts forward.

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Source: Petroleum Economist, June, 1978.

1.4 PRICING OF OIL : ROLE OF THE CONTROLLING POWER

By Ali M. Jaidah, Secretary General of OPEC.

1. INTRODUCTION

It is a welcome opportunity for me to be able to address an academic audience like you. There are several challanges in this setting. Many of you will, no doubt, assume positions from which you can influence the policies of the United States in various degrees. If I can arouse your curiosity in the problems I shall raise, this in itself will be a worthwhile contribution to the debate on the desired New Economic Order we are involved in shaping.

The developing countries of the Third World, as well as the advanced countries of OECD, are committed, in principle, to reform the present inadequate state of affairs. A particularly interesting aspect of this encounter is that we might be starting our dialogue from very distant positions. You are citizens of the most advanced and influential industrial society, while I speak for a group of developing countries blamed for so many of the world's troubles, recession, inflation, energy shortages, currency problems.....etc.

There is nothing more fatal than mistrust and misunderstanding. In our world, so precariously surviving on a complexity of delicate balances, policies based on false assumption might undermine the whole balance. A great deal of suffering and unhappiness could be averted by keeping a dialogue going on between all parties concerned. Hopefully, a dialogue would bring about positive cooperation; but the least it could do would be to defuse unwarranted confrontation.

For these reasons, I have picked an area which might provoke most debate: oil prices. In my belief, facing the issue is better than ducking it.

There is a great body of literature on oil prices. Distinguished economists and oil men have approached the subject from various aspects. Many authors have tried to explain the nature of oil prices and their evolution. Several of them tackled the question from the point of view of the Majors or the consuming countries. Others tried hard to be objective.

Perhaps the most thorough work in the field of petroleum economics is the research by Professor Adelman during the Sixties and culminating in the publication of his masterly volume "The World Petroleum Market" round about the time when all his predictions were shattered by events proving the exact opposite of what he preached. During the Sixties, he showed, with painstaking throughness, that the marginal cost of supplying the world with oil for 15-20 years was about 20 cents per barrel, or at most,

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30 cents per barrel. His conclusion was that oil prices had only one way to go down.

II. CONTROLLING POWER AS PRICE MAKER

It is, indeed, a source of disappointment to realize that all these worthy men gave us little insight into the nature of oil prices and their probable direction. It is, however, neither rewarding nor charitable to accuse all of them of misjudgement. I would suggest that tools of analysis applied in the past, tools many of us still use, are not fitting to the situation under consideration. Equilibrium economics in a competitive environment, with its obsession to equate marginal costs with prices, is useless when we do not have a competitive situation and where the margin is nowhere in sight.

Why were oil prices around U.S. $ 3.00/bbl before the Second World War? Why were they just over U.S.$ 1.00 in the Middle East a few years ago? Why are they now over U.S.$ 12.00? We will never find the answer in marginal cost nor in Ricardian rent. We can only find it in an objective analysis of the forces which have a vested interest in oil prices and have the power to influence those prices. Such forces can bring to bear various pressures to manipulate prices to serve their own interests; whether by direct or indirect means.

It is important to remember that the oil industry until very recently, was dominated by Western companies and Western governments, if we set aside the oil industry in the U.S.S.R. If we go back to the origin of Oil Agreements in the areas which now comprise OPEC Member Countries, we find that those co-called Agreements were one-sided affairs. Concessions were carved up along the lines in which spheres of influence were determined as part of the spoils which followed the great wars. Many Oil Agreements, especially those concluded before the Second World War, were the result of negotiations between unequal parties. Many oil companies which used to operate in OPEC Member countries resembled a state within a state. They were extensions of the foreign policies of the "Controlling Powers" - especially the United States and Great Britian. Other European powers were involved in the spoils, but to a lesser extent. The International Majors, which are basically Anglo-Saxon, entered our countries as the instruments of the traditional European powers on the one hand and the ascending political and economic influence of the United States, on the other hand.

These Majors exercised the "Controlling Power" on behalf of their respective partons. This is well-documented history now. Where we are mislead is in the pretensions that the Majors made their pricing policy purely on commercial terms, subject to traditional competitive equilibria.

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Prior to World War II, the bulk of oil entering international trade came from the U.S.A. Therefore, the oil exported from the Gulf of Mexico was not allowed to be undercut by cheaper oil coming from the new producers of the Middle East. This gave rise to the "Gulf-Plus" formula, which stipulated that the price of oil anywhere outside the U.S. was equal to its price in the Gulf of Mexico plus the cost of transporting it to any point of sale. During the war effort, the European Allies were pressing for cheaper fuel. New theories were promulgated to pronounce that this indeed was an economic equilibrium. The famous "Watershed" theories first demanded that oil coming into Europe had to have a similar price whether it was exported from the Middle East or form the Gulf of Mexico. This meant bringing down the oil prices in the Middle East. Later, oil prices in the Middle East were brought down further when the same Watershed theories were adjusted to allow the United States to import oil from the Middle East. By the late Forties, oil prices in the Middle East were lower than those on the Eastern Seaboard of the U.S.A. by the same magnitude by which they were higher prior to the war.

What had dictated those price reductions? The producing countries were given at the time a flat four English shillings per ton. No substantial changes in the cost of production have taken place. The only change can be traced to the shift in the balance of forces making up the "Controlling Power". The higher prices forced on Europe earlier gave way to the new relationship of the Allies during and immediately after the War. Cheap fuels for Europe were an essential pre-requisite for its recovery, and thus an integral part of the Marshall Plan. The oil resources of the present members of OPEC, especially those in the Middle East, were speedily developed in one of the most massive operations in recent history. Perhaps this cheap source of energy contributed more than any other factor to the rapid recovery of Europe in the Post-War period. It is not too much to ask now that Europe should repay some of its debt to the developing countries of OPEC in their own efforts at industrialization.

Until the early Fifties, when "Profit-Sharing" arrangements prevailed, oil companies were not interested in the price level as long as they could maximize their total net income after taxation in their own countries. They paid no taxes to the producing countries. Their net profits were determined by the difference between their total costs and average income on sales of petroleum products. Crude oil prices were never real outside the United States. There, they represented the income of oil producers who were selling oil to the big oil companies. Those companies bought oil in the real sense of the word from the numerous private producers of Texas and Lousisiana.

Nobody sold oil in the Middle East - and nobody bought it in any real sense. There were only big swaps between the International Majors. Crude oil prices were mere entires in the books of the Majors.

Variations in the Posted Prices of Middle Eastern oil, prior to profit-sharing, meant little to the producing countries, apart from the fact that the value of their resources was being downgraded. But when profit-sharing came about, it was based on Posted Prices, which were already low enough. As if this were more than we deserved, Posted Prices were further lowered in the spring of 1959 by $ .05 - .25 per barrel in Venezuela and by an average of $ .18 per barrel in the Middle East. In August of 1960, Middle Eastern oil prices were further reduced by another $ .04- .14 per ba-rrel. This unreasonable exercise of power by price makers was the direct provocation which forced oil producers to form an organization for oil exporters to counterbalance the prevailing controlling power of the Majors backed by the governments of the U.S.A. and Europe. OPEC came into being one month after the last price reduction.

To the Majors, payments to producing governments were a form of cost. Any elementary textbook would tell you that corporations tend to minimize average costs. With Posted Prices at $ 1.80 per barrel, the cost of lifting oil was less than $ 1.00, and the books of the companies were showing profits in the range of $ .80 per barrel. This meant a rate of return on investment in the region of 100% in many producing countries. The book-value of those investments was low indeed, and many investments were fully amortized. To make their exorbitant profits at the production stage look acceptable, the Majors used to lump all their Eastern Hemisphere accounts together, thereby showing more moderate returns. They reduced their apparent profitability (and tax liability) further by ploughing back a lot of investment to their home countries (see table 1). During the Sixties, the companies resorted to a number of tactics to prevent the newly formed OPEC from realizing its aim of adjusting Posted Prices upwards. The arguments they advanced were mainly as follows :

1. There was an increasing surplus of oil in the world, as attested by surplus capacity reaching 50% in some cases.
2. Soviet exports were forcing the Majors to put down their prices.
3. Independent oil companies were creating hot competition and forcing prices down.

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First, the story of surplus sounds ood for companies which were pouring billions into the North Sea, Alaska, and elsewhere outside OPEC in order to develop new capacities (see table 1). In any case, anyone who looks at the production of Kuwait, Iran and Iraq during the Fifties would realize that the companies not only turned the taps on and off to meet exactly the quantities consumed, but also that they developed surplus capacities to pressurize one country or the other. During the Sixties, they were pressurizing the whole of OPEC. The truth is that spare production capacity has always been part of the oil industry without resulting in over-supply.

Secondly, Soviet oil was never a real threat. It came very slowly, moving from about 16 million tons of crude oil and petroleum products exported outside the socialist countries, to about 30 million tons in 1965. By 1970, those exports were about 48 M.T., representing less than 4% of world oil exports during that year, at a time when annual demand increases were about twice as much.

Thirdly, independent oil companies never made prices in the situation that existed at the time, but rather followed the Majors in pricing decisions as marginal producers normally do. It is curious to note that those very independents were paying more in taxes and other forms of income to OPEC Countries than the Majors, despite the fact that their actual costs of production were higher and their fields smaller. Many of them had to sell their crude back to the Majors because they had no outlets.

The Majors went a step further. A new phenomenon appeared in the mid-Sixties called "arms-length transactions": a sort of occasional show to demonstrate how prices of crude oil were going down. We were treated to a spectacle where crude oil prices were shown to go down from $ 1.80 per barrel in the early Sixties to about $ 1.30 per barrel by the end of that decade. Despite this decline which was supposed to have a detrimental effect on net corporate profits, these net profits rose from about $ 2.8 billion in 1961 to about $ 4.8 billion in 1970 (see table 2).

Here we come to the real crux of the matter. Prices of petroleum products are the only really meaingful reference, if we want to analyse the oil industry. It is perhaps here that the traditional economic analysts made their mistake. They tried to analyse crude oil prices - which were of little relevance - and ignored the real point where demand makes itself felt: the final prices of petroleum products.

A composite barrel of petroleum products in the main European markets averaged about $ 13.60 when OPEC came into being. If we remove the direct costs of production, transportation, refining and distribution, we might be

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left with more than $ 10 per barrel, even if we allow normal return on capital for investment in the various stages. There are many variations in costs as well as in product prices from one country to the other. We are here interested only in the order of magnitude. What we want to stress very strongly is that the real price for petroleum is the price for petroleum products and not Posted Prices or what is called arms-length prices of crude oil. It is at this price that demand interacts with supply. It is at this price that the consumer makes his choice felt. It follows that the split of profits at this price level reflects the real relationship between the forces that make up the "Controlling Power".

When OPEC came into being, the consumer governments of Europe took over $ 7 per barrel - or about 70% of the profit the producer governments getting only about $ 0.76, or 7.6% (see table 3). The companies books might not show the full net income per barrel, but this is attributable to the fact that they were using profits generated from operations in OPEC to finance less rewarding activities.

It is food for thought to pounder on the idea that, if the governments of the main consuming countries had been prepared to pass down the total rent generated by oil to its rightful resource owners, the individual consumers might be still paying for a composite barrel of products, prices not much different from what they used to do before OPEC was set up.

III. SHARING THE CONTROL OF POWER

OPEC succeeded in putting an end to the unilateral determination of Posted Prices by the oil companies right from the start. It concentrated on the only real hard factthat its end of the operation income per barrel exported. In this connection, it got more from independent companies than from the Majors. Those newcomers were prepared to share their controlling power with OPEC countries.

New agreements were reached with these newcomers in new areas or areas relinquished by the Majors. The new type of agreements recognized the sovereignty of our countries over our resources. They brought in the principle of participation with our national companies (or the relevant state organs).

New conservation laws were enacted to put an end to the wasteful production techniques practiced by the Majors, making some use of U.S. conservation experience. New regulations brought the old concessions gradually into the fold. OPEC income from oil exported from the Middle-East moved from about $ 0.76 per barrel when OPEC came into being in 1960, to $ 1.35 in 1971, and to $ 1.56 in 1972. What is more important, OPEC began to share the Controlling Power.

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This new status enabled OPEC to take over the decision to determine its income per barrel exported on October 16, 1973. Thus, OPEC increased its income per barrel on the Marker Crude to an average of about $ 9 in 1974 and to $ 10 in 1975.

This completely new situation caught the other side of the Controlling Power (i.e. the oil companies and the importing countries of the OECD) of guard. The taxes levied by consumer governments on a composite barrel of products in Europe were about $ 7.60 when OPEC came into being. They had gone up to $ 8.70 in 1971 and to $ 11.40 in 1973, which represents a much greater increase than OPEC income. OPEC income had gone up by $ 1.54 per barrel while consumer governments in Europe increased their share by $ 4.40 for the same period. But, in 1974, OPEC increased its share by $ 6.70 per barrel, while the European governments had to bring down their average income by about $ 1.00 per barrel. This was a truly historic shift in controlling power. But it did not last long. By 1975, those govern-ments pushed up their income by about $ 4.40 per barrel of products, and continue to enhance it even further at the expense of the final consumer.

These facts reveal a situation which cannot be analysed in terms of the classical theory of international trade where all parties increase their welfare when each concentrates on his comparative advantage. Here we have a situation of competition to get a larger slice of the same cake : the value generated by a barrel of crude oil. The main contending parties are :

- The Consuming Countries of the OECD
- The International Majors, and
- The Member Countries of OPEC

Since 1973, the International Majors and other companies of the OECD Countries have lost most of their claim to independent behaviour, especially since the creation of the International Energy Agency and its complex controls and logistic powers.

If we measure the share of power by the slice of the income, we find only 30% of the total worth of a barrel in Europe of about $ 33.20 going to OPEC countries in 1975. The consumer governments get 45% of that in direct taxes. They also get further income through the Value Added Tax (VAT), and yet an other slice through taxes on the income of oil companies.

If we analyse the respective share in the power to control, in terms of decision, OPEC might turn out to share even less than 40% of the real decisions. The reasons for this belief are many :-

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1. The OPEC Countries still make the real price decisions at the end of the line and, therefore, they control total demand. OPEC can only manipulate their income at the point of export.

2. The OECD Countries hold the vital element of pricing goods and services on which we spend our money. Our import price index has more than doubled since the beginning of 1974, thus halving the value of our oil exports.

3. OPEC Countries have little influence on the International Monetary and Financial Institutions which matter so much to the currency of pricing (i.e., the U.S.Dollar), and to our temporary surpluses which are recycled to the OECD Countries.

4. The OECD Countries control the basic decisions affecting the development of indigenous alternatives to oil, as well as the direction of research and development in this area.

Those who have waited so much ink and paper to warn the world of the evils of the dictatorial powers of an irresponsible/ unrepentant advocates of Western hegemony over the Third /OPEC are World. OPEC has thrown all of its weight into the effort either misto bring about a New Economic Order for the world; a world informed, or in which those who had little say in the evaluation of else they their resources would share in the controlling power. We are want a fair deal; a package in which the producers, manufacturers and users of the exhaustible resources of the world would cooperate in striving towards a higher quality of life for all people.

IV. CONCEPTUAL PROBLEMS IN OIL PRICING

If, for a moment, we imagine that the world is one economy, without boundaries and without conflicting interests, and then ask the following question : How to price petroleum resources? What answers do we get?

Liquid and gaseous hydrocarbons (oil and gas) are finite in their availability. They are exhaustible resources like so many of the natural resources on which our civilization was built. We cannot use up those resources as if they were inexhaustible.

The economic theory of exhaustible resources tells us that the optimal price for such finite resources - like the prices of goods held in a warhouse - should rise annually in real terms at rates equal to interest rates or some appropriate discount factor for time. This is necessary to induce an orderly production profile over time and to maximize the present value of the profit or rent derived

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from the reserves of our common resources. This price curve which rises over time should help to restrict demand, the closer we come to the point of scarcity and depletion. In this way, other technologies would meet future human requirements at the higher price level; a price level sufficient to make the necessary technologies viable. The price curve should not be so steep that alternatives take over before the resource has been used up, nor so flat that the result is depletion without making alternative viable. The conditions for such optimal pricing and production policy can never be met in real life, but must be kept in mind. One of the difficulties about petroleum prices is that hydrocarbons are not a homogenous commodity meeting a single demand. Residual fuel oil for power generation is the lest valuable form of using hydrocarbons in direct burning. A more efficient form of consuming petroleum is in the internal combustion engine. Perhaps the most rewarding use of hydrocarbons is not in the field of energy, but in using them as a petrochemical feed to produce synthetics, fertilizers, proteins, etc. Each of these uses represents an optimal price level different from the others. We should not think of a price level for oil which takes only power generation into account and depletes the resources on that basis alone. Another vital issue has to be examined in our theoretical unified world. Future generations cannot be doomed by our present waste of scarce resources. Some consideration for inter-generational equity has to be made. Theoretical price curves are not enough. We might find out that direct conservation is called for, not only to avoid waste (like U.S. conservation and pro-rationing laws), but also to provide for the future. This deliberate holding back of production would necessarily mean upward price adjustment. We have to give up a little to save the future.

Now we have to come back to reality and see what all this means in the harsher light of our divided world.

The pricing of petroleum products, we find, tends to encourage wasteful burning and heavily penalize the more efficient users. As an example of this, we find that in Italy, a power station can buy fuel oil at about $ 91.20 per ton at a time when other alternatives in power generation are estimated to cost over $ 150 per ton of oil equivalent. Premium gasoline, on the other hand, costs the motorist over $ 790 per ton, while alternatives are nowhere in sight. This is a general pattern in all OECD countries, including the U.S. This sort of situation is only possible because prices of crude oil are separated from prices of products.

By this separation, two things are achieved; less is given to producers, and some of the high rentability of petroleum resources is used to subsidize inefficient uses. If we cannot ask for oil prices to go up to the level

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of the most efficient use (with the highest rent), at least we can initially argue that oil prices could be related to the alternatives of the least efficient use, which is, in this case, nuclear energy.

Rent and rentability can only be related to the resource base from which they arise. The fact that this rent goes largely to consumer governments has to be gradually redressed. One aspect has to be eliminated as speedily as possible for the sake of rational utilization of fossil fuels. Much of the rent derived from oil is used by the industrial countries in direct and indirect subsidies to coal and nuclear industries. To find out the real cost of nuclear energy, you have to let electricity prices rise gradually to the point where private capital starts pouring into nuclear power plants. All environmental and waste-disposal costs have to be added to the investments requirements. Only at that level could be say that the cost of alternative technology is real. This level can serve as a floor for oil prices - not a ceiling. We must start from now to think about limiting the use of oil in direct burning and to divert it to more efficient uses. Those uses naturally have greater rentability.

V. SOME INTERIM CONSIDERATIONS

While striving to find aworkable formula for international cooperation in the UN, UNCTAD, the Paris Conference and other fora, OPEC is concerned about the implications of crude oil pricing in the interim period.

OPEC has accepted the responsibility of meeting world requirements for crude oil. This has resulted in production rates in some countries in excess of their immediate requirements for foreign exchange. Temporary monetary surpluses have been generated. To avoid any disturbance in the already shaky international money markets, those surpluses were recycled to the OECD countries. Large sums were also set aside for the needy countries of the Third World. These surpluses must be given profitable and secure investment channels by the consumers whose high demand requirements continue to force the generation of such surpluses.

A more serious problem is the effect of inflation on oil prices and prices of imports of the OPEC Countries. Unless inflation is checked, OPEC has no choice but to adjust its oil prices to maintain the real value of its exports. Long price freezes mean a decline in real oil prices. If this continues, we are found to face another crisis coupled with absolute energy shortages. A solution to the high levels of inflation cannot be found in lowering the

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prices of imported oil. It is to be found in a better control of money supply and a wage policy related to productivity. We do not accept the argument that the poorer nations of the world, including OPEC Countries which are all developing countries, should pay the price for keeping up the living standard in the advanced countries beyond the means of those countries.

As I said earlier, OPEC Countries are developing countries. The money we get from the export of oil is only a means to achieve our development requirements. We have to transform our exhuastible assets into fixed capital formation which enables our economies to achieve sustained growth. In this development effort, we need a counter-commitment on the part of the consumers to help in making such development possible, especially with respect to the transfer of technology at reasonable terms.

Coupled with this development objective, we have to stress another responsibility to the future generation of our countries. We should not be expected to deplete our energy resources without consideration for the energy requirements of our own countries in the future. It would be a great folly indeed, if we should allow our oil to be exported at low prices and thus condemn our future generations to import energy at much higher costs. Either we are provided with a global energy package whereby we are guaranteed alternative technologies at reasonable costs, or we will have to modify gradually our open-ended commitment to meet the world's demand for oil.

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Source: Petroleum Intelligence Weekly, Special Supplement of May 16, 1977.

1.5 TWO TIER PRICE SYSTEM WAS A WORTHWHILE EXPERIENCE

In an article entitled "Reflections on the Two-Tier Price System: A Worthwhile Experience" published in the August issue of the OPEC Review, Mr. Ali Jaidah, Secretary General of OPEC, writes that the differences of opinion which were voiced at the Doha OPEC Conference and resulted in the two-tier price system "were not a harbinger of OPEC's doom but, on the contrary, the normal healthy expression of that democratic principle which says that everybody has the right to his own point of view."

Mr. Jaidah says that it would be strange indeed to expect all thirteen of the OPEC countries, which are spread over three continents, to reach unanimity on every issue raised, adding that the two-tier system was a compromise designed to take account of individual member countries' views. "At no time during the deliberations was the solidarity of the Organization in danger of being impaired," he affirms, "for all OPEC member countries know that their interests can be best served by OPEC. They would never permit internal differences to destroy an institution so painstakingly built up over the years, for in so doing they would be destroying themselves."

Mr. Jaidah stresses that OPEC's role in the world is no longer confined to protecting the interests of its own members: "Indeed, what began as the Organization's raison d'etre has long since been overtaken by responsibilities of a far greater magnitude. I refer, of course, to the other developing countries of the Third World and the struggle to establish a new international economic order to replace the present inequities prevailing in the management and distribution of the world's national wealth and natural resources. Within this context one can understand OPEC's stand and the role it chose to play at the Conference on International Economic Cooperation (CIEC)."

After listing the generous outflow of loans and contributions from the OPEC countries via the $ 1.6 billion OPEC Special Fund and other bilateral and multilateral channels, he assets that the volume of resources transferred from oil exporting countries to other developing countries has amounted to approximately 6 percent of the former's GNP since 1974, half of which has been highly concessionary.

Mr. Jaidah argues that it is in the interest of the industrialized oil importing countries that OPEC should continue to speak for the producers because it has shown a great deal of understanding for the West's economic problems in recent years: "Despite continuing inroads into oil revenues as a result of imported inflation, OPEC has shown moderation in oil price increases and faithfully adhered to its commitment to meet the demand for oil at considerable sacrifice to its own future generations."

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He points out that OPEC is now too deeply involved in world economic affairs to permit its existence to be threatened by transitory differences of opinion, and that any serious damage done to the Organization could only be to the detriment of both the developing and the developed countries.

Finally, he concludes by saying that to the extent that the two-tier price system demonstrated OPEC's inherent democracy and the awareness of its members of the importance of their unity, as well as refuting once and for all the widely held misconception that OPEC is a cartel, "this particular chapter in the OPEC story can be described as a worthwhile experience."

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Source: Middle East Survey.

1.6 ESTIMATED COST OF ALTERNATIVE FUELS

In an article, Dr.M.L.Sharrah, Senior Vice-President for Research & Engineering of the Continental Oil Company(CONCO) in the latest issue of the Conoco Company journal on the basis of research and development in other sources of energy has estimated that even the most promising alternatives to oil would require a price of $ 24-27/barrel to make them commercially viable. This is much expensive in USA compared with imported oil at $13/barrel and new domestic oil at $11/barrel. Even assuming a moderate 15% return on invested capital, Dr.Sharrah concludes that the prices of the five alternative sources of energy closest to profitable exploitation are all in the range of $ 24 to $27/barrel (1975 dollars energy equivlance with oil basis). Taking into account plant construction and operating costs, Dr.Sharrah estimates the necessary price of oil from tar sands at $ 27 a barrel; of oil from Shale at $24 a barrel; of coal-gasification at $24 a barrel of coal liquification at $24/barrel and of methanol from coal at $24 a barrel. "Improved technology will probably provide only slight improvement in the economies. Furthermore, lower raw material costs, capital requirements or operating costs seem unlikely in the future".

Dr.Sharrah is even less optimistic about a second group of alternative sources of energy. The broader reactor, despite its potential economic advantages, will not make a significant contribution to energy supplies before the mid-1990's at the earliest, largely because many questions of safety and reliability have yet to be answered, questions that can only be answered satisfactorily by years of demonstration. Nuclear fusion is extremely difficult to achieve and control and, to date, no one has succeeded in making controlled fusion produce more energy than it consumes. Although significant technological advances can be expected over the next 10 years, it is unlikely that fusion will contribute to energy supplies until well into the next century.

Turning to solar energy, Dr.Sharrah says: "Solar cells require no fuel other than sunlight, are relatively indestructible, and require little if any maintenance. When an economical way to convert sunlight to electricity is found, this alternative could be a major source of power. I dont' believe, however, that it is just around the corner." The prospects for geothermal energy are also not good. Geysers are rare, probably exhaustible and their output is small. While it is technically feasible to reach hot dry rock below the earth's crust, holes would have to be drilled into the earth and a fluid would have to be put down some of the holes to be vaporized. The cost of such a project would be tremendous, Dr.Sharrah comments: "' rank getting energy from hot dry rocks lowest in probability for early commercial development."

Source: Middle East Economic Survey, Vol.XIX, No.47
13 September, 1976, Pages 6 and 7.

1.7 PRICING OF INTERNATIONAL OIL IN U.S.$ VIS-A-VIS SDRs - AN ANALYSIS AND EVALUATION FOR THE PERIOD 1974 to 1977 WITH SPECIFIC REFERENCE TO INDIA

(Contributed by E & S Division)

POL imports constitutes an important proportion of India's total imports (28%) today and this position is not expected to change in the foreseeable future despite efforts made in the direction to explore and exploit more oil resources from both onshore and offshore areas. The Draft Sixth Plan (1978-79 to 1982-83) envisages a significant rise in consumption of POL products from a level of 25.6 MMT in 1977-78 to 36.6 MMT in 1982-83 and in the production of indigenous crude oil from a level of about 13 MMT in 1978-79 to about 18 MMT in 1982-83. At the en-visaged level of POL consumption and indigenous production of crude oil (both onshore and offshore), the imports of crude oil is estimated to increase from the current level of 14 MMT per annum to 17.7 MMT in 1982-83 while the product imports are likely to remain at the level of around 2 MMT per annum. Various prognostic estim-ate and econometric forecast made by Experts International Ag-encies indicate that a situation of stringent oil supplies might develop by middle of 1980s leading to inevit-able rise in crude prices in terms of constant dollars, leave apart current dollars which, of late, has shown signs of weakness. On a very conservative forecast of 4 to 5% per annum rise in international price of crude oil, the present f.o.b. pr-ice of international crude of $ 12.71/bbl is likely to reach or even exceed a level of $ 15/bbl by 1982-83; and our total imp-ort bill for both crude and petroleum products may reach a high figure of about Rs.2000 crores (or $ 2200 million) per annum on current reck-oning. These estimates are based on the curre-nt value of dollar vis-a-vis rupee which under a regime of floating exchange rates might vary upwards or downwards or remain st-able depending upon the relative strength of the U.S. dollar vis-a-vis Indian rupee. In view of our high import bill for POL products, both exchange rate variations and international crude price variations are of important economic significance to our econo-my, since a 10% variation in $/rupee exchange rate or similar variation in international price of crude wo-uld, on current reckoning make an impact of Rs.150 to Rs.200 crores per annum over the peri-od 1978-79/1982-83.

2. In terms of the existing arrangement where prices of international crude and POL are expressed in US$ and payments are also made in U.S.$, one could visualise of atleast 4 distinct situation :

i) A rise of say 10% in price of imported crude oil and similar rise in product prices would affect our current import bill for POL by about Rs.150 crores per annum, since present import of POL is reckoned at over Rs.1500 crores ;

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ii) A 10% depreciation in the dollar value of rupee, apart from affecting our overall import bill would reduce our import bill for crude oil and petroleum products by nearly Rs.150 crores per annum ;

iii) A rise of 10% in the dollar price of oil (POL) accompanied by say a 10% erosion in dollar value vis-a-vis Indian rupee would hardly make any impact but our import bill for all other commodities would fall by about 10%; and

iv) A 10% rise in dollar value of oil accompanied by similar appreciation in dollar value of rupee will have the 'composite effect' of magnifying our current import bill (in terms of rupees) to the tune of about Rs.300 crores per annum, apart from inflating our 'import bill for all other commodities'.

3. We could visualise variety of other permutations and combinations as set out above within the framework of prevailing international monetary arrangements wherein oil prices are not only set in terms of dollars but payments are also made in dollars. However, one of the main weakness of the existing arrangement which is based on floating exchange rates is that in a period of unusual inflation or recession such an arrangement causes instability in international monetary transactions. The U.S. economy, which once was a powerful economy in defending the value of dollar vis-a-vis gold has today not been able to stabilise the external value of its dollar. Frequent variations in the value of U.S. dollar has created a situation of unstability and whenever dollar has shown signs of weakness (resulting in fall in oil revenues for the OPEC), the OPEC countries have been prompted to consider setting up price for their oil in terms of more stable international currency like SDR.

4. Of late, a move is afoot in OPEC's circle for setting the price of oil in terms of SDRs or some variant of SDR instead of U.S.dollar because of the continued weakness of U.S. Dollar in recent months which has eroded by around 5% (from 1 SDR = 1.16 $ in September 1977 to 1 SDR = 1.215 $ in January 1978). The SDR is based on the weighted average of the exchange rates of standard basket of 16 major currencies having more than 1% share of world's exports. The weights assigned to each of the 16 currencies for valuation of SDR and sample valuation in respect of each currency is given in the attached Statement I. The advantage claimed for

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pricing of oil in terms of SDR is that it provides the OPEC with a reliable unit of account consistent with measure of stability. If on a particular day the dollar was weak it would make only a nominal impact on the value of SDR since Deutch Mark or French 'Franc' would have gained in relation to dollar. The pricing of oil in terms of SDR provides a hedge to oil exporting countries against inflation in Western countries and consequent fall in their revenue earnings from oil. It is this aspect of SDR (in the wake of falling dollar value), which has pushed once again SDR to the centre of international oil and financial transactions, although there are for-ces/pressures which are working in other directions too. For instance, U.A.E. has proposed a new system for quoting crude oil prices using a composite unit of which U.S. dollar would represent 70%, OPEC currencies 20% and gold 10%.

5. Historically OPEC's efforts to overcome problem of currency fluctuati-ons has come up only when U.S.$ has shown signs of persistent we-akness. As early as January 1972, the Geneva I Agreement between the OPEC and the oil companies provided for a quarterly adjustment of prices in line with a formula based on a basket of 9 currencies. This was amended by June 1973 Geneva II Agreement which provided for monthly adjustment of prices ba-sed on a basket of 11 currencies and included Australian dollar, Belgian Franc, Canadian dollar, French Franc, West German Mark, Italian Lira, Japanese Yen, Netherl-ands Givilder, Swedish Kroner, U.K. Pound Sterling and Swiss Franc. The dollar was purposely excluded in order to avoid its impact on the valuation of basket of above currencies. However, the whole formula was abandoned in the wake of oil crisis and oil price explosion at the end of 1973. The OPEC countries, on account of renewed weakness of dollar in the mid 1975, again decided in principle to adopt SDR as a unit of account for expression of their crude oil prices. But this decision too remained unimplemented because of the restrengthening of dollar just at that time. In view of the fact that problem of pricing of oil either in terms of dollars or in terms of SDR or some variant of SDR has once again come to the forefront, it is relevant to analyse and evaluate the imp-act of such a move on our economy.

6. The object of this note is, therefore, to analyse and evaluate :

i) The relationship between US dollar/SDR and U.S. dollar/Indian rupee exchange rates over the last 4/5 years ;

ii) To what ext-ent, under the existing arrangement (of fixing the price of international oil in terms of U. S. dollars and making payments in terms of dollars), the $/rupee exchange

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variations over the base years say 1974, could have made an impact on our import bill over the years ; and

iii) (a) If the price of international crude or petroleum produ-cts had been set in terms of SDR but payments settled in terms of U.S. dollar or (b) if the pric-es were set in terms of SDR and payments also settled in SDRs what would have been their impact on our import bill for oil vis-a-vis existing arrangements.

7. A statement showing monthly exchange rate variations as between $/rupee, $/SDR and rupee/SDR since 1974 is provided as Atta-chment II. The following table gives the average annual conversion rates in respect of rupee/$, $/SDR and rupee/SDR :

Year	Average $/rupee ex.rate	Index	Average $/SDR ex.rate	Index	Average rupee/SDR ex.rate	Index
1974	7.94	100.00	1.205	100.0	9.56	100.0
1975	8.34	105.04	1.213	100.66	10.10	105.65
1976	8.92	112.34	1.155	95.85	10.33	108.05
1977	8.77	110.45	1.168	96.92	10.25	107.22
1978 (Jan-Feb.)	(8.21)	(103.4)	(1.215)	(100.83)	(9.96)	(104.18)

The following results emerge from the analysis of these figures :

i) It will be seen from the ab-ove figures that there is gr-eater degree of stability in rupee/SDR conversion rates than in the rupee/$ conversion rates if we take the annual average conversion rates. The appreciation in the rupee value of dollar was of the order of 12.34% in 1976 (over 1974) and 10.45% in 1977 (over 1974) as against 8.05% and 7.22% in respect of rupee value of SDR. The coefficient of variation in former case works out to 4.51% as against 1.35% in the rupee/SDR converion rates ;

ii) Over the four years period 1974 to 1977, the appreciation in the $/rupee conversion rate was higher than the appreciation in SDR/rupee exchan-ge rate. This means that if we had assumed 1974 as the base ye-ar for setting the price of oil in terms of SDR rather than in terms of $, and if the payment had also been made in terms of SDR, the foreign exchange outgo

in terms of SDRs would have been smaller than in the existing arrangement by about 2.92% (the ratio which differentials of 107.22 and 110.45 bears to 110.45). On current reckoning this would have made a total difference of about Rs.40 crores per annum in our import bill for oil ; and

iii) However, if the price of oil had been fixed in terms of SDRs and payment had been made in terms of dollars in 1977, we might have been slightly worse off over the situation existing by 0.18% calculated as follows :

$$\frac{107.22}{96.92} - (110.45) = (110.63 - 110.45) = 0.18\%$$

The concl-usions at (ii) and (iii) above would hold true even if we had assumed 1975 as the base year (when OPEC indicated the move to shift to SDRs) for fixation of crude oil price in terms of SDRs.

The broad conclusions that emerge from above analysis is that in period when rupee value of dollar is falling or dollar is weakening, it is advantageous for India (as in recent months) if pric-es of internati-onal crudes are set in terms of dollars, since a 10% erosion in dollar/rupee exchange rate would make an impa-ct of less than 3% or even lower in eroding the value of SDR (as the weightage given to U.S. dollar in SDR valuation is 33%). In a situation where rupee value for dollar is rising, India would tend to gain if prices of oil are set in terms of SDR, for a rise in the SDR value would be much less than in dollar value because of the countervailing effect of other currencies constituting SDR.

Statement I

The SDR: Weights and Sample Valuation

Currency	Weights assigned to each currency in one SDR	Currency units per SDR Sept. 13, 1974	Currency amounts under Rule O-3	Valuation of the SDR		Currency units for SDR Sept. 13, 1976
				Exchange rates 1	US dollar equivalent	
Australian dollar	1.5	0.7969	0.012	0.802	0.0150	0.9241
Austrian schilling	1.0	22.3392	0.220	17.800	0.0124	20.5050
Belgian franc	3.5	46.7562	1.600	38.730	0.0413	44.6148
Canadian dollar	6.0	1.1687	0.071	1.024	0.0727	1.1235
Danish krone	1.5	7.4227	0.110	6.035	0.0182	6.9531
Deutsche mark	12.5	3.1552	0.380	2.509	0.1514	2.8903
French franc	7.5	5.7029	0.440	4.929	0.0893	5.6771
Italian lira	6.0	783.945	47.000	840.500	0.0559	968.653
Japanese yen	7.5	357.641	26.000	287.450	0.0904	331.180
Netherlan-ds guilder	4.5	3.2130	0.140	2.622	0.0534	3.0209
Norweigian krone	1.5	6.5792	0.099	5.466	0.0181	6.2964
Pound Ste-rling	9.0	0.5114	0.045	1.748	0.0787	0.6590
South Afr-ican rand	1.0	0.8279	0.008	0.870	0.0094	1.0019
Spanish peseta	1.5	68.2939	1.100	67.920	0.0162	78.2411
Swedish krone	2.5	5.3042	0.130	4.380	0.0297	5.0446
U.S.Dollar	33.0	1.1839	0.400	1.000	0.4000	1.1521

1 Exchange rates in terms of currency un-its per U.S.dollar except for the Pound Sterling and the Canadian Dollar, which are expressed as U.S.dollars per currency unit.

Rate source : London rates except for the yen, which is the Tokyo representative rate.

So-urce: I.M.F. Survey 20th September, 1976, Supplement to the issue.

Statement II

Statement showing monthly exchange rate variations as between $/rupee, $/SDR and Rupee/SDR since 1974

	Rupee/$ exchange rate				$/SDR exchange rate				Rupee/SDR exchange rate			
	1974	1975	1976	1977	1974	1975	1976	1977	1974	1975	1976	1977
Janu-ary	8.26	7.91	8.87	8.90	1.21	1.24	1.17	1.15	9.99	9.81	10.38	10.24
February	8.00	7.81	8.87	8.93	1.21	1.26	1.17	1.16	9.68	9.84	10.38	10.36
March	7.84	7.84	8.90	8.86	1.21	1.25	1.16	1.16	9.40	9.80	10.32	10.28
April	7.75	7.94	8.98	8.85	1.21	1.24	1.15	1.16	9.38	9.85	10.33	10.27
May	7.66	8.00	9.05	8.87	1.21	1.25	1.14	1.16	9.27	10.00	10.32	10.29
June	7.78	8.20	8.93	8.87	1.21	1.24	1.15	1.17	9.41	10.17	10.27	10.38
July	7.87	8.44	8.87	8.82	1.20	1.19	1.15	1.17	9.44	10.04	10.20	10.32
August	8.03	8.62	8.93	8.78	1.18	1.19	1.16	1.16	9.48	10.26	10.27	10.18
September	8.03	8.81	9.05	8.75	1.19	1.16	1.15	1.16	9.56	10.22	10.50	10.15
October	8.00	8.78	8.93	8.75	1.20	1.19	1.15	1.18	9.60	10.45	10.27	10.33
November	8.02	8.82	8.89	8.52	1.21	1.17	1.15	1.18	9.70	10.22	10.22	10.05
December	8.00	8.88	8.81	8.39	1.22	1.17	1.16	1.21	9.76	10.39	10.22	10.15

2. ENERGY PROSPECTS

2.1 ENERGY CRISIS IN 1985?

by Robert Mabro

(The following article by Mr. Robert Mabro, fellow of St. Antony's College, Oxford, is based on a talk given in February 1978 at the Oil Economics Seminar held at the Middle East Center of Oxford University.)

The purpose of this paper is to discuss the validity of current predictions about the oil supply/demand balance in the medium term. Until very recently many students and observers of the energy scene were warning apathetic audiences about a 'second oil crisis' expected to occur sometime between 1984 and the early 1990s. A CIA Report, The International Energy Situation: Outlook to 1985, conveniently released in April 1977 when President Carter was launching with much publicity his proposals for a new US Energy Program, over-dramatized the issue. A month later, an international group of distinguished specialists published the results of a two-year research project known as the Workshop on Alternative Strategies (WAES). Though significantly less pessimistic than the CIA about prospects for 1985, their first major conclusion was that: "The supply of oil will fail to meet increasing demand before the year 2000, most probably between 1985 and 1995, even if energy prices rise 50% above current levels in real terms. Additional constraints on oil production will hasten this shortage, thereby reducing the time available for action on alternatives." WAES, Energy Global Prospects 1985-2000, pp. 3-4 (our underlining).

Recently, these views have been challenged. Several experts are now expressing disbelief about the dire predictions. The conventional wisdom about an energy crisis in 1985 was just beginning to crystallize when the first signs of its demise appeared. The newest perception is that "oil will be in surplus throughout the 1980s, if not beyond." The New York Times published on January 18, 1978, an article which purports to reflect the common contention of a varied group of oil analysts. They "make up an impressive cross-section of non-government energy experts." These experts "contend that oil supplies currently in abundance may remain adequate at least through 1990, thereby reducing the likelihood of an other extraordinary jump in prices."

In an attempt to form a judgment on these rival positions I propose to examine fairly closely the results of various forecasts of world energy demand for 1985. An understanding of the main assumptions on which these forecasts are based may held us to select the most plausible range of values likely to be taken by the important variables and to define a set of preferred estimates. But before embarking on this task, it will be useful to clarify certain points about the interpretation of forecasts and

the meaning of such concepts as shortages, surpluses and crisis.

The Concepts of Shortages and Surpluses

Shortages and surpluses, of course, do not mean that actual demand for oil will be different from actual supplies at any given date. Shortages and surpluses refer to discrepancies between the quantities of energy required to satisfy demand and the amounts that producers would be willing to supply, given the levels of incomes and prices and the state of technology postulated by the forecasting model or the planning scenario used. To forecast a shortage or a surplus for a specified future date is tantamount to saying that either the postulated rates of economic growth, or/and the postulated prices, or/and assumptions about technologies, institutions, government policies etc. will not hold. To predict an oil shortage is to predict, in fact, either an economic recession, or a price explosion, or a political upheaval, or socio-economic disruptions, or unspecified technical changes (or some combination of all that). Such forecasts also have normative implications in the sense that they lead to suggestions for policy measures to be taken by governments of oil producing and oil consuming countries.

Forecasts about oil demand/supply balances usually involve the following elements: (a) Global energy demand; (b)non-oil energy supplies;(c)non-OPEC oil supplies; and (d)OPEC oil supplies. The demand for OPEC oil is derived as a residual by subtracting from global energy demand all estimates of non-OPEC energy supplies. The common assumption is that demand for energy in the non-OPEC world is met first by all available sources other than OPEC oil. The residual is then compared with an estimate of likely OPEC oil exports. There is crisis for oil consuming countries if the desired demand for OPEC oil is not matched by the likely volume of OPEC exports. There is surplus if the desired demand falls short of the amount that OPEC is presumed wanting to export.

Because forecasts of demand for OPEC oil are derived as a residual, they tend to pick up all the errors which inevitably affect the estimates of total energy demand, and of supplies of nuclear, coal, gas,hydro-electric, non-OPEC oil and miscellaneous sources of primary energy (geothermal, solar,etc.). The comprison of this error-ridden forecast of demand for OPEC oil with figures about likely OPEC supplies provides the main basis of all predictions about future energy balances, and hence, about possible future crisis for the oil consuming world or for OPEC.

A Comparison of the CIA and the WAES Forecasts.

It is interesting to look closely at the CIA and the WAES forecasts and attempt to assess the range of variations

in every component of their estimates. In Table 1 data relating to global energy demand in 1985 are presented. The data are either for OECD countries or for the world outside Communistareas (WOCA), i.e. all countries other than the USSR, Eastern Europe and China. Note that the CIA assumes a rate of economic growth of 4.3% per annum between 1976 and 1985 for OECD, while WAES offers two alternative rates of growth for WOCA, namely, 5.2% (high) and 3.4%(low).

In Table 2, data relating to energy supplies are presented. The CIA estimates that WOCA would need 68 to 72 million barrels of oil per day in 1985, and that non-OPEC oil supplies would amount to 24 to 26.5 million b/d. WOCA would thus need something between 41.5 and 48 million b/d of OPEC oil in 1985. This demand is large and can justify by itself a prognosis of 'Crisis'. But the CIA added to the demand for OPEC oil another 3.5 to 4.5 million b/d representing their estimates of Communist Countries requirements. Much of the discussion of the CIA report focused on the forecasted oil deficit of the Eastern Bloc in 1985 Yet this item is fairly irrelevant, as we shall see later, to the issue at hand: whether desired demand for OPEC oil by 1985 will fall short of likely OPEC supplies.

WAES puts oil requirements in WOCA at 62.5 million b/d in the high growth case and at 58.2 million b/d in the low growth case. Demand for OPEC oil is forecast at 36 to 38 million b/d. WAES expects the Communist world to be roughly in balance. WAES provides a forecast for non-oil energy supplies, mainly coal, nuclear, hydro-electric and gas. CIA makes similar forecasts (presented in Table 3) for energy supplies in OECD countries only.

OPEC Oil Supplies in 1985.

An estimate of plausible OPEC oil supplies is needed for comparison with these demand forecasts. OPEC countries may be divided into three groups.

- Group 1 consists of countries which, in boom conditions, would be prepared to supply as much oil as technical capacity allows. These are: Algeria, Nigeria, Indonesia, Iran, Gabon, Ecuador and probably Iraq and Qatar. My own view is that this group could probably sustain a maximum production of 14.5 to 16.0 million b/d in 1985.

- Group 2 consists of countries which tend to put a conservation ceiling on their production even in market boom conditions. By 1985 these countries would include Kuwait, almost certainly Abu Dhabi (which, so far has not acted in this way but which must sooner or later turn conservationist to avoid financial indigestion and gross waste of resources) and perhaps Libya and Venezuela. This group would be prepared to supply between 7 and 9 million b/d in 1985.

- Group 3 has one member, namely Saudi Arabia. Assume maximum supplies from groups 1 and 2, i.e. 25 million b/d. Assume further that, because of exceptional circumstances, groups 1 and 2 find another 2 million b/d above this forecasted maximum and end up supplying 27 million b/d. The question of whether a desired demand for OPEC oil of, say, X million b/d can be satisfied will partly hinge on whether Saudi Arabia, in its role as swing producer, can or is willing to supply X minus 27 million b/d. Let us note that because oil is a depletable mineral resource, the producer's price and output policies critically depend on perceptions about the future. An 'atmosphere' of crisis would begin to prevail on the world petroleum market when growing demand begins to approach (not when demand reaches) the national maximum amount that producers could make available. I think that Saudi Arabia would be very unhappy if it had to supply more than 15 million b/d in 1985. This means that, on very generous assumption, the OPEC maximum is 42 million b/d. It also means, should demand for OPEC oil be growing at a fast rate in the mid-1980s, that a crisis would be perceived as imminent when demand begins to reach the 38-39 million b/d level and perhaps before.

If these latter estimates are correct, the CIA demand forecasts with or without the Communist Bloc oil deficit, imply a crisis. The WAES high growth alternative scenario brings the world to the threshold of a difficult energy situation: while the WAES low growth alternative leaves the world in 1985 in the safe region.

A Set of Preferred Demand Estimates

The question naturally arises: who to believe? The immediate reflex is to answer: neither. I feel unhappy with WAES forecasts of total energy demand for 1985 because the postulated rates of economic growth(high and low) are both extreme. I feel unhappy with the CIA estimate because they apply too high an energy coefficient (the ratio between growth of energy demand and growth of GDP)thus ignoring the effects of conservation. On non-oil energy supplies there is much uncertainly about nuclear (WAES are far too generous in expecting 10-12 million b/d oil equivalent in 1985 and recognize in their report that they are being hopeful) and excessive optimism about gas (at least by WAES). Estimates about non-OPEC oil, coal and hydro-electric energy and much more acceptable.

I have constructed in Table 4 a set of my own estimates based on judgment formed by a careful reading o WAES, CIA and other sources. For global energy demand, I have taken the actual consumption in 1976 as base. I have assumed with CIA an average annual rate of growth of 4.3% and with WAES and energy coefficient of 0.81 consistent with moderate conservation. (Recall that the energy coefficient before 1973 was slightly above 1. Also that some forecasters expect it to be as low as 0.63 on average between 1976and 1985 which seems totally implausible. To expect a gradual reduction between 1973 and 1985 leading to a value close to 0.65 in the end-year stands more to reason.) Thus my

preferred estimate of WOCA energy demand for 1985 is 124 million b/d of oil equivalent. My preferred estimates for non-oil supplies is 53 million b/d lower than either of the two WAES estimates. The difference with WAES arises, as explained above, from a more cautious assessment of the prospects for nuclear (and to a lesser extent gas) between now and 1985. I have no disagreement with an estimate of 24 million b/d of non-OPEC oil on which WAES and CIA seem broadly speaking to agree. Further, I shall ignore the CIA pessimistic views about energy balances in the Communist world. Not that I necessarily disagree but this item does not affect substantially the argument made here. Table 4 shows that on these assumptions the desired demand for OPEC oil may well be of the order of 47 million b/d. As argued earlier, such amounts are unlikely to be forthcoming.

Errors in Estimates

It is essential to make a further point. All the components of this exercise leading to the final prediction are subject to errors. In Table 4, I have defined ranges of variation for every item. If we assume very, very crudely that the errors for each item are independent and that the range defines four standard deviations (two on each side of the mean), one can calculate the range of values within which the estimate of demand for OPEC oil is likely to fall with 95% probability. The method is extremely simple-minded but it illustrates in a brutal manner an important point. The range within which an estimate derived as a residual can err is usually wide. Though my preferred estimate of the desired demand for OPEC oil in 1985 (assuming 4.3% annual growth in the world economy and a reduction of the energy coefficient from 1.0 in 1973 to an average figure of 0.81 between 1976 and 1985) is 47 million b/d, possible errors open up a range which could put this estimate anywhere between 34 and 60 million b/d.

Conclusions

Two sets of conclusions may be drawn. The first set relates to the forecasts. The critical examination of different exercises about energy prospects in the medium term leads me to conclude that there is a good change that a demand for OPEC oil in 1985 consistent with the assumptions about economic growth and conservation made here would exceed the amount that OPEC would be willing to supply. But an important note of caution would be sounded. There is something like a 20-25% probability that the demand for energy consistent with our assumptions about economic growth, conservation and alternative energy supplies would not imply imbalances by 1985.

The second set of conclusions relates to interpretation. The substantial point emerging from this exercise is that a constraint on the supply of oil could well mean that economic growth at 4.3% per annum will not be possible between now and 1985. To predict an energy crisis in 1985 turns out to be misleading even if our calculations were correct. Rather, one should pedict an economic crisis between now and some distant date. If the future energy balance is not right, something else has to give way. In the long run relief may come from:

(a) Greater supplies of non-oil energy sources(little more than forecasted in this exercise is likely to emerge by 1985).

(b) Greater economies from conservation(sure, but how much more than assumed between now and 1985).

In the short run an anticipated imbalance may force oil prices up in a disruptive way. This would cause an economic crisis of the familiar 1973 type. I do not expect such an event in the next few years because a repeat of the 1973 price explosion has become unthinkable. In the medium term, we are left with the rate of economic growth as the only factor likely to give way. The mechanism through which the world economy can find itself stagnating at fairly low rates of growth over a long period could operate as follows. Reflation of the world economy would shapren perceptions about the threat of energy imbalances and elicit fears about oil price rises and about inflation in the general price level. These fears would either inhibit governments from reflating or force them to slow down the pace of economic activity soon after it begins to accelerate.

In short, those who predict an energy crisis for themid-1980s are in fact predicting low economic growth for the world between now and then. And those who are confident about availabilities of oil throughout the 1980s are simply saying that the world economy will not grow fast enough for troubles to arise on the energy front. Paradoxically all are agreed despite appearance to the contrary. There is a small chance that things would not turn out to be as gloomy as suggested here. To my mind, the probability of a happy outcome for the world economy is not sufficiently high for comfort.

SOURCE:- MIDDLE EAST ECONOMIC SURVEY
Vol.XXI, No.25, 10 APRIL 1978.

Table 1

Demand for Energy 1985
(Million Barrels Daily of Oil Equivalent)

	CIA	WAES(High)	WAES(Low)
Rate of Economic Growth 1976-1985.	4.3%	5.2%	3.4%
World Outside Communist Areas(WOCA)		123	114
OECD(Excl.Australia & New Zealand).	99	97	93
Other Developed Countries.	2	3	2
OPEC		4.9	4.2
Non-OPEC Developing Countries.		18.2	14.9

Table 2

Energy Supplies for WOCA 1985
(Million Barrels Daily of Oil Equivalent)

	CIA	WAES(High)	WAES(Low)
Gas		21	18.4
Nuclear		12	10.1
Hydro-electric		7.8	7.3
Coal		19.3	19.4
Geothermal,Others		0.6	0.4
Total Non-Oil		60.7	55.6
Oil Required	68 - 72	62.5	58.2
Non-OPEC Oil.	24 - 26.5	24.7	22.0
OPEC Oil for WOCA	41.5- 48.0	38	36
Communist Countries Requirements	3.5- 4.5	1	
Total Oil Requirements from OPEC	45.0- 52.5	39	36

Table 3

The CIA Forecast 1985

(Million Barrels Daily of Oil Equivalent)

(1) OECD Energy Demand*	99-102
(2) OECD-Non-Oil Energy Supplies*	
Gas	16 -17
Coal	18 -19.5
Hydro-geo	6.5 -
Nuclear	5.5 - 7.0
Total Non-Oil	46 -50
(3) Oil Demand	
OECD((1) minus (2))*	49-56
Other Developed Countries	2.0
OPEC	4.0
NON-OPEC LDCs	12.0
Total Oil Demand	
(extreme ranges)	67-74
(preferred ranges)	68-72.6
(4) Oil Supplies	
Developed Countries	16-18
Non-OPEC LDCs	8-9
Total Non-OPEC	24-26.5
(5) Demand for OPEC Oil from WOCA	41.5-48.0
(6) Extra Demand from Communist Countries	3.5-4.5
(7) Total Demand for OPEC Oil	45.0-52.5

*Excluding Australia and New Zealand.

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Table-4

Own Analysis of WOCA Energy Demand 1985
(Million Barrels Daily of Oil Equivalent)

	Preferred Estimate	Ranges	S^2
Demand	124	114 -138	36
Supplies			
Gas	18	16 - 21	1.56
Nuclear	8	5.5 - 10	1.26
Hydro	7.5	7 - 8	0.06
Coal	19	17 - 20	0.56
Geothermal	0.5	0.5	0
Total:-	53		
Non-OPEC Oil	24	22 - 27	1.56
Requirements for OPEC oil	47	33 - 58.8	41.00, σ=6.4

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2.2 ENERGY CONSERVATION IN IRAN AND HEDGING AGAINST THE ENERGY CRUNCH

by Bijan Mossavar-Rahmani

(The following two articles by Mr. Bijan Mossavar-Rahmani of the Institute for International, Political and Economic Studies, Teheran, Iran are based on presentations delivered by him at the Fourth International Conference of the International Research Center for Energy and Economic Development, University of Colorado, Boulder, on 17-19 October 1977.)

I. Energy Conservation in Iran

Iran has during the course of the past few years called for a concerted international effort at conservation of non-renewable hydrocarbon resources. The widespread and still growing use of oil and gas as fuel should be curbed, Iran has argued, and replaced as rapidly as possible with greater reliance on alternate, and preferably fully renewable sources of energy. The world's limited oil and gas supplies should be utilized instead as feedstocks into petrochemicals processing industries were no viable substitutes are available.

Is this call being translated into action within oil and gas-rich Iran itself? The answer is yes, although it is probably still too early to judge how effective the conservation methods have been. But what is clear is that the principle of conservation has become an important cornerstone of national energy planning.

Iran's effect at maximizing conservation of hydrocarbons has basically been three-pronged.

First, there is the program for conservation at the well-head through maximizing ultimate recovery of crude oil from the country's fields, and through progressive elimination of the practice of flaring of associated gas incidentally produced with oil.

Second, Iran has embarked on a determined policy of broadening its energy base, to replace fossil fuels, where possible, with nuclear power, and eventually with solar power as well.

Finally, while oil and gas continue to be used, Iran has initiated a series of price penalties and tax incentives to encourage conservation in the actual comsumption of hydrocarbons, particularly in the private transport sector.

To understand how conservation can take place at the crude oil production stage, one should recall briefly how oil is recovered. An oil reservoir should not be thought of as a pool, although it is often referred to as such. Rather, within a given reservoir, droplets of crude oil saturate pores and cracks in permeable rock, much like water in a sponge. The oil in these structures is generally covered over by a large dome of trapped gas, and sits, in turn, on a layer of water and brine.

Once a well is drilled into this reservoir, pressure from the overlying trapped gas and the underlying trapped water begins to wash out the pores and drives the crude oil into the well, and ultimately to the surface. As oil is produced from the reservoir, this natural drive gradually declines until it ends, invariably leaving some of the oil initially in place unrecovered. How much oil is recovered by natural drive depends, of course, on reservoir conditions such as rock porosity, oil viscosity and type of drive.

But the recoverable percentage of oil in place is also sensitive to the rate of production. For natural drive to be most effective, the production of oil should be slow enough to permit uniform advance of either water or gas to invade and flush out oil droplets from tight sections of rock. Otherwise, at higher production rates, the more mobile water or gas will tend to form flow channels to the well, bypassing the oil and leaving a large portion of it trapped in the reservoir. Thus, there is some rate of production for any reservoir, in a given state of depletion, at which maximum effective use can be made of natural drive to increase ultimate recovery from that reservoir. A higher rate of production, it follows, would result in some avoidable reduction in ultimate recovery.

In earlier days when vast new deposits of crude oil were periodically being discovered, when production capacity worldwide far exceeded demand, and when no "energy crisis" seemed to loom ahead, little consideration was given to this notion of maximum efficient rate of recovery.

The oil exporting countries, faced with low and often falling oil prices on the one hand and rising development needs on the other, thought only of increasing their total revenues by pressing for increased production. Meanwhile, the international oil companies which operated the oilfields also shared these same short-term interests in producing as much from each reservoir and each country as the market would bear; usually by methods now considered to have been wasteful.

As a result, a larger than desirable proportion of the available natural drive was used up, and unduly great quantities of oil which could have been obtained remained trapped under-ground. Furthermore, under these circumstances, excessive amounts of associated gas produced together with oil were flared by the companies and wasted for lack of any economic ' interest in harnessing the gas.

Until recently, Iran was no exception. As a consequence of haphazard development of a number of oilfields, notably giant Gachsaran, the ultimate recovery from these fields from natural drive is believed to have been seriously reduced.

In other areas of wastage, it is estimated that in nearly 70 years of commercial oil production in the country, some 13 trillion cubic feet (tcf)of associated gas produced together with crude oil have been flared. Iran is now set to reverse that trend.

Secondary Recovery Projects.

To maximize natural reservoir drive, the earlier oil production targets of 7.5 to 8.0 million barrels a day have been lowered to about 6.2 million b/d.

Iran has also commenced what is certainly one of the most ambitious natural gas gathering-reinjection programs in the world. The multi-billion dollar venture is aimed at elimination of wasteful flaring of associated gas (still running at just under 1 tcf annually out of a total production of 1.8 tcf), recovery of valuable natural gas liquids (NGL)for use as petrochemicals feedstock and for other domestic purposes, and finally, reinjection of the remaining processed dry-gas into the main oilfields in Khuzestan to artificially sustain productive capacity and to extend the ultimate recovery of oil.

According to semi-official estimates, supplemental recovery through gas reinjection could increase the average oil-in-place recovery factor for Iran from the present level of 17% to close to 30%; adding about 20 billion barrels to Iran's proved reserves of 65 billion barrels.

A small pilot project to reinject dome gas from the Naft-e-Sefid field into Haft Kel reservoir was started in 1976, with reinjection rates now running at over 0.1 tcf a year. Other projects expected to come on stream over the next few years include;

-Removal of NGL from Pazanan field dome gas and reinjection of processed dry gas into Gachsaran and Marum fields.

-Recovery of NGL from Gachsaran associated gas and reinjection of the processed gas back into the field.

-Recovery of NGL from Rag-e-Sefid, Bibi Hakimeh, Paris and Karanj fields, and reinjection of processed gas into Bibi Hakimeh and Karanj.

Gathering of flared gas for reinjection not only serves to enhance recovery of oil which would otherwise be "lost," but provides a means of "storing" associated gas as well, since much of the reinjected gas can eventually be recovered over a period of years.

With the present programs, flaring of associated gas which covered nearly all production before 1970, and just under 60% in 1976, is expected to be reduced to a nominal amount by the mid-1980's.

Associated gas has been put to other non-reinjection uses also. Some 0.3 tcf of associated gas are exported to the Soviet Union each year through a cross-country pipeline, Iran Gas Trunkline I(IGAT I.) Spur lines from IGATI feed a number of cities en route, including Tehran, Shiraz, Isfahan andKashan. Associated gas is also presently used as a feedstock into several petrochemical plants, including those in Shiraz, Kharg Island and Bandar Shahpur. Under construction are several other gas-fed plants, the most important of which is the giant Iran-Japan Complex at Bandar Mahshahr.

Since total requirements for reinjection will exceed available supplies of associated gas in the coming years (about 2.7 tcf a year is planned for reinjection within five years) Iran has embarked on an intensive effort at finding sources of non-associated gas.

About one-quarter of all rigs now operating in Iran are drilling for gas only, and the rest for combined crude oil and gas. Part of the gas from one recent non-associated find, the or Pars field, for example, has already been planned for secondary recovery in the Khuzestan oilfields.

Diversification of Energy Sources

The second means by which Iran is attempting to conserve its hydrocarbon reserves is through increased reliance on non-conventional technologies for electricity generation.

Iran drew up an extensive program for peaceful uses of nuclear energy in 1974 which called for installation of 23,000 megawatts of nuclear capacity, or about 20 large-sized reactors, by 1994.

The Atomic Energy Organization of Iran was established in 1974, and negotiations were begun with a number of supplier countries for technological training and assistance as well as for the purchase of hardware and fuel. The list included, among others, the United States, Canada, France, West Germany, India and several African countries.

The first agreement for the purchase of reactors covered two 1,200 - megawatts each pressurized light water reactors from West Germany's Kraftwerk Union. Construction of the twin plants is already underway near Bushehr on the Persian Gulf on a turnkey basis, with Kraftwerk Union committed to supply the initial load of fuel for the reactors, plus reloadings for the

first 10 years of operation. The plants are expected to come on line by the early 1980's, and the possibility of acquiring up to four more West German reactors is also under consideration.

Additionally, Iran has negotiated the purchase of two 900- megawatts each pressurized light water reactors from France's Framatome. The French contract, too, includes a fuel agreement under which enriched uranium will be supplied for the reactors for up to 10 years. There is, furthermore, a reprocessing agreement according to which spent fuel from the two reactors will be shipped to France for reprocessing, and the uranium retrieved and returned for subsequent enrichment and use within Iran or for resale by Iran to a third party. This agreement does not cover the return of the highly toxic and potentially weapons-grade plutonium.

Other negotiations have been held intermittently with the United States for purchase of reactors. Trade talks in 1975 envisaged the construction of between six and eight nuclear reactors in Iran. However, the actual sales have been held up, pending the passage of legislation, now before Congress, governing American nuclear export policies.

Meanwhile, Iran has entered into discussions with a number of Western European countries and the United States for investment in uranium enrichment facilities. A 10% or about one billion French francs, share has been acquired in the EURODIF gaseous diffusion enrichment plant under construction in Tricastin, France. Other shareholders include France, Spain, Belgium and Italy, and the plant is expected to reach full capacity by the end of 1981.

Iran has also committed itself to subscribing to 25% of the shares of a similar facility called COREDIF, being planned with the other EURODIF partners.

To procure the uranium ore for enrichment at this facility and eventural use in its nuclear reactors, Iran has already concluded agreement-s with a number of countries for the acquisition of some 30,000 tons of ore. At home, one of the world's most extensive searches for uranium deposits has been launched; the 10- year search is budgeted at $300 million. Also under consideration are joint uranium exploration efforts in several African countries.

But looking to the long term, it is solar energy which holds the greatest promise for Iran as a source of fully renewable, and perhaps even cheap energy. Several universities and research centers have commenced work on limited but expanding solar energy projects. Pahlavi

University in Shiraz set up a solar energy center two years ago where research is conducted on space and water heating, steam cooking, dehydration and desalination. Two center projects have been approved, one for design and construction of a small town powered by solar energy, and the other, for the establishment of a 10-megawatt solar power station. The Arya Mehr University in Tehran is also involved in solar research, primarily on desalination and photovoltaic cells.

Other studies are underway to determine suitable sites for pilot wind and geothermal plants within the country, both of which have some potential as long-term substitutes for hydro-carbons.

Iran has announced its willingness to cooperate in international scientific research related to alternative sources of energy as another approach to reducing dependence on hydrocarbons.

Conservation Via Higher Prices

Finally, Iran has attempted to encourage conservation in actual use of petroleum products while dependence on these products continues in the short to medium term. Most of the measures which have been enacted to date are directed at reducing the rapid rate of growth in demand for gasoline, particularly by private automobile owners and operators.

It might be surprising to note that the price of premium gasoline in Iran is about $0.53 a gallon, not far below the retail price in much of the United States. The price of regular gasoline is about $0.43 a gallon. Furthermore, the prices of both premium and regular gasoline are slated to increase by an average of $0.11 a gallon each year for the next five years. By 1982, therefore, the prices of premium and regular gasoline will stand at $1.08 and $ 0.98 a gallon respectively.

The higher prices are expected to stimulate conservation in use by reducing unnecessary driving, while simultaneously a switch to smaller and more fuel-efficient automobiles. To speed up that transition, Iran has initiated a series to tax incentives for buyers and operators of smaller automobiles.

In 1976, a once-only progressive tax on new automobiles registered in Tehran was announced; the tax on a four-cylinder model was about $430, rising to $715 for a six-cylinder model and to a not unsubstantial $1,000 for the large eight-cylinder automobiles. Each car is also subject to additional annual taxes based on engine size; a four-cylinder automobile is taxed $71, a six-cylinder automobile $142, and an eight-cylinder one about $430 a year.

To further encourage purchase of smaller automobiles, Iran announced a substantial cut in the import duties for new, four-door, four-cylinder models, with engine capacities between 1,450 to 1,800 cc, and with a c.i.f. value under $5,000. The commercial benefit taxes, which were as high as 500% of the cif values of these "economy class" automobiles were slashed to only 60% cutting back prices by a reported $3,000 on average for each automobile.

The increases in gasoline prices and the tax incentives for smaller automobiles have certainly reduced the rate of growth in gasoline consumption, although it is still too early to determine by just how much.

Nonetheless, with these and other conservation programs, Iran expects that the total demestic consumption of petroleum products for fuel uses, which increased by 11.1% a year during the Fourth Development Plan (1967-72) and by 19.2% a year during the Fifth Development Plan (1973-78), will drop to an annual rate of 11.3% during the next five years. Thereafter, it is projected that the growth rate will decline gradually to just under 8.0% a year through 1987, and to about 5.5% a year during the last decade of the century.

The share of oil in the total primary energy consumption in the country will thus drop, according to recent estimates, from some 85% in 1977, to 72% in 1982 to 61% in 1987 and ultimately to 50% by 1997.

NATURAL GAS STATISTICS FOR IRAN

PRODUCTION: 1976*
(Billion Cubic Feet)

Company**	Produced	Utilized	Flared	%Flared
NIOC	10.1	6.2	3.9	38
NIOC/OSCO	1,674.4	703.4	970.9	58
IPAC	84.6	32.3	52.2	62
SIRIP	8.8	0.7	8.0	92
LAPCO	22.9	1.1	21.8	95
IMINOCO	16.6	0.8	15.8	95
Total	1,817.4	744.6	1,072.8	59

CONSUMPTION: 1975*
(Billion Cubic Feet)

	Amount	%
NIOC/OSCO		
Producer's Fuel	72.5	10
Gas Injection	34.3	5

	Amount	%
NIOC & Affiliated Companies	15.1	2
Domestic, Commercial & Other	83.4	11
Export to USSR via IGATI	327.7	44
Abadan Refinery	38.3	5
Shahpur Chemical Company	41.1	5
Net Deliveries to NGL Plants	65.7	9
Net Deliveries to Kharg Petrochemicals Company	46.9	6
Errors and Omission	19.3	3
TOTAL	744.6	100

*Figures may not add up to totals due to rounding.

**NIOC: National Iranian Oil Company; OSCO:Oil Service Company of Iran;IPAC:Iran Pan American Oil Company; SIRIP:Societe Irano-Italienne des Petroles;LAPCO:Lavan Petroleum Company; IMINOCO:Iran Marine International OIL Company.

II.Hedging Against The Energy Crisis:Two Perspectives

A consensus appears to be forming among energy watchers that the world is heading toward major crude oil shortages within the coming decade, perhaps as early as the next few years. During recent months, a wide range of official and private forecasts have been published warning that, in the absence of vatly increased energy conservation, world demand for oil will approach productive capacity, and then exceed it sometime in the mid-1980's.

The arguments laid forth in these reports may be summarized as follows:

-Despite reduced rates of economic growth in the major industrialized and oil importing countries, demand for energy will continueto grow by several percentage points each year into the 1980's.

-Non-oil energy sources will not be developed rapidly enough to make a major contribution toward meeting incremental energy demand in these countries before the end of the next decade. Environmental, political, technical and financial considerations have led to major delays in the development of nuclear, shale oil, coal liquefaction and solar energy programs. Given the long lead times required to develop and commercially produce non-conventional energy sources, the impact of such sources will not besignificant during this period.

-Savings from conservation in the major importing countries have been minor to date, and despite even more vigorous attempts, will not significantly reduce the anticipated growth in demand for energy.

-During the next few years, the supply problem will be masked because of increased oil production from Alaska and the North Sea. After about 1980, the flow of oil from these sources will stabilize and cannot rise to meet incremental increases in demand.

-Soviet Bloc countries may change from net exporters of oil to net importers, as production from their fields peaks and possibly slumps because of reservoir pressure problems.

-Increasing world demand and stable or stagnating oil production in the importing countries will increase reliance on OPEC oil. Demand for OPEC oil may thus rise from the present level of 32 -million barrels a day, to a minimum of 39 million b/d (OECD forecast) or to as much as 47 to 51 million b/d (CIA forecast) -see Table I.

However, it is far from certain, analysts conclude, whether the OPEC countries will be willing, or even able to supply such additional requirements for crude oil. According to the CIA report, "... Projected world demand for oil will approach productive capacity by the early 1980's and substantially exceed capacity by 1985. In these circumstances, prices will rise sharply to ration available supplies no matter what Saudi Arabia does."

While one might question methodology, statistical base or even the objectivity of any of these recent studies, their findings are surprisingly similar.

The oil importing countries are on a collision course. Unless massive new efforts are made at conservation, which seems unlikely given present attitudes and policies, serious oil shortages and sharply increased prices occurring sometime in the 1980's, seem inevitable. Moreover, oil prices will be pushed up not by any decision made by the OPEC countries, but by international market forces responding to supply and demand conditions.

Concern over the likely consequences of oil shortages and sudden jumps in prices on economic growth and social order within the oil importing countries is not limited to leaders in these countries alone. Rather, many in the oil exporting countries are also aware and concerned that substantial economic slowdown would not only affect demand for their oil, but that social up-heaval in the industrialized countries could have undesirable political repercussions elsewhere in the world as well. Both sides, therefore, share a similar interest in preventing such developments from taking place.

As an Iranian "energy watcher," I would like to submit for closer consideration two approaches by which oil exporters and importers might work together to try to minimize the potential energy shortages of the 1980's.

A Systematic Increase in Oil Prices.

One approach covers agreement over systematic increases in crude oil prices, and the other calls for simultaneous incentives to encourage greater international trade in natural gas. Both will, admittedly, entail costly increases in delivered energy prices, but are based on the simple premise that there are no longer cheap and easy solutions to the problem of meeting energy needs.

In the past, the media in many of the importing countries have been unfair, and at worse, irresponsible in their reporting of international energy issues, especially insofar as OPEC was concerned. This irresponsibility, furthermore, has proved a disservice not only to the oil exporters but to the importers themselves, perhaps to an even greater degree.

The media's treatment of OPEC, and the preoccupation with speculation over OPEC pricing decisions have shrouded the true nature of the energy problem. The energy problem has been treated not as a series of signals of serious approaching shortages, but rather, as the machination of a few oil-rich desert nations in collusion, at times, with the international oil companies.

Such media attitudes have fostered complacency in the importing countries, and have made no small contribution to the temptation on the part of the public or even the leadership in these countries to discuss international energy issues in emotional rather than in rational terms. What is still lacking today is a wide-ranging intellectual appreciation of the problem. There is a need, for example, to recognize, if not the legitimacy of the existing OPEC, price structure, at least the fact that present prices are here to stay and cannot but continue to go up, perhaps even dramatically.

The question that must then be faced is, whether the market should be allowed to decide how much and at what rate prices should rise, or whether the increases should be preplanned to minimize the potential disturbance a sudden, market-led hike would cause.

Such a sudden hike could mean a doubling of prices within a one to two-year period, to bring oil prices in line with prices of alternate energy sources, estimated variously at $20 to $30 a barrel oil equivalent. In a tight supply situation, oil prices could be pushed up even higher by over-anxious buyers, outbidding each other to gain first access to limited oil.

The shock of a large and sudden hike is inestimable and certainly undesirable. What is a more preferable route is to initiate a series of planned, annual adjustments which would raise prices to levels they would and should-otherwise reach in the mid to late 1980's but on a step by step basis.

Systematic increases would serve several functions. They would bring home to the consuming public the need for serious energy conservation, remove the uncertainty over prices that has plagued planners in exporting and importing countries alike, bring the price of oil on par with that of alternate energy sources and encourage the private sector to make much needed investments in such sources.

The increases would also develop an intellectual awareness of the energy problem, give the leadership in the major importing countries the political will and support to move ahead with stalled national energy Planning, and finally, protect the purchasing power of exporting countries in the face of inflation and the declining value of the dollar.

An agreed increase of about 15% a year over the next five to seven years, would for example, go a long way toward meeting some of those tasks. This idea goes beyond indexation proposals made over the last few years and since abandoned.

Wanted : A Boost for Natural Gas

A second approach by which oil exporters and importers might work together to try to minimize the potential energy shortages of the 1980's is the facilitation of greater international trade in natural gas. Natural gas has long been recognized as a clean, cheap, convenient and flexible fuel with a wide range of uses in heating, cooking and industry as well as a feedstock in petrochemicals processing. Its proven reserves worldwide, including gas found dissolved in or lying over crude oil (associated gas), and gas found in independent formations(non-associated gas) are sufficient to support a large expansion in its present trade.

Today, the bulk of natural gas consumption is concentrated in the Western Industrialized countries which have so far been able to meet their needs primarily through domestic production. However, domestic production in many of these countries is expected to peak, and then slide, within the next few years, while their demand for gas continues to rise.

Imports of natural gas from OPEC countries, for example, where much of the gas produced in association with crude oil is still being flared, can help to offset that gap. Total proved reserves ofOPEC gas are estimated at 790 trillion cubic feet (tcf) or more than half the non-communist world total. These reserves are equivalent in crude oil terms to some 137 billion barrels.

With the exception of a few projects, notably in Iran and Algeria, this large gas potential remains to be fully exploited and utilized. Why? The primary barrier to increased trade in natural gas or processed liquefied natural gas (LNG) is a financial one.

Presently, landed prices for imported gas in Western markets are simply too low, and the costs of gathering, treatment, processing and transportation over the long distances involved are far too high, to make gas export financially attractive to many OPEC countries.

Most of the price formulas now in use tie the price of landed gas to that of an equivalent amount of fuel oil. What these formulas do not take into account is the fact that the cost of transporting gas may be as much as 10 times that of transporting an equivalent amount of fuel oil.

The higher costs are attributable to massive investments required for long-distance pipelines to transport natural gas, or the similarly large investments required for specially designed and built carriers, gathering and liquefaction plants at the point of origin and regasification plants at the final destination in the case of LNG.

Among the OPEC countries, Iran, for one, has a large natural gas export potential, with proved reserves estimated at 370 tcf ,second only in the World to those of the Soviet Union and more than those of all other Middle East countries combined. The larger portion of these gas reserves, or about 53%, is of the associated kind, produced in conjection with crude oil from the Khuzestan oilfields. Until a decade ago, most of the associated gas produced was flared or wasted; today, flaring in Iran has been reduced by half.

Completion of the Iran Gas Trunkline(IGATI)which carries some 0.3 tcf of natural gas a year to the

Soviet Union in exchange for assistance in the construction of a steel plant in Isfahan and a machine tools plant in Arak, was an early attempt at harnessing and utilizing associated gas.

In addition to this export project, associated gas has also been earmarked for three other uses: as feedstock into the growing petrochemicals sector; for reinjection into the country's oilfields not only to stabilize the rate of production but to increase maximum yield from each reservoir; and for general industrial, commercial and home uses within the country. It is expected that by the mid-1980's, all the gas produced from the Khuzestan oilfields will be utilized.

Iran also houses huge non-associated gas-fields, many discovered only in recent years, whose potential is at least equal to, and perhaps twice as much as those of associated reserves. Important non-associated gasfields are located in the Khuzestan area, Qeshm Island, Kangan Khorasan and offshore in the Persian Gulf.

Four of the offshore discoveries, referred to as the C,B, F and G finds are considered to be particularly promising. The C structure, later renamed Pars field, was chesen for development drilling first because of its proximity to shore. Several test wells have already been drilled into the Pars field. Others are also being drilled, which if equally prolific, would indicate that this field is one of the larget in the world, holding as much as 75 tcf, according to the National Iranian Gas Company(NIGC).

NIGC also expects that as it gains more information about other fields through similar drilling activity, Iran's current proved reserves figures will be revised upward, ultimately approaching the 600 tcf mark.

On the basis of its discoveries of non-associated gas, Iran negotiated a 20-year sales contract with West Germany, France, Austria and Czechoslovakia for the export of some 0.6 tcf of gas a year, beginning in 1982. The Soviet Union will take delivery of this gas on behalf of the European buyers at the border near Astara. Gas for this project will come from Kangan, and will be carried through a new pipeline to run parallel to the existing IGATI.

A third major export project, formed as a joint venture between NIGC and a consortium of European,American and Japanese companies, involves the export of between 0.8 to 1.2 tcf of LNG a year. This so-called Kalingas project will draw on Pars field reserves over a period of 20 years.

By the end of the Sixty Development Plan in 1983,

these three projects will accourt for gas exports totaling 1.4 tcf a year, a miniscule amount compared to Iran's total reserves, and only a fraction of the volume the country could potentially export.

But Iran announced last year that it would no longer consider new gas export projects because of existing market conditions. With natural gas prices tied to fuel oil prices, while the transportation costs are substantially higher, the net returns on gas sales are obviously lower vis -a- vis oil sales. A country such as Iran, therefore risks reducing its total foreign exchange earnings by exporting gas, since customers for its high net return oil would conceivably shift demand toward low net return gas.

If Iran is to enter into new gas export projects, it will first require a major overhaul of international gas price formulas. While few expect a "take" equivalent in energy terms to that from oil, gas should nonetheless command a premium over other fossil fuels because of its desirable properties. Moreover, as in the case of oil, this price should be systematically increased until it approaches the cost of alternate energy sources within some agreed upon time frame. But even with increased prices, international trade in gas will only pick up significantly if there is a fairer sharing of investment costs, and risks, between exporters and importers.

Natural gas trade is characterized by a large degree of inflexibility. Given the limited number of treatment and receiving facilities worldwide, LNG, for example, which leaves a given liquefaction plant must be delivered - more or less- to the regasification plant for which it has been intended. A seller cannot divert large volumes of its LNG, as it could divert its crude oil, to alternative destinations over the short to medium term. The inflexibility is, of course, even greater where natural gas is carried by long-distance pipeline and the routes are physically fixed.

This raises important questions for the gas exporting country. What if an LNG carrier explodes off the coast of an importing country, leading to the closing down of receiving terminals under pressure from environmentalists? Where could the gas then be delivered?

To protect itself from such incidents, however unlikely, a seller might require a "take or pay" clause, in addition to a more equal sharing of capital investments.

The same inflexibility that binds the two sides, will also result in justified demands by the buyers for guaranteed supplies at agreed upon prices. What is clear is that the uncertainties that presently cloud natural gas trade must be removed rapidly before any one makes the massive financial commitments necessary.

Natural gas can make an important contribution to meeting energy needs in the coming years. And the financial burden on the importing countries, of co-investing in the required infra-structure is not overwhelming; particularly if one remembers that orders worth as much as tens of billions of dollars for thousands of miles of pipeline, dozens of liquefaction plants and hundred of carriers will be placed with the importing countries themselves. The orders would, in the short term, create a more favourable balance of payments position for the importers, boost their domestic industrial output, and ultimately, assist them in securing more energy supplies.

The important factor is time. If one accepts that the predicted energy crunch is not so very far off, and given the long lead times of five to then years required for LNG or pipeline projects, the decisions will have to be made now.

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Source: Middle East Economic Survey Vol.XXI, No.14 January 23, 1978.

TABLE I

RECENT PUBLISHED FORECASTS OF WORLD DEMAND FOR OPEC OIL*

(million barrels a day)

	1977	1980	1985	1990
OECD	-	33.5	39.3	-
EXXON	-	38	42	-
IEA	-	-	42-49	-
W.J.Levy	34	37-39	-	-
CIA	32	34	47-51	-
WAES/MIT**	-	29-32	36-39	-

*OECD:Organization for Economic Cooperation and Development; Exxon Oil Corporation:IEA:Internation/Energy Agency; /al Walter J.Levy Oil Consultants; CIA:US Central Intelligence Agency: WAES/MIT:Workshop on Alternate Energy Strategies/Massachusetts Institute of Technology.

**WAES/MIT figures show demand for the non-communist world only. Soviet Bloc demand for OPEC oil will account for another 2 to 4 million barrels a day for the 1980 to 1985 period according to estimates.

TABLE II

IRAN'S NATURAL GAS POTENTIAL*

(Trillion Cubic Feet)

Field	Proved	Probable	Possible
Khuzestan**	210	210	210
Khangiran	18	18	18
Tang-e-Bijar	0.5	0.6	0.6
Sarajeh	0.3	0.4	0.4
Gheshm	4	6	8
Kangan	11	15	21
Nar	14	17	21
Aghar	10	12	15
Pars"C"	54	65	75
Taqdis"B"	25	50	89
Taqdis"F"	9	17	66
Taqdis"G"	7	15	39
Sarkhun	5	7	10
Kashu	5	10	15
Baba Ghiar	2	2	5
Total:-	374.8	445	593

* National Iranian Gas Company estimates.

**Associated Gas only. The remaining fields are non-associated gasfields.

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2.3 ECONOMIC AND COMMERCIAL PROSPECTS OF SOLAR ENERGY

By B.A. Rahmer

The study of solar energy conversion, previously the preserve of small bands of enthusiasts, has suddenly caught the imagination of the scientific world, of commercial interests and of the public at large. A great deal of serious research has been started over the past three or four years though most researchers are, at this stage, more interested in the long-term potentialities than the immediate cost-effectiveness of their various development schemes. Some manufacturers and traders, on the other hand, are already trying to push the sale of their own relatively simple solar energy devices.

Last month's London symposium on Economic and Commercial Assessment of Solar Energy Conversion, organised by the UK Section of ISES (the International Solar Energy Society), has helped to some extent to clarify the issue. The symposium concentrated, in the main, on space and water heating devices - presumably because most of the other suggested applications of solar energy may be highly promising in the long run but require initially a far greater amount of fundamental research. Mr. J.E.Parrott of the University of Wales demonstrated, however, that the direct photovoltaic conversion of sunlight into electricity - already used in spacecraft - is now on the verge of competitiveness under the most favourable conditions on each, namely in desert areas where no power is available from central stations.*

It was interesting to learn that some 15 000 solar-heated hot water systems were in use in Florida already in 1965 - long before the onset of the international energy crisis - and that the number of solar thermal energy units in a small country such as Israel is now of the order of 100 000. In the UK, however, and in other countries with similar climatic conditions, the consensus of informed opinion is that the use of flat plate solar collectors even for water heating is at present uncompetitive, except perhaps where the only alternative heating source is non-storage electricity.

The economics of space heating

Space heating in the UK accounts for almost half the national energy requirements, but the full-scale use of solar panels for this purpose would be excessively expensive, chiefly because sunshine is a rare phenomenon during the

* Much more optimistic claims have just been made by Mr.S.R.Ovshinsky, of Energy Conversion Devices Inc., Troy, Mich, USA, according to whom the production cost of solar cells can be dramatically cut by the use of novel materials.

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winter months when heating requirements are largest. It would be theoretically possible to store the heat from the sun for use in winter (inunderground water tanks, for example), but the accompanying table indicates that the investment cost of a combined solar heating and storage system in a typical private dwelling house would probably be about 15 times that of a comparable gas-fired system. It goes without saying that, on the basis of present-day prices, an initial investment expenditure of this order cannot easily be recovered by the subsequent annual savings on fuel.

Investment returns

Allowing, however, for the poor returns from most alternative forms of investment in the present inflationary situation, solar devices will be regarded as a less unattractive investment than appears from the quoted figures; and experts seem to be in general agreement that solar-based heating, in the spring and autumn if not the whole year round, could gradually beco-me more competitive even in countries like the UK. Private houseowners are prominent among prospective purchasers of solar installations, and the interest rates from capital investments which are normally available to them (such as from building society deposits) have lately been below the rate of UK price inflation; they will in future, at best, be slightly above the inflation rate, giving them a de facto annual yield of not more than, say, 1-2 per cent. The fact should also be taken into account that earnings from the latter investments would be subject to income tax while the installation of solar devices can be financed by mortgage loans which entitle the mortgagor to special tax relief.

Fuel prices to double ?

There is also a high degree of probability that fuel prices will in future rise even more rapidly than prices in general. The UK Department of Energy appears to think that the real internal price of fuel may double by the year 2000, rising at average annual rates of about 3½ per cent. The fuel bill of the gas-fired house in the accompanying table has been estimated at £ 120 annually (in terms of 1976 prices) throughout the 15-year life-time of the heating system. But, allowing for the assumed special rise in fuel prices, the bill (again in terms of a stable general price level) would go up to nearly £ 195 in the last year, averaging nearly £ 155 annually over the period as a whole. The overall financial advantage of conventional heating systems would then be correspondingly smaller.

There are, at atthe same time, fair chances for improving the technical efficiency of solar collectors and, above all, for developing mass production and thereby reducing costs and sales prices. However, virtually all the

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speakers at the consortium talked about the uncertainties which still bedevil the outlook, and Messrs A.H.Lancashire and K.R.Williams, both of Shell, made the valid point that manufacturers would almost certainly hesitate to engage in the mass production of solar heaters unless the government decided to tilt the scales in favour of the new devices by granting special incentives such as tax rebates or subsidies. (Government spending on solar energy in the UK is at present relatively small, amounting to barely £ 1.5 million/year though Britain may also benefit from the special EEC provision.

The authors also suggest that mass production could be helped by co-operation agreements of manufacturers with large builders and local authorities.

Government support

The call for government support is qualified by the statement that this would only be justified if there is a significant net saving of energy. The construction of solar collectors - as of all "energy-saving" devices - requires itself a significant initial energy expenditure: it has been suggested that the energy gain of a solar collector in the UK(ie the saving of energy over its life-time compared with the energy used in its manufacture) might be six to 12 according to how advanced a system is used. It should be added that the construction of conventional heating systems also requires an out lay of energy, but it is certainly true that an effort should be made to reduce the energy requirements for the construction of solar devices.

The point was made - most forcefully by Mr.Julian Keable of Helix Multi Professional Services - that heat pumps might be used either to supplement the work of solar panels, or as an alternative. Heat pumps, usually driven by electricity or gas, are utilising heat sources such as the ambient conditions of air, water or earth temperatures which, in turn, are entirely derived from solar energy. Their use so far has been mainly in the field of air conditioning or refrigeration; but, thanks to recent technical improvements, heat pumps are now being used in the southern parts of the USA on a quite substantial scale for cooling in summer and heating in winter. Properly engineered to UK climatic conditions, the author considers it feasible to achieve a heating output three times as large as the energy input.

COSTS OF HEATING SYSTEMS IN A U.K. DWELLING HOUSE a)
In £ per year (1976 prices)

	Gas-fired system	Solar and thermal storage	Heat pump
Installation b)	40	600	53
Maintenance	10	10	20
Fuel	120	Nil	60
Total c)	170	610	133

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a) Assuming a new, well insulated family dwelling with well-managed thermostatic controls, all the heat systems to have a working life of fifteen years.

b) The figures represent one-fifteenth of the initial cost.

c) Gross, i.e. without allowance for amortisation, inflation, etc.

Referring again to the accompanying table, we find that the assumed investment cost of a heat pump system would only be slightly higher than that of a comparable gas-fired system, and very much smaller than that of solar panels in combination with thermal storage. The pump, as indicated, would probably use only about one-third of the amount of energy required for conventional gas-heating though its cost may amount to perhaps one-half, because of such factors as different tariff structures. Maintenance costs, admittedly, would be relatively high but the indications are that the system, if energetically fostered, could soon become highly competitive. Leaving alone its possible uses in industry and elsewhere, it is regarded as quite possible that, within 20 years, heat pumps, probably driven by gas or electricity, may provide 30 per cent or more of the domestic heating market in the UK.

The proceedings were supplemented by a report of two Cambridge researchers - Messrs J.G.Littler and R.B. Thomas - on their 'autarchic' housing project. Helped by heavy insulation, multiple glazing and other special architectural features, the house in question is to depend for its energy requirements entirely on solar collectors and on a wind-driven genarator. One interesting fact emerging from these studies is that the wind generator appears to be superior as a sourceof heat.

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Source: Petroleum Economist, August 1977.

2.4 ENERGY PLAN OFFERS PRIZES TO ALL - A U.S. EXPERIENCE

by Edward Symonds

On the evening of April 20 in an address to both chambers of the Congress, President Carter only partly answered the question most vital to the entire future of the international energy business: Is the United States which holds more of the trumps than any other major producer or consumer interested in looking beyond its own short-term national interest in energy affairs? Although in his National Energy Plan he failed to pay attention to the international aspects, there is no reason to doubt that the domestic emphasis and direction as pronounced will hold good at least until the 1980s.

Though the outcome depends on difficult Congressional decisions, the confidence of this prediction rests partly on the basic stability of the American political and economic structure, and partly on the fact that the preceding Administration, so different in party sympathies and tactical possibilities, had already endorsed most of the policies now adopted by President Carter. Efficiency in use is still being heavily stressed as it was the 55 miles/hour national speed limit and the 27.5 miles/US gallon motorcar target introduced by the preceding Administration. A reduced level of imports down to 6 million barrels a day by 1985 (less than half the level predicted for that year) is the objective now, as it was when the Ford Administration announced the $ 2 per barrel import fee. (Imports were 7.3 million b/d in 1976).

This time, special wellhead taxes will also be imposed on existing supplies of domestic oil, equal to the difference between the present controlled price of oil and the world price, to force up the whole price level of indigenous crudes produced. The money thus collected will be returned to "the consumers and workers of America."

Efforts to stimulate production will continue to focus on new gas and new oil - with the addition of the proposed Energy Resources Fund to foster activity in new producing areas abroad. As last time, environmental problems will offer a stumbling block, and have forced the Carter Administration to postpone its message on the environment until after the energy plan has tested Congressional and public feelings.

The main difference between the old and new programme comes from the increased sense of urgency. This was explained by President Carter at a press conference shortly before the energy message was delivered, in terms of a less hopeful long-term supply outlook. Some years ago - probably because of an inexact interpretation of the terms proved, indicated, inferred and probable reserves -

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the Central Intelligence Agency provided the basis for exaggerated estimates of the scale of world petroleum resources. In a recently released report it has drastically reduced its estimates, bringing them closer to those prepared by major oil companies. Largely because of a finding that the Soviet Union may have to import as much as 3 million barrels daily within the next 10 years, the official view now conforms with those oil companies that have for some years been warning that supplies will become increasingly tight during the 1980s.

Emphasis on gasoline

The prudent course in this new perspective is to cut back petroleum consumption before market forces begin to impose too high a price. Gasoline consumption, accounting for nearly half the total oil demand in the United States, is the prime target for the Carter programme. But the barriers to much higher gasoline prices are judged to be almost insuperable. Consequently, the proposed additional tax will not come into force until the beginning of 1979 and then only at the modest rate of 5 cents per US gallon, compared with the present federal tax of 4 cents. The proposal is that gasoline shall carry an extra tax of upto 50 cents per gallon, but not until the 1980s and then only if gasoline consumption maintains its recent growth rate of 5 per cent or more annually. To discourage the continuation of this rate, target consumption figures are being worked out with the total expected to start declining after 1980.

Because of the unlikeliness of this shrinkage direct restraints are to be placed on wasteful cars. Excluding those imported from Canada and those already on the road, a tax ranging up to $ 2500 will be imposed on cars delivering 11 miles/US gallon or less, and produced in 1985 or later. As a further inducement, rebates will be paid for cars with outstanding mileage records- $500, for instance, on cars (excluding imports) delivering 38 miles/US gallon or more. Higher taxes are also in store for gasoline used in boats, private planes and for other inessential purposes.

Even more striking, however, are the proposed increases in taxes on crude oil. Although full decontrol proved too bitter a pill to swallow, a similar effect will be achieved by a wellhead tax that will raise the lower-tier price to the upper-tier level through the imposition of a new levy, effective within 30 days of enactment of the programme, of about $6 per barrel on lower-tier ('old') oil. Territory oil will be decontrolled; other new oil, defined as that flowing from new wells lying at least 5 miles from any existing well, will be progressively released, allowing it to rise over three years to the 1977 landed price of imports (at present some $14.50 per barrel), with allowances for US inflation. Through an acceleration of the timetable

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set out in the Ford Administration's Energy Policy and Conservation Act, the wellhead tax on upper-tier ('new') oil will allow the price of that oil to rise to the world level by May 1979.

This programme will not iron out all the present distortions in the domestic market, but it will go far enough to allow abolition of the incredible complex entitlement system. For products it will have the advance of eliminating, after the end of summer, price and allocation controls on gasoline and all other products.

In the hope that the Natural Gas Act of 1938 will at last be repealed, the Administration proposes that a similar phased decontrol programme be applied to gas. For new gas (from wells spudded this year or later, and with the same 5-mile restriction) the oil-equivalent price will be allowed - a difficult concept, estimated to yield about $1.75 per thousand cu ft in today's market. For old gas 32 cents will be the floor and $ 1.45 the ceiling as contracts for flowing gas expire. Exemptions for small producers and for direct purchases by industrial consumers are expected to be renewed. Intrastate purchases, which provided a lifeline for essential uses during last winter's supply crisis, will henceforth be controlled - but at the higher-price levels indicated above.

As with the $30 billion to be collected under the 1975 proposals, consumers and politicians are already vying for the spoils of the wellhead and other tax increases. The crude tax alone is expected to yield some $18 billion annually. Here again the Carter Administration is following precedent. The revenues will be returned to the consumer - with the promise of a "dollar-for-dollar" rebate to home-heating customers, whose oil prices rise by as much as one-third.

President Carter's message was given added urgency by the recent surge in imports. Even in March when the most severe weather had ended they were still running at 9.4 million b/d - a 41 per cent increase over the preceding year although domestic demand had only risen by 4.1 per cent. Meanwhile, dependence on the least secure sources has been growing at an alarming pace with volumes about doubling since the embargo in the case of imports from Arabian and Nigerian sources, while supplies from Venezuela have fallen by 38 per cent and those from Canada by 54 per cent. Yet the energy programme concentrates its efforts on reducing the total volume of imports rather than on favouring those sources likely to be least exposed to interruption.

Earlier this year the Congressional budget office presented an outline of five alternative energy policies and indicated their possible impact on import volumes. At one extreme was a programme to cut imports to as low as

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some 2 million b/d by the mid-1980s, and the other was a low consumer-cost programme allowing imports to soar to more than 12 million b/d. In effect, the Carter package chooses the middle ground with imports to be cut below the latest levels and with the growth of domestic demand to be slowed down by strong emphasis on environmental protection.

Tax credits for savi-ng energy

To encourage energy saving tax credits of up to $410 per household are being offered to those who insulate their homes or in other ways cut down their energy consumption, with up to $2 000 offered to those installing solar collectors or similar devices. For industry, which will be required to switch progressively from oil or gas-fired boilers to coal, an additional 10 per cent investment tax credit will be offered to companies investing in power generation equipment to be operated in conjunction with their process-heat boilers. Through "co-generation" of this type, refi-neries and similar energy-intensive plants expect to be able to save as much as 500 000 b/d of residual oil or equivalent.

Although air-quality standards will not be relaxed to the extent demanded by both oil and coal suppliers, coal consumption will be favoured to such an extent that domestic supplies will be expected to rise by two-thirds to a total of more than 1 billion tons in 1985. Great hopes are also pinned on nuclear energy. Although the breeder reactor programme is to be slowed down and the plutonium cycle indefinitely held back, siting and other regulatory simplifications will be introduced with the intention of cutting as much as one-quarter off the present lead-time of about 10 years required to authorise and complete a conventional nuclear plant.

The impact of the entire package on energy prices will be sizeable, though efforts are to be made to soften it through the tax rebates mentioned earlier, and to direct it through the introduction of rate reform in electricity supply and incremental pricing of natural gas. Even so Mr. Charles Schultze, chairman of the Council of Economic Advisors, estimates that the price index will be forced up by nearly ½ per cent at a time when the Administration is struggling to hold the total rise at less than 6 per cent. If the effect of the measures proposed is to bring a sharp drop in energy use, the price impact would indeed be cushioned.

But much time and tenacity will be needed, if the Carter programme is to reach its target of an energy growth rate reduced from an actual 4.8 per cent last year to an average of less than 2 per cent in the years ahead. Renewed warnings over company profiteering and the need for accounting reassignments have raised fresh doubts whether the tenacity in the direction and the time is not later than the policy makers think.

Source: Petroleum Economist, May 1977.

2.5 DEVELOPMENT OF OPEC GAS POTENTIAL COULD ALLEVIATE ENERGY CRISIS

OPEC's huge natural gas reserves could make a substantial contribution towards alleviating the rapidly evolving energy crisis, but only if higher prices and a fairer sharing of risk between buyers and sellers permits a full-scale mobilization of these reserves, according to Mr. Nordine Ait Laoussine, the Vice President of Algeria's national oil company Sonatrach. Speaking to the fifth International Liquefied Natural Gas (LNG) Conference in Dusseldorf on 29th August, Mr. Ait Laoussine said that current gas exports from OPEC amount to 19 billion cubic meters annually- or 340,000 b/d of oil equivalent - while some 120 billion cu.ms/y are flared. Contracts already signed by OPEC members will raise exports to 3 million b/d of oil equivalent by 1985, but this figure is dwarfed by total OPEC gas reserves estimated at 22,000 billion cu ms. or 140 billion barrels of oil equivalent, capable of sustaining gas exports equivalent to 20 million b/d of oil.

Among the main points made by Mr. Ait Laoussine in his speech were the following :

- Algeria does not expect hydrocarbons from tar sands, shale and coal to make a significant contribution to energy supplies in the next 15 years. Studies indicate that by 1990 these sources are unlikely to contribute more than 1.5 million b/d of oil equivalent to world supply, requiring an investment of some $60 billion.

- Pricing of LNG in consumer markets on the basis of fuel oil would lead to a negative value of between 40 and 70 cents at the wellhead for the producer. Using the concept of a guaranteed minimum price, Algeria is currently receiving 30-40 cents per million Btu as the wellhead, equivalent to $ 2.00/barrel on oil equivalent.

- Studies by Sonatrach show that the price of synthetic gas from coal in the US will be in the area of $6.50/million Btu in 1985, which is almost double the highest price authorized by the FPC for regasified imports from Algeria. "In other words, the fob price of Algerian LNG could more than double before other sources of energy begin to generate even a modest return for the countries which produce them."

- The total capital investment required to exploit the gas reserves of the Gulf area alone amounts to some $300 billion, much of which would benefit the balance of payments of the consuming countries.

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The following is a summary of Mr. Ait Laoussine's speech :

After noting that the signs of a new energy crisis are already visible, and that it will be difficult to meet world energy demand in future years, Mr. Ait Laoussine said that while the search for non-conventional energy sources should be continued, attention should also be given to the prospects for developing other energy sources.

"One of the main incremental sources of energy lies in conservation. The OECD has estimated that a sustained conservati-on program could result in economies equivalent to 4 milli-on b/d by 1985. This is comparable to the combined current production of Kuwait and the UAE, although one must remain sceptical about the real possibility of achieving economies of this scale.

"As for the other possible sources of energy .... we for our part estimate that in the best possible circumstances liquid or gaseous hydrocarbons extracted from shale, tar sands or coal will co-ntribute less than 1.5 million b/d in 1990 - when world oil consumption is expected to exceed 90 million b/d - while requiring an investment of around $ 60 billion at current prices.

"In these circumstances, why do we not turn to the considerab-le gas reserves in the OPEC countries, and all the more so si-nce this valuable energy source is at present mostly wasted through fla-ring? OPEC natural gas reserves already contribute significantly to world natural gas supplies in the form of LNG or via international gas pipelines. Thus 10 billion cubic meters of gas, equivalent to 180,000 b/d of oil , are currently being exported annually as LNG. Pipeline exports amount to 9 billion cu.ms./year or 160,000 b/d of oil equivalent. These figures, how-ever, represent only a small proportion of the sales agreements already signed by the OPEC countries.

"In fact, the gas export projects announced by various OPEC countries cover a volume of some 165 billion cu.ms./year, of which some 44% are in Algeria and around 36% in the Gulf States, including Iranian gas exports to Europe by pipeline via the Soviet Union. These projects, most of which will be operational by 1985, amount to the equivalent of 3 million b/d or 10% of OPEC's current oil production.

"But this figure is itself relatively insignificant when compa-red to the potential of OPEC's total reserves, which have been estimated at some 22,000 billion cubic meters or 140 billion barrels of oil equivalent. I am convinced this estimate is well below OPEC's real reserves, since important prospects have not yet been the object of sustained exploration and several gas fields have not been fully delineated, as is the case in Algeria. In fact the gas reserves so far

.../-

discovered come from "acci-dental" discoveries, since exploration for gas on its own has not been encouraged outside the consuming countries.

"Having established that OPEC's gas reserves are undeniably a major world energy source, it is appropriate to examine how they were exploited in 1976 when, although OPEC gas exports rose to 20 billion cu.ms./y, some 120 billion cu.ms. was flared. This wastage amounts to 2.2 million b/d of oil equivalent or more than half the potential energy conservation estimated by the OECD in 1985. It also represents three-quarters of Western Europe's 1975 gas consumption, two and a half times the present consumption of West Germany, and one and a half times the 1990 projections of synthetic hydro-carbons production in 1990 from shale, tar sands and coal together.

"The utilization of OPEC's total gas reserves would represent transactions 50 times larger than the present level. Here it is a question of the potential production of a valuable, noble and clean form of energy equal to 20 million b/d of oil equivalent, two and a half times the current output of the USA or two-thirds of OPEC's present production. Thus the export commitments so far entered into by the OPEC countries represent only a fraction of the possible volume. More specifically, they represent only 7% of existing potential for the Gulf countries.

"The exploitation of the gas resources in the Gulf would result in considerable movement of capital for the purchase of tankers, processing plants and pipelines which would have a beneficial effect on the balance of payments of the consuming countries. These purchases are estimated at 1,000 LNG carriers of 125,000 cu.ms. capacity at a cost of $150 million each, 100 liquefaction plants each with a capacity of 10 billion cu .ms./y at a unit cost of $1.5 billion, and 100 regasification plants of 8 billion cu.ms./y capacity costi-ng $300 million each . Overall, the total capital required to exploit natural gas in the Gulf alone would be $300 billion. Unfortunately the derisory value so far ascribed to this non-renewable, high-performance and secure resource has not encouraged certain OPEC countries to undertake export operations.

"In fact, on the basis of present fuel oil prices in the main consuming countries, an LNG project in the Gulf aimed at supplying the US or European market would result in a negative wellhead value for the exporter of 70 cents and 40 cents per million Btu respectively. If the fob sales price had been calculated in this manner in Algeria, the wellhead return would have been infinitesimal compared to the revenue from oil in Btu terms.

.../-

"It is for this reason that Algeria has opposed the setting of FOB prices for LNG on the basis of parity with fuel oil prices in the consuming countries and has obtained a fairer value for its exports through a guaranteed minimum price. On the basis of current fob sales prices for LNG Algeria receives at the wellhead between 30 and 40 cents per million Btu, or some $2.00/barrel in terms of oil equivalent. Gas producers in the US receive four times as much.

"I believe the cost of access to alternative energy sources gives the current price of LNG a considerable margin for improvement, so that an increase in the wellhead value of OPEC gas is highly possible in economic terms. We have calculated that in the Chicago area the cost of synthetic gas from coal, which is the most abundant resource capable of producing energy of as high a quality as natural gas, would be in the region of $6.50 per million Btu in 1985 (1985 dollars), which is almost double the highest price authorized by the Federal Power Commission for regasified imports from Algeria.

"This study shows that the production of one million Btu/year in the form of LNG requires a capital investment of some $8.00 in Algeria and $9.00 in the Gulf, while for the production of the same quantity of energy from alternative sources, not taking into account the cost of environmental protection, the investment required would be 50% higher.

"In the future the price of natural gas as much as the price of oil will determine the development of tar sands, shale, coal oil, synthetic natural gas and the natural gas reserves of the Gulf and the Arctic regions. In other words, the fob price of Algerian LNG could more than double before other sources of energy begin to generate even a modest return for the countries which pro-duce them.

"The world energy situation has become so contradictory that we no longer have the option of cheap supplies. Either prices will rise or supply will be inadequate."

Mr. Ait Laoussine said that in addition to a price increase, a fairer division of risk between buyer and seller would be required to mobilize OPEC gas reserves, since at present more than half the investment must be put up by the seller. A typical US-oriented LNG project on the Algerian ownership pattern costs about $4.2 billion at 1976 prices, and of this $2.3 billion is for the production faci-lities in the producing country. If the producer undertakes ha-lf the shipping, the percentage of the overall cost he bears rises to 75%. To co-unter this Mr. Ait Laoussine proposes that the "cost of service" concept currently applied to US public utilities should be employed for international LNG deals, starting downstream from the wellhead, on the following bases :

- The seller's installations are dedicated exclusively to the buyer.
- The real costs of the delivery chain are transferred in toto to the buyer and paid for by the consumer.
- The seller receives a guaranteed return on his investments.

Source: Middle East Survey.

2.6 NATURAL GAS:
PROBLEMS FOR WORLD TRADE

by Andrew Lumsden

Of late there is at least an increasing appreciation of the central problem concerning this premium fuel; either usage must be curtailed in the main consuming areas, with consequent pressure on alternatives including oil, or the very expensive international / must be raised from its /trade comparatively low current levels. The ideal third solution- a great increase in the natural gas reserves of the main consuming areas- has to be borne in mind, but cannot be relied on by planners now trying to make energy balance forecasts.

To take the last point first, since it sets the scene for the other choices to be made, the proved gas reserves of the main consuming areas in the free world (North America and Western Europe) at the start of this year were under 12000 billion cubic metres while consumption-very nearly equalling production-was some 840 billion cu m in 1976. Dividing reserves by the 1976 rate of production gives the prospect that North America will run out of natural gas by 1990-only 12 years from now- and Western Europe by about the year 2000. With the US 30 per cent dependent on Natural gas for its total energy supply, and Western Europe 13 per cent dependent (going as high as 47 per cent in the Netherlands) this is a sombre picture to set alongside the effort to reduce proportionate dependence on oil. Two gathering crises seem to be set for a common crunch point in the last decade of this century.

It is, of course, necessary to ask whether the "proved" figure for natural gas reserves is the proper indicator to use. "Probable" extra natural gas reserves in Western Europe (ie the volumes confidently expected when the necessary work on proving up is done)would add another seven years or so at 1976 rates of production. Beyond "probable" there is a further category of "possible", meaning statistically possible based on a combination of present geological knowledge and the historic rate of success in exploring for gas. In this category it has been estimated that US natural gas reserves could be four times the "proved" level (see footnote (b) to the accompanying table of production and reserves).

Conversion of the "possible" reserves in the US to proved status, assuming the gas was there, would require a massive programme of exploration and development, but would transform not merely the US but the global energy picture. The decline in US natural gas consumption, with its unpleasant side effects on oil demand, would be arrested or reversed. The largest gas consumer in the world(40 per cent of global consumption)would free itself of the need to find marginal gas supplies abroad.

And self sufficiency - if all the "possible" reserves could conceivably be tapped - would jump by 40 or more years. The resulting time-span would be reasonably comfortable, given the serious work now being undertakne on commercially viable processes for gasification of coal.

The unavoidable search for imports.

The only major consumers left in the market for growing supplies of internationally traded gas would be Western Europe and Japan, and the Soviet satellities in the Eastern bloc. Both are in some respects better placed than the US to receive rising gas imports: Europe because its existing reserves have a longer life and because the continent is better placed geographically vis-a-vis Africa and even Iran; Japan because it can turn to Brunei, Indonesia, Malaysia, and Western Australia (and currently to Alaska) as well as to the Gulf. However, it would be foolish to assume that there is much chance of US pressure on international demand for gas being averted by a swift proving up of vast new indigenous reserves, or that any new reserves could restore US self-sufficiency within a decade. The price which Europe and Japan are going to have to pay for gas imports over the rest of this century are going to be further inflated by US entry into the market.

Assuming, as companies supplying gas to the consumer in the US, Western Europe and Japan must do, that no major reversal in the run-down of US gas reserves is going to come about for at least a decade, the prospect is for rising gas imports coupled (thanks to higher prices) with a slower rise- but presumably no fall- in global natural gas consumption. Internationally traded natural gas in 1976 totalled an estimated 137 billion cubic metres, or some 10 per cent of total global natural gas consumption. One recent estimate* is that just over 20 years from now imports by Western Europe (230), North America (170), and Japan (85) could total some 490 billion cu m a year, a more than three-fold jump. On the most conservate estimate it may be supposed that this would involve a transfer of some $40 billion a year from consuming nations to natural gas suppliers, excluding the capital cost of pipelines, LNG facilities, etc.

This very rough forecast of the cash transfer that may be looming up leads on to the peculiar difficulties attached to a major increase in international trading of natural gas. This could well be summarised as the energy crisis concealed behind the more obvious and pre-eminent worry about oil. World reserves of proved (let along probable or possible) natural gas are very large, equal to quarter to half a century of consumption at the 1976 rate (see footnote(c) in our table for qualifications).

*Global Prospects 1985-2000, Workshop on Alternative Energy Strategies.

The distribution geographically has been more fortunate than with oil, except in the luckless case of Japan, but with self-sufficiency prospectively on the down-turn in the USA and Western Europe, the greatest reservoir of unutilised natural gas is to be found in the oil-associated and dissociated gas fields in the Middle East, primarily Iran, and Africa.

OPEC'S standpoint on exports

A start was made some time ago on tapping the surplus gas of North Africa where Algeria and Libya are already well established suppliers, primarily to Western Europe but also on a small scale (as LNG) to North America. Jockeying for firm contracts with these countries and also with newer sources in the Middle East has also been going on for some years, resulting in several major deals that should be operational in the 1980s (viz the arrangement by which Iran will supply 17 billion cu m a year of gas to the Russians of which 11 billion will be "switched" to Western Europe; 25 billion cu m year to go to North America from Algeria as LNG, and possibly further large quantities from Nigeria; up to 11 billion cu m year to go, possibly by pipeline, from Algeria to Italy; and at least 3.2 billion cu m year to go from the Gulf to Japan). The totals are still very uncertain, but they fall far short of the import requirement that may have to be lined up 20 years from now on the already quoted projections for Western Europe, the USA, and Japan.

Gross production of natural gas in the Middle East in 1976 (excluding gas reinjected but including gas flared) was about 130 billion cubic metres with a further 40 billion flared in Africa. Setting aside problems of quality, access, and transport, Africa and the Middle East are unquestionably the obvious places to go if the natural gas self-sufficiency of the major consuming blocs tails off as expected. Here lies the energy crisis to some degree masked by the pre-eminent concern over oil; Iran and Algeria have already said that they are not open to any contracts further than the ones now approved in principle; Saudi Arabia has said that it is not open to export projects until it has settled its internal programme for gas utilisation; and all OPEC states are agreed that gas export projects and pricing are a matter of common concern, and Iran and Venezuela have agreed to produce a joint policy document.

North-South talks

Natural gas accordingly takes an as yet shadown, but likely to become all too clear, place on the south side of the North-South dialogue-that is, among the raw materials required by the industrialised world, but viewed as a finite resource by owners in the developing world. The virtues of natural gas, both as fuel and as petrochemicals feedstock are apparent to two owners, and though gas export prices have so far lagged behind parity with competitive oils in gas importing markets, OPEC spokesmen have already made it clear that they do not intend to go on sharing the historic US

and Western European view of natural gas as a cheap supplement to the energy balance. It can be assumed that not only in capital investment, but in sums transferred to producer states, the major consuming blocs are going to the made to pay very dearly for incremental natural gas supplies a decade or so from now; or cut gas consumption in line with decreasing self-sufficiency (throwing the burden on other high-cost energy supplies); or, in the case of the USA, deliberately set out to develop very substantial extra reserves at home.

WORLD:ESTIMATED COMMERCIAL PRODUCTION OF NATURAL GAS AND PROVED RESERVES

Billion (thousand million)cubic metres+

	Commercial Productiona)		Reservesb)		as % of	Life of
	1975	1976	Ist Jan. 1970	Ist Jan. 1977	world.	reservesc) years.
North America						
USA d)	569.40	560.30	7791	6117	9.4	11
Canadac)	87.50	88.90	1473	1651	2.5	19
	657	649	9264	7768	12.0	12
Caribbean						
Venezuela*	12.75	12.30	751	1152	1.8	94
Trinidad	1.40	1.50	85	97	.1	65
Colombia	2.10	2.20	79	141	.2	64
	16	16	915	1390	2.1	87
Other Latin America						
Argentina	6.30	6.30	181	192	.3	30
Bolivia	1.80	1.90	85	141	.2	74
Brazil	0.60	0.60	26	25	negi	42
Chile	3.60	3.60	79	57	.1	16
Ecuador*	0.03	0.03	20	150	.2	--
Mexico	16.90	17.20	340	339	.5	20
Peru	0.90	0.90	5	62	.1	69
	30	31	736	966	1.5	31
Middle East						
Abu Dhabi*	1.10	1.50	249	566	.9	377
Bahrain	2.10	2.10	11	84	.1	40
Duabi*	0.60	0.60	20	42	negi	70
Iran*d)	17.00	17.60	3030	10708	16.5	608
Iraq*d)	1.60	1.50	552	764	1.2	509
Israel	0.06	0.60	2	1	negi	---
Kuwait*f)	5.17	5.38	1215	969	1.5	180
Oman	0.40	0.50	57	56	.1	112
Qatar*g)	2.22	2.22	207	779	1.2	351

WORLD : ESTIMATED COMMERCIAL PRODUCTION OF NATURAL GAS AND PROVED RESERVES

Billion (Thousand million) cubic metres

	Commercial Production a)		Reserves b)		as % of world.	Life of reserves c)
	1975	1976	1st Jan. 1970	1st Jan. 1977		years
S.Arabia*d)	3.30	4.30	1498	1855	2.9	431
Sharjah*	na	na	na	28	negl	-
Syria g)	0.17	0.18	14	100	.2	-
Turkey	0.10	0.10	9	1	negl	-
	34	36	6864	15953	24.6	443
Africa						
Algeria*	6.30	7.20	4106	3563	5.5	495
Angola Cabinda	0.06	0.06	28	42	negl	-
Congo	0.02	0.02	na	28	negl	-
Egypt	0.40	0.40	40	79	.1	198
Gabon*	0.05	0.05	14	79	.1	-
Libya*	3.80	4.00	736	730	1.1	183
Morocco	0.07	0.08	1	1	negl	-
Nigeria*	0.40	0.40	142	1245	1.9	-
Tunisia	0.21	0.21	14	186	.3	-
Zaire	-	-	-	54	.1	-
	11	12	5081	5998	9.3	500
Western Europe						
Austria	2.36	2.49	11	16	negl	6
Denmark	-	-	-	65	.1	-
France	7.30	7.10	204	140	.2	20
W.Germany	18.20	18.80	292	209	.3	11
Greece	-	-	-	11	negl	-
Ireland	-	-	-	283	.4	-
Italy	13.80	14.80	198	200	.3	14
Netherlands	90.85	96.00	2421	1760	2.7	18
Norway	-	-	-	524	.8	-
Spain	0.10	0.10	na	14	negl	140
U.K.	36.85	38.70	991	809	1.2	21
	169	178	4117	4031	6.2	23
Far East						
Afghanistan	3.00	3.00	144	77	.1	26
Australia	5.00	5.95	357	915	1.4	154
Bangladesh	0.60	0.60	-	226	.3	377
Brunei	6.00	7.76	57	238	.4	31
Burma	0.20	0.20	3	4	negl	20
India	1.00	1.17	40	99	.2	85
Indonesia*	1.00	1.00	79	680	1.0	680
Japan	2.43	2.48	20	59	.1	24

WORLD: ESTIMATED COMMERCIAL PRODUCTION OF NATURAL GAS AND PROVED RESERVES

Billion (thousand million) cubic metres†

	Commercial Production a) 1975	1976	Reserves b) 1st Jan. 1970	1st Jan. 1977	as % of world.	Life of reserves c) years
Malaysia	0.30	0.32	57	425	.7	-
N Zealand	0.30	1.68	184	175	.3	104
Pakistan	5.00	5.20	535	448	.7	86
Taiwan	1.90	2.00	28	22	negl	11
Thailand	-	-	-	28	negl	-
	27	31	1504	3396	5.2	110
FREE WORLD						
W Hemisphere	703	696	10915	10124	15.6	15
E Hemisphere	241	257	17566	29378	45.3	114
	944	953	28481	39502	60.9	41
of which, OPEC*	55	58	12619	23301	36.0	402
USSR & Eastern Europe						
Albania	na	na	9	11	negl	-
Bulgaria	0.20	0.22	28	13	negl	59
Czechoslovakia	0.72	0.80	14	17	negl	21
E Germany	8.10	8.30	14	100	.2	12
Hungary	5.20	6.00	119	108	.2	18
Poland	6.00	6.60	9	97	.1	15
Romania	26.50	30.50	170	187	.3	6
USSR	289.00	320.00	9119	24000	37.0	75
Yugoslaiva	1.55	1.73	34	59	.1	34
	337	374	9516	24592	37.9	66
China	16	17	102	718	1.1	42
World:	1297	1344	38099	64812	100.0	48

† For rough equivalents in cubic feet divide by 10 for billion cubic feet daily; divide reserves by 30 for million million cubic metre = 35.315 cu ft.

*Member of OPEC.

a) Excluding flared or reinjected. b) Mainly exuluding probable and possible reserves, primarily Iranian, which if included might raise global reserves some 50 per cent. In addition, an American Gas Association sponsored survey has estimated that proved, probable and possible US natural gas reserves could be a combined 26000 billion cu m or four times the proved level used in this table.

The Potential Gas Committee puts proved, probable, possible, and speculative reserves at 32 000 billion cu m. Due to rounding, percentages may not quite equal 100. Negal = under .08 per cent. c) Reserves at 1st Jan 1977 divided by 1976 rate of commercial production. Exclusion of wasted gas production means life of reserves is somewhat overstated - however, reserves are conservative, being confined to proved. d) Proportion of reserves associated with oil: USA 27 per cent Iran 56 per cent, Iraq 65 per cent; Saudi Arabia 78 per cent (half share of Neutral Zone included). e) Includes Mackenzie Delta and Arctic Islands. f) Includes half share of Neutral Zone. g) Proved and probable reserves combined.

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Source: Petroleum Economist, July 1977.

2.7 WORLD ENERGY: FROM RAPID GROWTH TO STANDSTILL

by B.A. Rahmer

The dynamic changes in the structure of energy supply and demand during the third quarter of this century, are strikingly illustreated by the figures in the United Nations' latest specialised statistical survey.* The new compilation contains detailed year-by-year information about production, consumption and trading for all the main primary and secondary fuels, covering over 200 countries with an estimated population (in 1974) of 3890 million people- virtually the whole world. The preceding UN surveys were rather less comprehensive, spanning much shorter periods.

The most significant single fact emerging from the survey- and illustrated in the accompanying chart- is the more than three-fold expansion of the world's aggregate consumption of energy (excluding firewood and other "non-commerical" fuels),from 2493 million tonnes coal equivalent in 1950 to 7971 million in 1974. Though there was a simultaneous population growth of about 55 per cent, energy consumption per head in the world as a whole doubled over the same 25 years from an annual average of 1 004 kilogrammes, in terms of coal equivalent, to as much as 2059 kg.

Total world energy consumption is shown to have risen at average annual rates of 5.5 per cent in the 1950s, 5 per cent in the 1960s, and 4.8 per cent during 1971-73. Not surprisingly, the growth virtually ended, at least temporarily, in the wake of the hefty crude oil price increase of 1973/74: there was a modest 0.8 per cent rise in world energy consumption in 1974, but the Communist countries were not immediately affected by the oil crisis, and consumption in the non-Communist world actually declined by about 1 per cent. Figures for 1975 in the UN study are incomplete, buy they seem to indicate a standstill or small overall decline in energy consumption even if the Communist countries are included.

The economically advanced areas of the non-Communist world-North America, West Europe, Japan, Australia/New Zealand, South Africa and Israel-account for only about one-fifth of the World's population, but they consumed in 1974 three-fifths (4794 million tce) of all the available energy. The USSR and the other Communist countries of East Europe(excluding Yugoslavia), with barely one-tenth of the world's population, accounted in the same year for close on one-quarter(1851million tce) of world energy consumption.

*World Energy Supplies 1950-1974.Statistical Paper,Series3, No.19 Price:clothbound US $38.00; paperbound US$30.00(or equivalent in other currencies).825 pages.Publishing Service, United Nations, New York, NY 10017,USA(The compilation is complete up to 1974 and also contain some figures for 1975).

The remaining 70 per cent or so of the world's population live in developing countries and had at their disposal less than 17 per cent of the commercial fuel and power resources available for consumption in 1974. However, contrary to widespread impressions, the relative share of these countries (taken as a whole) has more than doubled since 1950 when it amounted to barely 6½ per cent of the total, and this increase was only partially due to the explosive population growth in this part of the world. Sight should not be lost of the fact that most of the developing countries have a warm climate with correspondingly low heating requirements, and that many of them make use of relatively large-supplementary quantities of "non-commercial" energy, including firewood as well as cow-dung (notably in India), wind power, and muscle power of draught animals.

Considerable differences in per capita consumption persist not only between the industrial and pre-industrial parts of the world but, even more, between individual countries with different economic and social standards. The US, at the top of the league +, consumes, roughly speaking, between 2 and 3½ times the amount of fuel and power, per head of population, as the main countries of western and estern Europe, or Australia and Japan (see accompanying table). More strikingly, its per capita consumption equals 57 times that of India and over 1 000 times that of Yemen. The people of North America - some 236 million all told - account for just about one-third of the world's aggregate energy consumption, and for nearly half (48 per cent) of that in the non-Communist world.

WORLD: ENERGY CONSUMPTION PER HEAD IN 1974

	kg coal equivalent.	Per cent of total a) Solid fuels	Liquid fuels.	Natural gas	Primary electricity.
World	2059	31.8	44.7	20.9	2.6
Market economies:					
Developed	6349	22.6	50.8	23.4	3.2
Other	394	18.5	62.0	16.0	3.6
Communist areas:					
in Europe(and USSR)	5139	44.4	31.8	22.8	1.1
in Asia b)	675	85.0	13.3	0.7	1.0
USA	11485	20.6	43.9	33.3	2.2
Canada	9816	9.3	51.1	27.8	11.8
Australia	5997	46.7	43.5	7.8	2.1
West Germany	5698	32.4	50.2	16.1	1.3
United Kingdom	5464	38.1	45.0	15.4	1.5
USSR	5252	35.8	37.0	26.0	1.2
France	4342	19.6	66.3	10.2	3.8
Japan	3839	20.3	74.4	2.5	2.7

Italy	3224	6.9	75.4	14.5	3.2
Argentina	1861	3.0	70.4	25.1	1.5
China b)	650	84.5	13.9	0.8	0.8
India	201	71.8	24.3	0.8	3.1
Nigeria	94	5.3	75.4	15.1	4.2
Ethoipia	31	0.6	94.3	-	5.1
Haiti	31	-	90.0	-	10.0
Mali	24	-	97.0	-	3.0
Yemen Arab Republic	10	-	100.0	-	-

A)Due to rounding the figures do not always add up to 100.0

b)though coal certainly predominates, there are independent estimates according to which the share of other fuels in China (and therefore in the whole of the Asian Communist areas) is higher than shown.

The quarter-century under review witnessed at least three further developments of fundamental significance: a large-scale change from coal and lignite to hydrocarbon fuels, a big increase in the generation of electricity, and a remarkable growth in the volume of the international fuel trade.

Coal and lignite, the leading commercial fuels since the start of the industrial revolution, still accounted for more than half the world's energy consumption throughout the 1950s, but their share by 1974 had fallen to less than one-third. In absolute terms, coal and lignite consumption (excluding bunkers)increased over the 25 year period by about 65 per cent-ie far less rapidly than total energy consumption (see chart)- and this rise was chiefly concentrated in China, the USSR and East Europe were the relative share of solid fuels has, in general, remained highly significant. The increase in coal and lignite consumption in the non-Communist world over the same period amounted to barely 10 per cent; and, as a result, there are very few non-Communist countries left- India and South Africa are the foremost examples - where solid fuels in the mid-1970s continue as the predominant commercial fuels.

Simultaneously, the share of hydrocarbon fuels in the world's rapidly rising energy consumption went up from 37 per cent in 1950 to 65½ per cent in 1974. Inland consumption of petroleum based-liquid fuels increased 5.3 - fold over these years and natural gas comsumption increased 6.8-fold, the former reaching over 2,300 million tonnes(3567 million tce) and the latter about 1250 billion cubic metres (1668 million tce). The sharp increase in the demand for these fuels was an inevitable result of their competitive advantages, though the consequent gradual exhausion of the relevant reserves makes it imperative during the remainder of this century to concentrate on energy conservation, on the development of new alternative energy sources and, to some extent, on a revival of coal and lignite production.

World consumption of electricity went up 6.5-fold during the review period, reaching 6245 GWH in 1974. Most of the electricity- indeed, an increasing proportion over the period - came from conventional thermal plants whose heat losses have significantly contributed to the enormous increase in the demand for fossil fuels. (It may be estimated, on the basis of the UN figures, that nearly one-third of the world's output of fossil fuels, in terms of energy content, has been used in recent years for the generation of electricity.) Against this, consumption of primary electricity in 1974 included only 1433 GWh hydro- and 234 GWh nuclear power, thus covering little more than one-quarter of world demand for electric power and a mere 2.6 per cent of the world's total energy demand.

The expansion of the international fuel trade over the 25 years has also been nearly 6.5-fold. Less than one-fifth of all the available commercial energy in 1950 entered the international trade, but the proportion in recent years was, of course, chiefly due to the development of oil production in the exporting centres of the Middle East and Africa, and total crude oil exports, often over long distances, moved up, year by year, from 141 million tonnes in 1950 to a peak of 1574 million tonnes in 1974. Exports constituted 26 per cent of the World's annual crude oil production at the beginning and 56 per cent at the end of the review period.

Exports of natural gas were of little significance in the 1950s and even in the early 1960s, but have since been given a strong impetus through the development of LNG tankers and intra-continental pipeline systems. They reached over 110 billion cu m in 1974, covering 8.8 per cent of world demand for natural gas in that year, and continue to grow at a rapid rate. The annual volumes of solid fuels traded internationally during 1950-74 are shown to have fluctuated between the equivalent of 6 and 9 per cent of world production of coal and lignite.

+ = As far as countries with large or fairly large populations are concerned. Energy consumption per head is even larger in a few small oil-producing countries such as Kuwait, Qater,etc.

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Source: Petroleum Economist June 1977.

2.8 FIVE-FOLD INCREASE IN LPG EXPORTS PREDICTED BY 1985

According to an OPEC analysis, world LPG export availability is expected to rise five-fold from the 9 million tons/year level in 1975 to 35 million t/y by 1980-82 and 47 million t/y by 1985. Of these volumes the OPEC share is estimated to be over 80%.
(see tab-le on page 87)

In an article in the latest issue of the OPEC Review, OPEC Senior Economi c Analyst Abderrezsak Ferroukhy considers whether LPG trade can expand in future at a sufficient rate to absorb the projected surplus available in the Gulf. He concludes that the projected 35 million ton-level for the early 1980's, equivalent to 830,000 b/d of crude, would be a substantial cont-ribution to the world energy supply, and any surplus could be absorbed by further market penetration.

However, this is dependent on the establishment of a market pricing mechan-ism which in turn is governed by several factors. Firstly LPG should be considered as a premium fuel because of its inherent chara-cteristics; it is clean-burning, suitable for a variety of uses and easy to transport. Second-ly, the investment required for LPG projects is high, but despite this Gulf producers have shown a willingness to respond to market realities. Thir-dly, potential additional availability will guarantee stability of supply. However in order to ensure maximum market penetration, LPG should be priced in relation to competitive oil products as far as possible. In this light, marketing possibilities should be reexamined in the two principal LPG importing countries, the US and Japan.

In the US, demand for imported LPG is growing due to declining natural gas production. In 1975, imported LPG averaged around 40% of total consu-mption - 60 million tons - and marketing possibilities are further enhanced by the compatibility between the LPG and the natural gas markets (to the extent that an LPG standby system is held in readiness to take over in the event that the natural gas supply is curtailed). The main end-user where increased consumption is expected in industry, but further marketing possibilities lie in petroc-hemical feedstocks, where LPG could be used as an alter-native to naphtha and gas oil, and motor fuel blending. In the event of President Carter's energy guidelines being enacted by law, increased demand at higher price levels could be expected from the industrial sec-tor.

Japan, which is at prese-nt a considerable smaller market than the US, is nevertheless the world's largest importer of seaborne LPG. Over the past five years, LPG imports have risen at a 12% average, considerably faster than the growth of overall energy con-sumption. In the future, seaborne LPG imports are expected to continue on a large scale due to the combined effects of anti-pollution measures and the resultant increase in demand for clean-burning fuels, limited pipeline expansion programs and stagnating domestic suppl-ies. Consumpti-on is expected to rise by 6-7% over the next few years in the traditional LPG-oriented markets of the domestic, indu-strial and transportation sectors, but the largest increase is expected to come from the newly-emerging power generation market.

Source: Middle East Survey

ESTIMATED LPG EXPORT AVAILABILITY

(1000 tons/year)

Country	1978	%share	1980/82	%share	1985	%share
OPEC countries						
Middle East*	10300	62	22500	64	33500	70
North Africa	1200	7	3000	9	3400	7
Indonesia	700	4	1500	4	2000	4
Venezuela	1700	10	1700	5	1500	3
Total OPEC	13900	83	28700	82	40400	84
Others						
Australia	1600	10	2000	6	2000	4
North Sea	1200	7	4200	12	5500	12
World Export Avai-lable**	16700	100	34900	100	47900	100

* Iran, Iraq, Kuwait, Qatar, U.A.E., Saudi Arabia.

** Does not include intra-North American export movements, Canada and Mexico, estimated at approximately 3 million tons/year for the period under review.

2.9 SAUDI ARABIA - NATURAL GAS UTILISATION PLANS

A. Summary

1. In 1976 the Saudi Arabian government announced plans for substantially increasing the utilisation of the country's associated natural gas production, 80% of which was being flared.

2. This was to be achieved as a result of :

- Aramco expanding its own existing gas processing plants;
- Aramco constructing additional facilities on behalf of the Saudi government.

3. It was anticipated that implementation of the plans would result in available installed capacity of 1.4 million b/d of Natural Gas Liquids (NGLS), comprising ethane, propane, butane and natural gasoline. If working at full capacity the plants would process 6,000 million cu ft/day (62,000 million cu.metres p.a.) of natural gas. This would require a crude oil production rate of about 12 million b/d.

4. In 1977 the scale of the government's gas plan was significantly reduced and the completion date delayed to the mid 1980s.

5. The capacity of the Aramco and government facilities combined is now likely to be 0.9 million b/d of NGLs. Some uncertainty appears to exist as to the level of gas input which will be required for this le-vel of output to be obtained, reports generally ranging between 4,000 - 5,000 million cu ft/day.

6. Taking into account the fields which, under the revised plans, will not now be connected to the gas gathering system, this level of natural gas input is likely to be associated with a crude oil production level of no more than 10 million b/d.

B. Aramco Facilities

7. Since the mid 1960s Aramco has been processing limited quantities of associated gas at its Abqaiq NGL plant* and exporting propane, butane and natural gasoline from the Ras Tanura fractionation facilities**.

8. Production of these liquids amounted to 185,000 b/d in 1976. In 1977 export capacity was increased to 300,000 b/d as a result of the addition of an NGL processing unit at Berri, and further expansion to 350,000 b/d is expected.

* NGL plants separate natural gas derived from gas/oil separators into methane, liquids and sulphur etc.

** Fractionation plants split the liquids derived from the NGL plant into its constituent parts, i.e. ethane, propane, butane and natural gasoline.

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9. Aramco's facilities are now capable of processing a total of 1,000 million cu ft/day of gas from the Abqaiq and Berri fields associated with a combined crude oil production level of around 2.5 million b/d from the two fields.

10. The entire output of propane, butane and natural gasoline from Aramco's facilities are exported, with the ethane and residual methane being used locally as fuel at the Jubail industrial complex.

C. Government Gas Plan

11. The original plans envisaged production of about 1 million b/d of NGL with exports commencing on a limited scale in 1979.

12. To achieve this objective a total of about 5,000 million cu ft/day of natur-al gas was to be processed at six new NGL plants to be built at: Safaniya, Khurais, Uthmaniyah, Shedgum, Abqaiq and Berri (these la-tter two being in addition to Aramco's own facilities at these fields).

13. From these NGL plants residual methane gas was to be supplied to loc-al industrial markets at Jubail and Dammam and the gas liquids delivered by pipeline to two fractionation centres, one at Ju'aymah in the Persian Gulf and one in the Red Sea coast at Yanbu. Here, ethane was to be extracted for use as petrochemical feedstock and the remaining propane, butane and natural gasoline exported.

14. The subsequent scaling down of the government plan means that :

- Only four of the proposed six new NGL plants will now be built, the additional facilities at Abqaiq and the new plant at Khurais being cancelled ;
- completion of the initial stages of the project, the construction of the NGL facilities at Berri and Shedgum and the fractionation centre at Ju'aymah will not now be realised until the early 1980s at the earliest ;
- the remaining two NGL plants at Safaniya and Uthmaniyah and the proposed pipeline to Yanbu and fractionation facilities are not now scheduled for completion until the mid 1980s.

15. If the revised gas plan goes ahead as scheduled, Saudi Arab-ia will be by far the largest single exporter of NGLs, accounting for around half the anticipated total export capacity in the Middle East by the mid 1980s.

16. Tables 1 and 2 summarise NGL output currently anticipated in the mid 1980s. Table 3 outlines the likely future overall pattern of gas utilisation based on these plans.

Source: Petroleum Economics Ltd., London, September, 1978.

Table 1

Saudi Arabia

Estimated Natural Gas Liquids Availability 1985

000 b/d

	Aramco	Government		Total	
		I	II	I	II
Ethane	(a)	450	200	450	200
Propane	155	310	275	465	535
Butane	105	140		245	
Natural Gasoline	90	110	35	200	125
Total	350	1010	510	1360	860
Ass. Gas Processed (million cu ft/day)	1000	5000	3500	6000	4000 (b)

I - Based on government plans established in 1976.

II - Based on revision of plans made in 1977 and latest available information.

(a) Precise details of quantities of ethane available are not known.

(b) Assumed low of estimated range (see point 5).

Table 2

Saudi Arabia

Estimated Natural Gas Liquid Exports

from Major Export Terminals 1985

000 b/d

	Persian Gulf		Red Sea	
	Ras Tanura	Ju'aymah	Yanbu	Total
Propane/Butane	260	145	130	535
Natural Gasoline	90	-	35	125
Total	350	145	165	660

Table 3

Saudi Arabia

Estimated Natural Gas Utilisation 1973-85

000 million cu metres p.a.

	1973	1974	1975	1976	1985
Availability					
Gas Production	44.3	47.3	37.8	47.2	62 (a)
Re-injection	1.8	2.0	3.0	3.5	21
Flared	38.0	39.1	29.2	37.4	
Gas Processed	4.5	6.2	5.6	6.3	41
Fuel and Losses	2.2	3.5	2.7	2.7	10 (b)
Net Availability	2.3	2.7	2.9	3.6	31
Utilisation					
Exports (LPG)	1.1	1.6	1.7	2.3	9 (c)
Internal Use: Methane	0.7	0.7	0.8	0.9	5 (d)
Ethane					3 (e)
Other Gases	0.2	0.2	0.2	0.2	6
Losses	0.3	0.2	0.2	0.2	8 (f)
Total Utilisation	2.3	2.7	2.9	3.6	31

(a) Associated gas production from 12 million b/d crude oil output. If gas output is lower due to lower level of crude production (see part 6) quantity of gas flared/reinjected would be lower.

(b) Assumed approximate 25% of gas processed.

(c) Exports of 660,000 b/d (Table 1) converted at average factor of around 35 cu metres/bbl.

(d) Assuming maximum usage by power generation sector and other industries.

(e) Requirements for planned petrochemical facilities at Jubail and Yanbu.

(f) Unutilised quantities of methane and ethane.

3. NORTH SEA DEVELOPMENTS

3.1 OPTIMAL DEVELOPMENT OF THE NORTH SEA'S OIL FIELDS - A SUMMARY

By Peter Odell

In an earlier study, Odell & Rosing ("The North Sea Oil Province - A Simulation Model of Development" - Energy Policy Vol.2,No.4, Dec.1974, pages 316-329) predicted recoverable North Sea oil resources of 78 x 10^9 barrel - at the 90% probability level. This prediction was then about twice as large as most oil companies' figures for the size of the North Sea. To try to establish the reasons for this difference in estimates, the authors initiated a series of discussions with many oil companies operating in the North Sea. From these, it became clear that the difference arose mainly as a result of contrasting views on the concept of resources and the so-called resource base.

For any given oil province the size of the resource base depends on the number of fields and their size. How many of the finite number of oil accumulations that will be discovered is a function of the investment in the exploration effort and such investment may well be terminated before all the prospects have been tested - because economic and/or political conditions make continuing efforts not worthwhile. From what various companies have indicated in their North Sea exploration strategy, it seem that lack of interest in finding the smaller fields may account for about 1/3rd of this difference between higher and lower figures for the provinces oil resources. However, this still leaves most of the differences inaccounted for and for explanation of this, it is necessary to turn to another element which emerged from the discussions - the degree to which discovered fields are planned to be exploited. Of the oil in place is a reservoir a certain percentage will be recoverable with a given technology and over an economically relevant time period (the latter being a function of the present value of future oil production and/or of the limited design life of the producing facilities). However, the percentage recovered is basically an economic rather than a technical variable, for it depends on the investme-nt made in the oil recovery system. In turn, the investment decision must be based on expectation of a return which matches alternative opportunities available to a company - so giving a minimum acceptable level of profitability on a field's development and reducing the size of a field to less than its technical potential.

It is this difference between the technical and the commercial reserves of North Sea oil fields with which Odell and Rosing's study is concerned; not simply, as originally intended as an explanation for contrasts in estimates on the size of the resources base. Additionally and much more significantly, it is now suggested that the difference exposes a normal conflict of interest between the exploring company on the one hand and the country represented by the Government on the other - as a consequence of field development decisions and the contrasting interest of the two parties from then.

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For three North Sea fields about which enough information on reservoir characteristics was publicly available, Odell and Rosing calculated their size in terms of economically recoverable reserves. They showed these to be a function of the investment the company was prepared to make on the field - specifically in terms of the number and size of producing platforms to be installed. As each additional platform in an increasingly complex producing system is less productive - so giving an increasing unit cost curve - it is less attractive to the company developing the field. Thus, the company will choose to develop the field only upto the point at which its rate of return does not fall below a minimum acceptable level - of say 25-35% after tax.

The U.K. Govt. on the other hand is concerned with maximising its benefits from oil development - notably in terms of the balance of payments effects of the oil produced and of tax reserves. Thus, in respect of any particular field, the country's interest lies in having output maximised - providing that rising costs do not eliminate taxable reserves. In brief, what is optimal for the company is not optimal for the country. In respect of the three fields investigated the difference appears to amount to about 30% - to the country's disadvantage.

Odell and Rosing's monograph, however, was more than diagnostic for it attempted to show that reconciliation between company and Government interests can be achieved. To secure this aim, companies have to be persuaded to produce more of the technically recoverable oil from a field by means of financial inducements which enable a company move to a more intensive/extensive/development of a field without loss to itself. Several ways in which this could be achieved - including remission of royalties, reduced tax rates and even direct Government financed involvement in a field - were considered. All possible methods, however, necessitate continuing and intensive state participation in the decision making process, right from the earliest days of the anaysis of a field's potential. On the basis of such cooperation, conditions can be created in which fields become 'bigger' than commercially defined and from the development of which both company and State can benefit.

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Source: Energy Policy, December 1977.

3.2 OPTIMAL DEVELOPMENT OF THE NORTH SEA'S OIL FIELDS

C.G.Wall, D.C.Wilson and W.Jones

This article sets out to critically review the methodology and assumptions of Professor Odell and Dr.Rosing in their study Optimal Development of the North Sea's Oil Fields. Both the technical and economic evaluations have been examined and strongly criticised, and the authors imply that Odell and Rosing's study does not represent a competent basis for the conclusions drawn.

Evaluation of oilfield development involves recourse to both technology and economics. Technology provides estimates of oil reserves, recoverability, and a description of the set of physical systems which may be employed in production. The description of any one system will indicate the number of platforms to be used and the time profile of oil recovery. The role of economics is to choose between available systems according to an appropriate objective, which may be commercial profit or total social benefits. The economist is also charged with the task of identifying any dissonance between such objectives.

In their recently published book Optimal Development of the North Sea's Oil Fields, Professor P.R.Odell and Dr.K.E.Rosing, of Erasmus University, Rotterdam, describe a general evaluation model and the results of specific simulation for three fields - Forties, Montrose and Piper. Odell has taken the prime policy variable to be the number of production platforms to be used on a field. For each possible number of platforms he has attempted to find the optimum configuration or placing. From this calculation he derives the expected oil production profile. The revenue forecast from this production is then combined with cost data to perform an economic assessment of each system. This work has led Odell to stress one basic conclusion - that the UK as a whole would benefit from more intensive exploitation of each field. (Forties, for example, should have been developed with six platforms, not four). As a corollary he adds that the extra investment should be financed by the government.

If this conclusion is valid, then it is crucially important to UK policy (two extra platforms for Forties alone would cost almost £ 1000 million). Odell's conclusion has received much publicity, and it is vital that the und-erlying technical and economic assumptions should be critically examined.

There are many controversial aspects of Odell's report, but this article sets out to expose its technical errors, misconcept-ions and inconsistencies, which result in the oil production values used by the authors being wholly inapplicable to any comparative study. None of the case studies quoted by the authors in support of their thesis represents a true comparison, as would have been apparent had the most elementary of routine checks been made in the course of their studies.

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Physical principles of oil production

Although the co-mplexity of the systems under study can make detailed analysis of oil reservoirs extremely difficult, the basic principles of oil production are simple. The type of study attempted by Odell need not involve advanced technical concepts. Had such a study been executed competently and accurately, a real contribution to public understanding of the subject might have emerged. It is apparent from the report's termino-logy that most of the simple technical concepts necessary for such a study have been explained to the authors in their widespr-ead and prolonged discussions with engineers familiar with the industry. It is equally apparent that these explanations have not been understood, and that few of the criticisms made of earlier drafts of the study have been heeded.

Objective

It is Odell's objective to demonstrate that the rate of recovery and also the ultimate recovery from a reservoir are very strongly dependent upon the intensity of development of that reservoir - that is, upon the number of wells that are drilled to exploit and deplete it (this concept was discredited many years ago). He then purports to show that his optimal development sc-hemes are superior to those actually adopted for three field studies, and accordingly that the UK is a substantial loser.

It is generally accepted that in any comparative study it is desirable to compare like with like, and that comparisons should be based on physically identical base cases. This Odell has signally failed to do, and his results are essentially the inevitable outcome of grossly erroneous input data. The calcula-tions necessary to calculate the oil in pace will be demonst-rated later, but Table 1 shows the incompatibility of Odell's and the oil company's figures.

It is not surprising that Odell expects to get more oil from a field containing 7800 million bbl, than BP expect to get from Forties, which is thought to contain about 4400 million bbl. This is not a case where the uncertainty in estimates can be claimed in support of a higher vabue, since the essence of a comparison is that similar cases should be studied. It is a measure of Odell's inadequacy in the field of petroleum engineering that he has failed to realize that his own assumptions should make it impossible for his model to generate production figures greater than the company estimates, and that his figures must indicate error in the model.

Oil in place

To demonstrate why the Odell and Rosing study is so much in error it is necessary to discuss briefly the method of calcula-ting oil in place.

Table 1. Comparison of oil estimates by Odell and operating company

	Oil in place (million bbl)		
	Forties	Montross	Piper
Company estimate	4400	450	1550
Odell model	7833	1048	2385

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Three factors are necessary to determine how much oil is present in a reservoir - the net volume of the rock that contains the oil, the porosity or void space in the rock, and the fraction of that porosity occupied by oil.

The volume of oil in the reservoir is then calculated as the product (net oil bearing rock volume) x (average porosity) x (oil fraction), or symbolically

$$V_r = Q \times S_c$$

to estimate the rock vo-lume, contour maps are constructed, based on seismic interpretati-ons and data from wells drilled. These are reinterpreted and re-plotted as 'pay thickness' maps - contours of equal thickness of oil-bearing rock. These maps (isopachs) may be plotted in either (or both) of two ways. Because geological strata are almost invariably heterogenous, any oil-bearing formati-on will contain intervals of non-productive shales or fine silts, and poorly productive fine shaly sands. Of the total (gross) reservoir rock thickness, only a part (net) will produce oil, and isopachs may then be net or gross pay isopachs.

The procedure in reserve estimating is to planimeter the contours of an isopach map to determine the area bound-ed by each contour. From the areas and thickness the volume of rock constit-uting the reservoir is calculated. If a gross pay isopach has been used, then this must be multiplied by a net: gross ratio to determi-ne the net reservoir volume. It is importa-nt to note that this is the estimated volume of the whole reservoir. The porosity is found from cores (large samples of the reservoir rock brought to the surface) using standard laborat-ory techniques, or by in situ measurements.

It is impossible to measure the oil saturation, but it can be inferred, being the part of the porosity not occupied by water. Since electrical measurements given an estimate of the water fraction S_w, the oil fraction S_o is conventionally defined as $(1-S_w)$. The oil in place in the reservoir is now defined as $V_r \times (1-S_w)$.

In flowing from reservoir to storage tank, oil undergoes volume changes, shrinking to a small volume as agas is released. The oil content of the reservoir in terms of oil measure in the storage tank is

$$\frac{(V_r) \cdot Q \cdot (1 - S_w)}{B}$$

the vol-ume factor B being a number greater than unity. This is a simple, physically comprehensible and consistent equation.

By this stage of his analysis, Odell has made two gross erros, both of which indicate a complete lack of understanding of the subjects of his widespread discussions. The major error

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is the complete neglect of the net:gross ratio. Although the terms net and gross are us-ed in the report, they are used in an incorrect sense. The elementary petroleum literature is quite explicit and unambiguous on their correct use. The second error is in a misformulation of the reserve equation where a term $(1 - S_w B)$ is substituted for $(1 - S_w)/B$. Odell repeatedly refers to a mythical term 'oil-water separation' which has no physical reality or significance, and the obvious physical inconsistency of his expression $V.Q.(1-S_w B)$ is not apparent to him. The overall effect of these errors is to generate the wholly false and greatly inflated values of the oil initially in place in the reservoir which have already been given. It would have been expected that Odell would, by this stage, have checked that the oil in place assumed by the model corresponded with reality. Instead the study was continued using these inflated and non-comparable values.

Production profiles and recovery factors

Conve-ntional reservoir analysis proceeds to analytical or numerical studies designed to evaluate the fraction of oil recoverable under a variety of assumptions of reservoir development and control. Given a volume of recoverable oil, and an estimate of the performance of producing wells, the number of wells necessary to generate any desired production profile can be calculated and the economics for a variety of development schemes evaluated. The industry is well aware of the benefits of accelerated production as calculated by DCF methods, and is perhaps more aware than most of the shortcomings of DCF methods studied in isolation.

In la-rge reservoirs, good reservoir practice and reservoir control will generally result in peak production being limited initially to the range of 5-10% per annum of expected ultimate recovery, while studies of reservoir response are made.

Odell's model is incapable of evaluating recovery factors or well performance, and the proper use of this model requires as input the output of a complete reservoir study. (That this makes the model entirely redundant is not the subject of this discussion). The model therefore uses company estimates of recovery factor, and it might have been expected that having specified an input of one value (eg 40% in the case of Forties), the emergence as output of an entirely different, much higher value (56% for Forties) would have given pause for thought.

Again, Odell's lack of comprehension of basic physical principles is apparent in his approach to evaluation of production profiles and the misuse of available data. Drainage areas for wells are assigned arbitrarily, and the unwarranted assumption is made that no oil can be recovered from outside these areas over the produc-ing life of the field. One calculation is adduced in support of this approach in which additional oil is assumed to be recoverable. However, since this is arbitrarily and without reason simply assumed to be produced after 13 years, the DCF calculations applied inevitably result in this additional oil having negligible present value.

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A realistic approach to the question of drainage areas, well production performance and production profiles depends on specific reservoir properties, and a brief review of the three case studies made is desirable for a detailed criticism of the methods adopted.

The Forties field

BP's estimate of oil in the reservoir is 4400 million bbl. This is the estimate for the whole accumulation (including the Shell - Esso area), on which the public references are specific and unambiguous. Any genuine comparison of development schemes must take this value for the initial contents of the reservoir is 7833 million bbl, obtained from the ultimate production of 2538 million bbl for the 7-platform case divided by his overall recovery factor of (0.4 x 0.9 x 0.9 = 0.324). Odell's estimate of oil present is therefore 78% greater than BP's. The error in this case is due mainly to neglect of the net:gross ratio. The value of 0.7 assumed for the factor $(1-S_w B)$ is not very different from the value of $(1-S_w)/B$ of 0.67 calculable from published data.

Odell claims that a comparison of his own 4-platform system and BP's development lends validity to his model. Because the model assumed that only oil within the arbitrary well drainage areas is produced, the oil in place in the limited drainage area of the four platforms can be calculated as 6213 million bbl - nearly 50% more than BP consider the whole field to contain. We would consider this anything but a valid comparison.

To consider further the validity of the assumptions that oil between inclined hexagons, and between circular drainage areas and circumscribed hexagons is not recoverable in 'economically rele-vant time periods', some simple calculations can be made. Taking the simple case of Odell's drainage area of 120 acres concentric within a reservoir of 2000 acres, a time can be calculated when all parts of the reservoir will contribute equally to production. That is, one acre at the perimeter (1 mile from the centre) will contribute as much as one acre adjacent to the well bore. For a reservoir of the properties published for the Forties field, this is about 72 hours from the start of production. After this time, there would be flow into the inner area of 120 acres equal to 94% of the rate of oil production.

A similar calcula-tion can be made for the whole Forties reservoir. To make a comparison, Odell assumes that over the 'economically relevant time period' for the one-platform case, only 28% of the reservoir will contribute to production, and the outer 72% will be undepleted. We would assume that an economically relevant period would be 10-18 years. Our own calculations indicate that for this case the most remote boundaries of the field would contribute equally to production with all other parts of the field after about six months. Odell's analogy of a single postman serving a city is peculiarly inappropriate in this si-tuation, and th-is would have been apparent had he made basic calculations instead of arbitrary assumptions.

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Ultimate production from Forties can then be expected to be rather insensitive to the intensity of development, this being governed by the requirements of peak production rate. Again, a very simple calculation can determine the required number of wells. Allowing for the possibility that estimates of oil in place and/or recovery factor might prove to be low, take the optimistic case of there being 2400 million bbl recov-erable (this compares with BP's estimate of 1800 million bbl). Adopting Odell's slightly high factor of 11% per annum of the recoverable as a peak rate, this gives a peak daily rate of about 720 000 bbl. From the published data, we would estimate average producing well performance as about 12,000 bbl/day. The number of producing wells required is then 60 . Allowing for wells shut in for maintenance or test, about 72 producers would be adequate for all purposes. Pressure maintenance will require about one injector for every two producers, so that a total of 108 wells is needed. This compares with 172 producers for Odell's 'optimum' case.

This number might just be accommodated by three platforms, but is comfortably accommodated by four. Recent production history shows that one half of the required capacity is obtainable from 22 wells only, so that it is unlikely that all drilling slots available on four platforms will actually be used.

By reviewing this particular case at some legth, it has been possi-ble easily to compare Odell's arbitrary assumptions with simple, but valid, calculations, and to demonstrate directly the lack of a physical basis for these assumptions and the essential falsity of his model.

The Montrose field

This case is of interest because of the sheer enormity of the errors made. The value of $(1-Sw)B$ is calculable from published data as having a value of about 0.3. Odell uses a value for his expression $(1-S_W B)$ of 0.65. Together with his omission of the net:gross ratio , the overall result is in error by more than 100%. Again, the emergence of a recovery factor of 93% for the input of a value of 49% might have been expected to be worthy of notice or comment.

Odell remarks (probably correctly) that one reason for the locati-on chosen by Amoco could be the better exploitation of the culminations of the North and North West, where a low oil - water contact gives a thicker oil column. The obvious corollary to this, however, is missed. Since the reserve is based on an average oil - water contact, the presumption of an extra 60 million bbl (Odell values) recoverable from the North West inevitably implies that 60 million bbl less is recoverable from the eastern lobe where the contract is known to be higher.

It seems that oil in place in regions not covered by the platform is less than 40 million bbl. The oil column in these regions is thin, and recovery factors greater than 0.33 are very unlikely to be realized in these conditions of poor reservoir quality. The oil potentially recoverable from North

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Montrose by drilling outside the present platform can then be estimated as being of the order of 10-15 million bbl. As Odell points out, investment cos-ts for platform development are prohibitively high when few wells are drilled. It is not the purpose of this paper to consider the detailed technical aspects of field developmen-t, but a number of schemes suggest themselves, some of which are known to be under consideration.

The Piper field

The errors in this case are similar to those in the Forties field case. The authors completely misconstrue quite unamb-iguous reserve figures, and fail to read relevant passages of their own referenc-es. For example, the report comments 'Occidental's location appears to eliminate the possibility of oil recov-ery from the downfau-lted southern part of the field'. Reference to the Occidental paper yields, 'These studies do not include the South Piper new pool discovery which will add additional oil when fully delineated ... from the production platform'. The refere-nces quoted give estimates for the reserve of 650-900 million bbl by Occidental engineers and 642 million bbl by the petroleum engineering consultants, DeGolyer and Macnaughton. To construe this as a revision from 900 million bbl to 650 million bbl consequent upon the decision to develop with one platform is wholly unwarranted.

Depletion policies in the North Sea

It is a recurrent threme of Odell's report that companies are 'cream-ing' North Sea fields of their 'easy-to-produce' oil. This paper should dispell any idea that Odell and Rosing are competent to make any asse-ssments in this field, but figures should be more convincing than comment. It should be apparent that if this were the case, recovery factors expected of North Sea reservoirs should be lower than those historically observed in oil provinces where the constraints of the North Sea do not apply. In the USA, where Odell's ideals - excessively intensive development due to multiple ownership, detailed reservoir definition from very close well spacing, extremely low economic limits of production, and scope in small fields for enhanced recovery methods - are largely met, the real-ities are otherwise. The overall cumulative throughout the history of the US industry barely exceeds 30%. For the large prolific fields discovered 30 and 40 years ago, and most closely analogous to the larger North Sea fields, the average is about 40%.

Due to the almost universal preparation for complete pressure maintenance by water injection, recovery efficiencies of 40-50% are quoted for North Sea reservoirs - higher values than have ever been sustained for known major oil provinces. The figur-es and the planning for maximum production directly deny Odell's claim. The absurdity of spending vast sums to find oil in more and more difficult environments while recoverable oil goes unproduced in easier environments should be apparent.

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Economic evaluation

The economic evaluation of oilfield development requires the output of a technical model. This section does not question further the quality of Odell's technical model, but examines how such technical data is transformed into an economic assessment.

This assessment, which is based on discounted cash flow analysis, is carried out with the aid of a financial simulation programme. Its results indicate to Odell that more intensive exploitation would be desirable. He confirms this conclusion from consideration of some more qualitative points. It is possibly this agre-ement between quantitative and qualitative argument that has protected his assumptions from the close scrutiny they deserve.

It may assist more critical examination of Odell's method to focus attention on those assumptions which are either contentious or wrong. These are six major points which require comment, which are dealt with in their order of appearance in the report. No implication of relative importance should be atta-ched to this order.

Capital cost inflation

The input data appears to disregard inflation of capital costs. The analysis is performed within the context of an assumed inflationary world - as evidenced explicity by a base case assum-ption of 10% per annum inflation rate, and implicitly by the choice of a 'low risk' discount rate as high as 15%. Uninflated capital costs are incompatible with this scenario.

The effect of th-is error will be to underestimate the present value of capital costs. In the case of the Forties field a decision to set up six platforms rather than four would have involved a large increment of investment taking place 6-7 years from commencement. If ca-pital costs keep pace with 10% per annum world inflation the cost of Odell's desired change will be almost double his estimate. Recent experience has shown that inflation in the price of North Sea investment has in fact been much greater than the general world rate.

Future oil prices

The future oil price estimates are quite implausible in the conte-xt of stated expectations of inflation.

> The base case predicts 10% per an-num world inflation and a $0.50/bbl per annum rate of increase in the price of oil. Separately, each is plausible. However, the combination of these assumptions indicates that, during the 20 year life of a North Sea field, the real price should drop by 73%. This is quite outside the range of general consensus.

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The scenario next adopted was an oil price stable in nominal money terms with world inflation of 5% per annum. The rationale behind this scenario is the possible weakening of the OPEC cartel with a consequent easing of the oil price. Paradoxically, this actually produces a higher real price of oil than the first scenario. The fall in the real price in this case is just 62%.

The final scenario was 5% per annum world inflation and a collapse of the oil price to $7.00/bbl. This indicates a fall in the real price of oil of 79%.

Economic theory predicts that the real price of exhaustible resources should rise as exhaustion is approached. Even if we accept that the current oil price is not representative of an underlying economic value but is bolstered by the power of the OPEC cartel, we must still find predictions of such a drop in value quite implausible.

The effect of this assumption, within Odell's analysis, must be grossly to undervalue oil recovered late in the life of a field, and hence to favour strongly the accelerated recovery available from more platforms.

Discount rate

There is no basis for the very high discount rates applied to investment in further platforms. Odell assumes that investment in the first platform on a field should be evaluated at a discount rate of 15%. He then argues that, because of the increased risk associated with fur-ther platforms, additional investment should be discounted at progressively higher rates until a possible seventh platform is disco-unted at the amazing rate of 45%.

Even if we neglect the most fundamental objection, which is accounting for risk through variations in the discount rate, this particular applicati-on must be quite unacceptable. The risk premium required in the rate of return from a project is not directly related to the variance of the return from the project, but to the covariance of that return with respect to the average return av-ailable from the capital market. This is because any other ele-ment of variati-on in the cash flows can be diversified away, fir-st by the oil company undertaking many projects, and seco-nd by the oil company sharehold-er maintaining a wide protfolio of shares . Provided that analaysis is performed on estimated mean cash flows (not necessarily the most likely) then no premium need be added to the discount rate if there is no increased risk of the further platform investment which can be associated directly with movement of the general capital market. It should be clear that the probability of recoveri-ng as much extra oil as expect-ed from a seventh platform is unrelated to the value of the Finan-cial Times index on any particular day, so that the same disc-ount rate should be used to evaluate investment in that as any other.

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It should be noted that the 15% rate set for the initial inve-stment will itself contain a small risk premium. This is because the return will be crucially dependent on the price of, and therefore demand for, oil. This in turn may be related to the general strength of the economy and therefore the performance of the ca-pital market. Hence a positive covariance may exist between project and market return. However, this relation should become no more marked with an increase in the number of platforms used.

At first sight this error would be expected to mediate against Odell's conclusion. However, a further error in the combination of these incremental discount rates makes the opposite effect equally plausible. The method of evaluating total inv-estment at a weighted average discount rate (discussed in detailed below) causes the combination of these erroneously high marginal discount rates with the initial rate so that all the inves-tment is discounted too heavily. The effect of this will be a further undervaluation of later cash flows, with consequent favouring a accelerated recovery, although the penalizing of more platforms probably still dominates.

Weighted average

The technique of combining discount rates to form a weighted average is incor rect even if the various marginal rates are correctly specified.

The effect of applying a single weighted average discount rate is to discount the total too deavily. This will exaggerate each of the errors of the previous section.

Government borrowing rate

It is wrong to apply the cost of government borrowing as the discount rate appropriate to assessment of government investment in the North Sea.

The government is able to invest through the capital market just as private individuals may do. As returns from the market are in general higher than the cost of risk free government debt, Odell presumably concludes that the government should buy all companies and make a big profit on behalf of the taxpayer - this is nonsense.

Odell quotes Michael Posner's reference to government as the ultimate gambler with unlimited funds. This description may be fa-ir, but as indicated previously the unlimited funds only allow the diversific-ation of uncorrelated risk. The gove-rnment and ultimately the taxpayer must accept any residual risk and in consequence should not be indifferent to the level of that risk. The government are unable to diversify appreciably more than many other investors(Such as the large institutions) and should therefore look for the same return from inve-stment as other participants in the market.

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By accepting this differential between rates of discount appplicable to private and public investment, Odell wishes to replace private money assumed to cost 30% with public money assumed to cost 12% for the finance of a fifth or sixth platform in a field. It should come as no surprise to find that such investment apparently provides a much higher present value which if allocated correctly can leave everyone better off. However, this increase in present value is totally spurious. The same set of physical assets combined in the same manner to produce oil at the same rate must have the same total value for the country.

Government borrowing cost

Even if the cost of government borrowing had been the applicable rate, Odell still finds the wrong figure for this. It may have been true that the interest rate on medium-term government stock was 12%. However, this rate is only applicable to loans (or investments) denominated in sterling. Odell evaluates all cash flows in US dollars, so the discount rate should reflect interest rates in that currency. US dollar rates are lower because the dollar is expected to depreciate in value, through inflation, less quickly than sterling. While the cost to the UK government of medium-term sterling may be 12%, the cost of US dollars for a similar term would be only 7-8%.

The relevance of this mistake to Odell's conclusion is of course illusory, as neither the 12% nor the 7% rate has any use in the proper evaluation of government investment.

The same mistake may have been made for private investment. The required 15% for low risk investment may have been derived from required sterling returns rather than the lower return in dollars, which is acceptable. Again, the general discount rate may have been overestimated.

Such substantive discussion of Odell's qualitative considerations is not possible since they are neither sufficiently explicit nor exact. Some limited observations may be made.

Odell gives several reasons for oil companies to avoid accelerated production, such as the higher investment required for each barrel per day of production capacity. He indicates the influence of these factors on the commercial optimum, but fails to point out that the same arguments are equally applicable to the social optimum and are no cause for a divergence between the two.

The report refers to the enhanced recovery available, within 'an economically relevant time period', from a more intensive production system. Not surprisingly the degree of such enhanced recovery depends entirely upon the decision of 'an economically relevant time period'. It is clear that by discounting too heavily and undervaluing future oil, Odell has badly misconceived the length of this period. By his own words,

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his chosen discount rates give near zero present value to oil left in the ground after 10 years. Why then is not every petroleum producing national desperate to accelerate production to exhaust their reserves within this time? (The existence of a cartel may account for certain major producers, but not all the minor countries whose production could not affect the cartel price).

Odell claims that benefits from more intensive production will accrue to the economy: in the short term through jobs and profits from construction work, and in the longer term through GNP and the balance of payments. However, the benefits of jobs, profits, and an improved balance of payments are neither evaluated nor incorporated within the quantitative model, and cannot be responsible for its conclusions.

Externalities such as these should be included in analysis of government policy. However, Odell has failed to evaluate them and has omitted many others:

> If a justifiable objective of policy is political/ of /stability supply, should we not consider maximization of the period over which our production is equal to our demand (or 90% of demand so that the period of effective self-sufficiency may be slightly extended)?
>
> North Sea technology is improving rapidly. By investing heavily now, do we forego improvement in design which may come shortly from our experience of investment already committed?
>
> Can our platform construction industry cope with a big increase in number of orders, or will these have to be met largely from imports? If the industry can cope, is there no danger of building up capacity too quickly before the demand for platforms then collapses?
>
> If we run a heavy balance of payments surplus, can we still cope with management of the economy?

These are important questions in the design of policy and they must bear heavily upon decisions to accelerate development.

Conclusion

It should be clear from this examination that Odell's report provides no competent basis for his conclusions. Incorrect physical assumptions have caused Odell to badly misconstrue the quantity of oil available from different systems of exploitation. Furthermore, errors in the economic analysis have exacerbated the inaccuracy of the evaluation to the extent that we cannot contemplate this report as a foundation for policy.

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We do not su-ggest that technical appraisal, with the same aim, is not worthwhile, nor do we disregard the possibility that externalities or tax distortion may cause a conflict between commercial and social interests. However, we do suggest that Odell's methodology and assumptions need complete reconstruction before they can provide any serious framework for this analysis.

Optimal Development of the North Sea's Oil Fields has received considerable publicity. It is important that the report's positive contribution should not be a particular conclusion but the stimulation of public debate. Only through more rigorous examination of all the issues involved can we derive a better policy for the development of the North Sea.

Source: Energy Policy, December, 1977 .

3.3 OPITMAL DEVELOPMENT OF THE NORTH SEA'S OIL FIELDS - THE REPLY.

Peter Odell and Kenneth E. Rosing

We consider that Wall et al's technical criticisms of our monog-raph are irrele-vant or ill-confused. Their volumetric analytic method is inadeq-uate and their approach to the platform/wells location question conflicts with oil industry views. On the economic aspects, Wall et al avoid the central issue we considered - on how to resolve company-government conflict - and instead take up an issue - on the overall speed of North Sea development - which we did not discuss. We show, moreover, how this criticism of our study is largely unsubstanti-ated pers-onal opinion and, as such, unworthy of consideration, even if many of Wall et al's arguments were not erroneous.

Wall et al have produced a critique of our monograph on the op-timal development of the North Sea's oilfields which totally ignores the essential theme of the study. This is that government and company interests in the development of large, off-shore oilfields are different, but that, despite this, governmen-ts have both the opportunity and the option to modify the economic environment within which the companies must operate. The companies can thus be persuaded to act in the nation's best interest, without the modification adversely affecting their commercial interests. Even if the severe criticisms of our work presented by Wall et al were correct (and we do not believe this to be the case), this essential point which has emerged from our research remains vali-d.

The critique is in two distinct parts - on reservoir calculati-ons and engineering aspects, and on the economics. This division of the article is one of its main weakness, for the engineering and economic aspects of off-shore optimal develop-ment decisions are so interrelated that it is impossible, as we tried to show in our monograph, to deal separately with the issues involved. Indeed, it seems to be the absence of early and sufficiently comprehensive economic components in evaluations of an oil-field's recoverable reserves (particularly viewed from the national viewpoint rather than that of the company which has discovered the reservoir) that has already led to production plans for Nor-th Sea fields which appear to be far from optimal from the British taxpayer's point of view. In as far as our monograph appears to have stimulated interest by the UK Department of Energy in the national aspects of the economics of reservoir development (to complement its existing technical inte-rest in reservoir en-gineering), perhaps we may already fairly claim a useful result from our efforts to hypothesize nati-onally optimal devel-opment approaches to North Sea oil production. Nevertheless, notwithstanding the symbiotic relationship between the engineering and economic aspects of North Sea oilfield development in the context of important national as well as company interests, we are obliged in this

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rejoinder to react to the separate - and apparently in-dependent - efforts of Wall and Wilson on engineering and Jones on economics.

Engineering aspects

On the size of reservoirs

Wall et al point out that we consulted with experts in the field of analysis outside our direct technical competence - the field of reservoir engineering. Indeed we did, and we wonder why Professor Wall, one of the experts consulted, has changed his op-inion so radically since he reviewed an earlier draft of our work and discussed it with us at length. On that occasion he expressed general approval of our methods, and while raising detailed points, such as issues of 'over drilling', his opinion on the work as a whole was that 'a more sophisticated model of the reservoir would change the results by only about five per cent'. We are left pondering what changes in circumstances and/or what external pressures could have produced Wall's remarkable volte-face.

$(1-S_wB)$?

Wall et al asset that much of our alleged error in our volumetric calculations on reservoir size is due to a mistake in the term $(1-S_wB)$ in the equation we used for estimating oil in place. This is imp-ossible, for we use no such term anywhere in our monograph. Much of the credibility of the argument against us collapses simply because of this falsification of our work. Where we do use a similar term, $(1-B\ S_w)$, we clearly state, in our definition of terms, that $B\ S_w$ represents a single estimate representing two pieces of data which are not available to the public. As we use an estimate for this term, it is self-evident that no mathematical manipulation of the term is possible - or indeed invo-lved. The long and tedious explanation as to why we should have divided rather than multiplied is therfore splendidly irrelevant.

Measuring the bulk volume of a reservoir

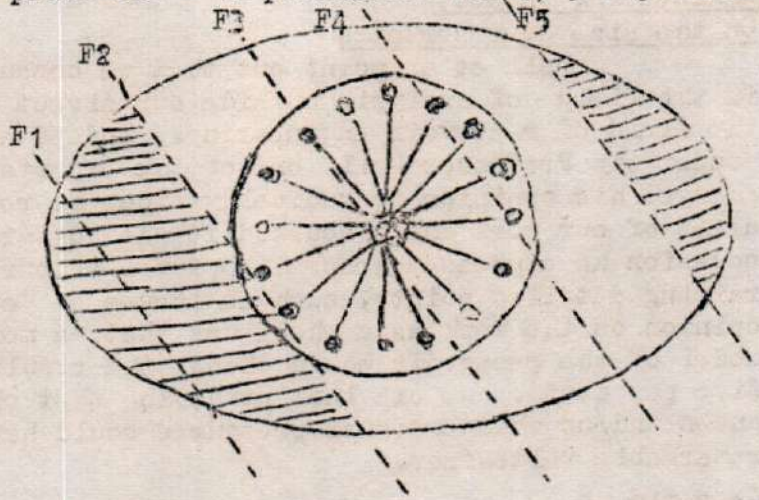
Wall et al challenge our calculations of the volumes of oil in place and of oil recoverable from the reservoirs. They state that it is 'impossible for his (Odell and Rosing's) model to generate production figures greater than the company estimates.' They fail, however, to present any evidence to justify their categorical statement. Unfortunately, Wall et al are again mistaken, for our model is able to produce higher recoverable reserves and higher production figures than those reported by the compan-ies, because the bulk volumes of the reservoirs which we calculate from the evidence publicly available is greater than those indic-ated by the ope-rators. Their failure lies in their simple acceptance, without 'the most elementary of routine checks, of the volu-mes announced by the companies for their fields.

Wall et al explain quite clearly the normal text-book method of volumetrically estimating oil in place and recoverable reserves, which presumably is used by their former colleagues in the oil companies. But they omit one important point in their summary of that methodology - the method used to convert

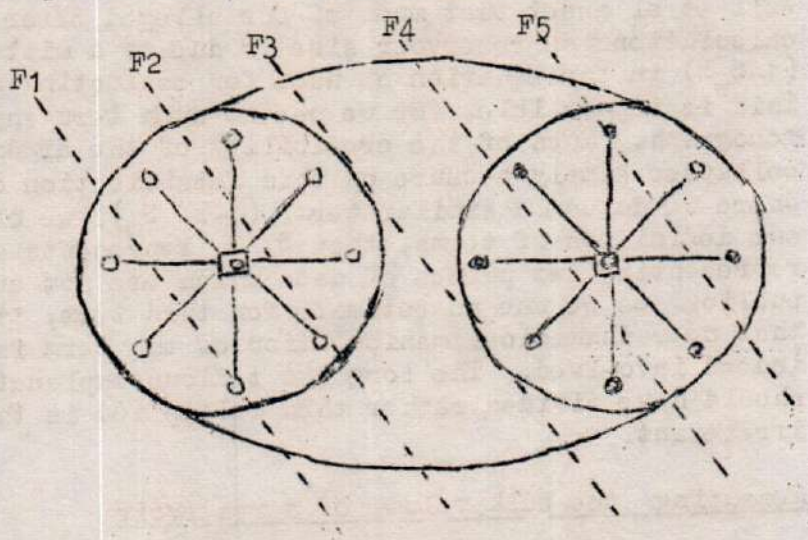
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Optimal Development of the North Sea's Oil Fields - the reply

One platf-orm - 12 production wells, 5 injection wells



Two platf-orms - 12 production 6 injection wells



● Production well

o Injection well

Platform

..... Fault

Undrained areas

— — Field boundary (closing contour)

Figure 3. Recoverable reserve(econ-omic) as determined by fault pattern and/or initial development scheme.

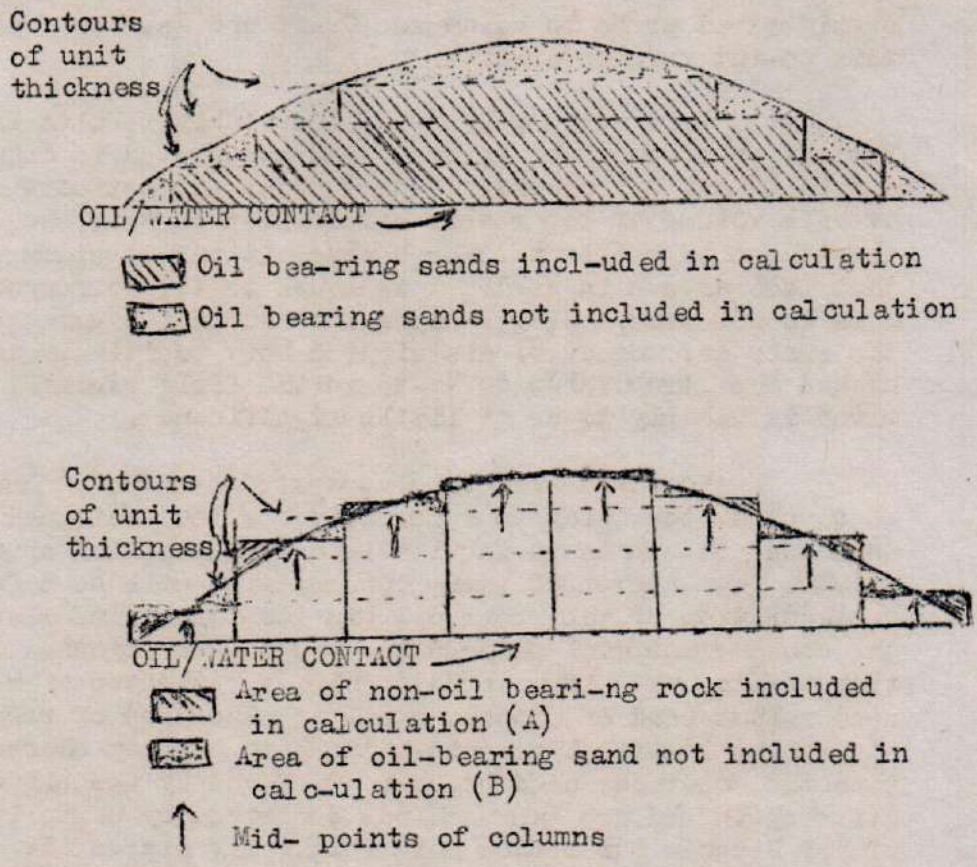


Figure 1 Ar-ea of oil-bearing sands calcula-ted by planimetry

Figure 2 Ar-ea of oil-bearing sands calculated by interpolated column heights.

planimetered areas to volumes. Craft and Hawkins cover this po-int very clearly.

This method, however, inevitably results in under-estimation of the bulk volume, as demonstrated in Figure 1. Our method (Figure 2) provides a more accur-ate estimate of the true overall volume of the reserv-oir rock, though it should be noted that there is still an error because it is necessary to assume that each area A in Figure 2 is equal to the corresponding area B. This is not true, but the error introduced is very small and the error is, moreover, distributed both positively and negatively around the true value so that, in the field overall, the net error is lik-ely to be of little significance.

Compared with this accurate method of measurement, Wall et al chose to employ an inherently less accurate method in which, as shown, th-ere is an inevitable underestimation of the bulk volume. The degree of their conservatism will be a function of the configuration of the reservoir (in its three dimensions) and of the contour interval ch-osen for the calcula-tions. The interpola-tion method must always produce higher estimates of reservoir sand volume (and of stocktank oil in place and of recoverable oil, when using identical porosit-y and permeability characteristics) than the me-thods used by Wall et al and by the oil companies (if they indeed use the meth-ods described by our critics), simply because our method more faithfully represents reality. The differences for the Forties field are shown below.

Volumetric calculations for the Forties field

Table 1 shows volumetric calcula-tions for the Forties field calcul-ated in four different ways. Comparison of columns 3 and 4 indica-tes the significant magnitude (about 17% in this case) of the inevitable underestimate obtained by using Wall et al's method, while the values which they quote (column 1) are another 19% less than those in colu-mn 3. This latter difference may well arise because of the introduction at this stage of a variable (not publicly available) in the calculations of the volume of producing sands, i.e. the sp-ecific ratio of net to gross volume of producing sands in the pa-rticular reservoir. As indicated above, there was (and is) no publicly available information on the net:gross sand ratio for the Forties field. Although we mentioned the importance of this variable in reservoir calculations, we were unab-le to incorpora-te it specifically in our analysis. Various allo-wances were made in our monograph calculations for fac-tors reducing the producibility of the reservoir, inclu-ding the net:gross ratio, but if we are now correct in assuming that Wall et al's 19% reduc-tion (the difference between columns 1 and 3 in Table 1) is entir-ely due to the difference between gross and net sands' volume, then we have overestimated the size of the recoverable reserves by about 12%.

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Table 1. Volumetric analysis of the Forties field

	Wall et al from BP	Wall et al from Odell & Rosing	Odell & Rosing following Wall et al's directions	Odell & Rosing's true volume method
Volume of sands (Million m^3)	3729	5377	4755	5751
Stock tank oil in place (million bbl)	4400	6345	5611	6786
Recoverable reserves (million bbl)	1800	2538	2244	2714

Nevertheless, even if we accept that Figure 8-13 in our monograph overstates the values by at most 12%, so that each curve in that graph should be lowered by at most that amount, the shape of the curve is not affected and the argument presented remains unaltered by the minor recalculation necessary to adjust our reservoir size calculations to take full note of the non-roducing sandsin the Forties field.

On producing an oilfield

Wall et al argue that the more intensive field development schemes we investigated inevitably mean over-drilling and over-investment , and they imply that the less intensive field development schemes will, in any case, produce as much oil. The crucial point is the spatial coverage of a field which can be achieved by a specific number of wells and platforms. We have discussed this point with other reservoir engineers, and they agree with our interpretation of terms such as 'average well spacing' and 'platform draw areas'. We took these to define the portion of a field which can be depleted by wells drilled by deviated drilling from platforms, given that there is a 'normal draw area per well' in respect of the volume of the sands that can thus be depleted in an economically relevant time period.

This is entirely different from simply drilling more wells in areas which can already be served by existing wells, as Wall et al imply we suggested - and which they indicated would mean a repetition of earlier 'mistakes' in depleting reservoirs in the USA. In the context of the North Sea's development, their reference to previous US experience is totally fallacious. That experience related to developments for which oilfield management was primitive, and where regimes of pressure maintenance were established only near the end of the fields' lives

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because of ownership problems as well as undeveloped technology. In those circumstances there was over-drilling and over-exploitation of reservoirs, leading to low ultimate recovery rates. Such experience is entirely irrelevant to the managerial, physical and technological conditions that prevail in the North Sea province.

There is also a major difference, in economic terms, between the development of onshore and offshore fields. In developing an onshore field a company is committed only to the cost of drilling each well (or perhaps a small group of wells) in turn. In (as in the North Sea), the company has to commit itself to the cost of installing a platform from which to drill, the cost of which is virtually the same whether it is used for one well or for 27 as in the Forties field. This 'lumpiness' in the investment required for developing an off-shore field creates a very different economic environment. Indeed, it dictates a different set of considerations for evaluating the physical development process. deep water offshore development

The spatial coverage problem

We maintain that the spatial coverage of an offshore field achieved using the production system initially determined for installation is one of the most critical variable in the production regime for that field. Increasing the portion of the field covered by platforms (by adding platforms to the production system) will normally increase the economically recoverable reserves of a field: when what is 'economic' depends upon the timing of production.

This is clearly recognized by oil companies. Chevron, for example, have announced that the addition of a third platform to the producing system they are to install on the Miniam field increases the recoverable reserves of that field from 850 million bbl to 1100 million bbl. This must be due mainly to the fact that the portion of the field which can be covered by the platforms to be placed on the field has been increased. There is no other change which could account for the magnitude of increase in the reserves' estimates. A recent report on the Miniam field has been even more specific both on the additional platform and the additional wells on the field:

The planned development scheme for the Miniam field in October 1975 included two platforms, one in the central and one in the southern portion of the field. Because the reservoir is more narrow in the northern portion, the use of a third platform has been evaluated based on the economics of recovering more oil in less time... There have been several changes in the (production) limiting factors since the last report, causing significantly higher maximum production rates. Tubing size has been increased ... the capacity of the oil processing facilities was increased and five more wells are added to the Northern platform ... These changes resulted in a faster

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production rate build-up and much higher maximum daily rates of oil production.

Amoco has made much the same point in writing to us about various possible production schemes for draining a hypothetical field. Figure 3 was appended to the following Amoco description of the economics of recovering the reserves of a field with various faults:

It shows the existence of faults serving to rule out a natural water drive ... In an effort to enjoy higher recovery through water flooding, the operator would seek to inject water into the reservoir but ... the result would be limited by the number of available well slots (on the platform) and the ability of the operator accurately to identify and locate the various fault traps and to penetrate them with both an injection well and one or more producing wells (this the undrained areas on the field as shown). This illustrates the not uncommon situation whereby a field which almost justified two platforms at the outset but which has developed initially with only one platform ... this would in effect rule out the possibility of the second platform at a later date ... for by locating the first platform right in the middle of the deposit none of the edge areas in this are big enough to support a second platform. With better economics (higher prices, lower taxes?) at the outset, two platforms towards the extremes of the field area might have been justified by a higher reserve.

From this description of the physical characteristics of off-shore reservoirs and the economics of their producing systems, Amoco (as with Chevron) seems to think that more platforms and more wells give more coverage and more recoverable reserves.

The technical literature contains many oblique reference to this central problem of spatial coverage. The exploration director of CFP is reported by Noroil as saying that 'Alwyn's oil reserves were insufficient to warrant the use of several production platforms, but a single platform would not be capable of bringing out enough oil from the field.

Finally, it also seems worth recording that in our discussions with British Petroleum on the spatial coverage problem, there was such interest in the analytical methodology we were talking about BP's spokesman suggested that we should be given - in confidence - the necessary reservoir data on a field, which at that time (February 1976) had not been publicly announced, to see what solution we could reach in respect of the economics of its producibility by one, two or more platform system. Again, the company concerned appeared to think that the spatial coverage problem is one of importance in determining recoverable reserves over economically relevant time periods.

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Other criticisms

We have identified the major errors, misunderstandings and misleading elements in the engineering part of Wall et al's article. There are other points in their criticism which seem irrelevant, inconsistent or mistaken.

Wall et al state that we recommended direct government investment for developing a field - this is not so. What we do recommend is a more flexible governmental policy for fields being developed, modifying the economic environment within which the companies operate, to encourage a more complete development of the field which would still be profitable to the operating company. At present, inflexible government policy on royalities and taxes leads companies to plan the development that is likely to maximize their profits after tax - with the tax being taken as a fixed element in their cost evaluations. This approach appears to limit the total planned recovery from a field to less than that which is technically recoverable. In one of our examples, the mechanism investigated for engendering governmental encouragement of the field's development was direct investment, but other strategies, such as modified taxation policy and loan guarantees, to achieve optimal development of a field, were also presented.

According to Wall et al our definition of the drainage area of wells is arbitrary. This is untrue, however, for we assigned the well drainage areas either on the basis of information on this variable as published by the appropriate operating company (for Forties and Montrose), or from estimates we made from the indirect evidence in the literature (in the case of the Piper Field).

Wall et al state that the term $(1-S_w)/B$ can be estimated from published data, and state that our incorrect estimates of it are responsible for the 'error' in our calculations of recoverable oil. For the Forties field we have an estimate which is certainly within the error of the value they give (0.70 compared with 0.67). In the case of Montrose, it would appear that they have misinterpreted our statement of the term. The factor they quote from our study should not be 0.65, but 1.00 - 0.65 = 0.35; this again is well within the error of the term, which they give as 0.30. They do not mention our estimate for the Piper field - why not? Is our estimate again accurate within the error of the (still publicly unknown) value estimated by the operating company? They then fault us because the operating companies have, on producing the reservoirs, discovered that they are producing better than their estimates of $(1-S_w)/B$ led them to expect. Our model had to be calibrated from the data as published by the operators up to the summer of 1976, and it was within the framework of this data

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that we tried to simulate the information environment within which the companies' production decisions were made. If it has now been demonstrated that fewer wells are necessary to produce certain quantities of oil than the companies originally estimated, then the average well spacing could have been greater than they originally expected. This revised view of the situation is totally external to our work, and if there has to be criticism of production estimates then it has to be of those made by the operators. It cannot be criticism of our work, which could only be based on what the companies had publicly reported at the time we were attempting to simulate the fields' development. With better data we could have more effectively calibrated our model.

Wall et al's general approach on reservoir engineering

One aspect of Wall et al's criticism of our study is in one way more important than all the substantive matters with which we have dealt above. There are no citations or literature references in the engineering section of their article. For example, they do not cite the publication(s) which contain the information from which $(1-S_w)/B$ can be calculated. They expect the reader simply to accept that such publications exist. Nor do they provide any citation or other indication of the performance of their calculations, but merely present the reader with the result.

The principle basis of the scientific method is replicability, but as Wall et al do not produce the evidence on which they base their work, it is impossible for another scholar to duplicate or analyse the bases of their criticism. The reader is continually expected to accept statements for which there is no collaborative evidence. This approach would seem to violate the most basic principle of publishing in any academic discipline, including, we are sure, their own discipline of reservoir engineering. Their closest approximation of a citation is 'BP estimate', expressed in various ways. Other esoteric items of factual knowledge lack even this sort of prosaic reference.

We are criticized for our lack of academic rigour, but we at least give the reader the opportunity of verifying or of refuting our results, through explanation, accreditation and citation - that is by adhering to the rules of academic publishing. Wall et al's article comprises only unsubstantiated personal opinion. For this reason alone their paper is unworthy of consideration even had we not shown that many of their arguments are erroneous or false.

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Economic aspects

We can agree on one item in the economics section of Wall et al's article - their final comment that public attention and debate in respect of the economics of North Sea oil need to be stimulated. This was the prime motivation to publish our monograph which, we concluded, 'may perhaps have indicated an approach which can achieve the reconciliation of the conflicting interest of state and oil companies'. However, Wall et al's contribution to this important debate is entirely negative and its somewhat interperate tone smacks more of the familiar propaganda that 'what is right for the companies must be right for the community' than it does of any wish to continue the search for the truth.

The detailed criticisms

Our capital costs estimates did not disregard inflation, as Wall et al claimed. We did not consider that anyone could fail to recognize the need for incoporating rising prices into the costs of North Sea installations, so we did not think it necessary to spell this out. However, it can clearly be seen to be incorporated in our inputs, for example in Table 7-1 which shows capital costs of the various platforms on the Forties field. Early-period installations (including pipeline costs) are each about $ 300 million (a figure based on the published data for platform installation in 1975-6). For the fifth, sixth and seventh platform (in the systems with a larger number of platforms, so involving platforms which are built and installed up to several years later than the early ones), the capital costs per platform range from $450 to $535 million.

We chose three specific cases dealing with the future price of oil and inflation rate. Our base case, with 10% per annum inflation and a $12.50 per barrel oil prices in 1975 rising by $0.50 cents per annum, is not a prophecy - it is the kind of reasonable guess that all investors have to make about the future behaviour of the economic system relevant to their interests. In early discussions of our work with British Petroleum, we found that these figures for inflation rate and price of oil were close to their best guesses for movements in the two variables. Since then (1975), the two variables have, indeed, moved roughly in line with these base case figures. The assumption that running costs increase proportionately more quickly than oil price is, of course, related partly to the fact that the former is a function of rising British costs (with its higher than average inflation) while the latter is a reflection of OPEC's reaction to the overall change in international price levels.

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We stated specifically that there are many sophisticated theorems for finding the right discount rate to evaluate past, present and future revenue and expenditure flows. This, of course, is necessary so that one can realistically model the way a company looks at the opportunity cost of its investment in general, as well as the way in which it takes into account the 'specific risk' of developing the North Sea's potential. The method we chose was certainly not related to the Dow Jones or the Financial Times indexes, as Wall et al seem to imply but was related to the unique circumstances of the alternative investment decisions that can be taken for developing North Sea oilfields. At the time that the development decision on a field has to be taken, the availability of information on the existence and recoverability of oil varies spatially (because of the limited nature of the field exploration programme that can be undertaken in the evaluation stage). In such circumstances, a company can only equate the commercial validity of the most certain, the less certain, and the least certain flows of oil from the field (by means of possible alternative production systems) by varying the discount rate it uses for measuring the return on geographically discrete 'lumps' of investment. These separate 'lumps' then aggregate in different ways to define a series of systems of varying cost and of varying productivity. As Wall et al point out, the oil company may undertake a variety of projects, all with independent risks. However, rather than risk averaging - which implies taking on some high risk projects - the company selects those projects with a high potential pay-off. Varying the discount rates to include the increasing risk in developing a field more intensively allows the study of these alternatives.

The literature on the choice of discount rates did not appear to us to have considered this situation, and the cases quoted by Wall et al are quite irrelevant. We are still very much open to persuasion on the methodology we used (and on the appropriate way to combine the discount rates for different platforms in the same system - for which, incidentally, our most extensive range for various platform systems was 15-26.5%, not 15-45% as Wall et al erroneously indicated) but the criticisms here are entirely unhelpful and mistaken. Wall et al simply forgot - or failed to understand - that we are dealing with alternatives of 1, 2, 3 ... N platform systems, and not with incremental additions to a single system. We did, incidentally, also test the sensitivity of variation in the relative risk assessment by about 20% around the base case value. This resulted in changes in the present values of the two and three-platform systems on the Piper field (the inputs for which were used for the sensitivity analysis), but it did not alter the shape of the curves.

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Wall et al consider that we chose a 'wrong' figure for the cost of government borrowing. They use the extraordinary argument that because we worked in dollars we should have related the test discount rate to the cost of government borrowing in the US capital market. Any such calculation would, in the circumstances of 1975-76 (when we did the work), also have had to take near-future expectations of adverse changes in the $/£ exchange rate into account. This is exactly the same variable that was then expressed, through the financial market, by the difference at that time between the 12% government borrowing rate in the UK and lower borrowing rates in the USA.

The general issues

The first of these is the differential between private and public money and between private and public risk in investment decisions. Wall et al seem to believe that the world's financial markets are prefectly competitive with no institutional, geographical, or political constraints. Thus, all parties have an identical opportunity cost of capital in all circumstances, with variations only over time as the 'invisible hand' tugs the strings of the puppet actors up and down. Wall et al must surely be aware of the fallacy of this too simplistic view of the operation of the international financing system. Opportunity costs vary even between international companies, because there are constraints that are peculiar to some decision makers but not to others (a factor we described in our analysis of the Piper field, which is being developed by a consortium of companies whose economic behaviour is, and must be, very different from that of BP, the sole developer of the Forties field). They vary even more between companies which operate internationally and those with purely national interests. They vary most between major international oil companies (with their ability to rank their investment priorities against opportunities existing in many countries and in many circumstances) and national governments (whose investment opportunities are limited, by and large, to developments in their own national territories).

In the North Sea the oil companies can (and must) test the validity of their additional investment opportunity against alternative claims for their money provided by investment opportunities in the Gulf of Mexico, the Gulf of Thailand, or the North West Australian Shelf, or against opportunities for investing in coal mines in South Africa, open-cast coal mining in Sumatra, or shale oil developments in the USA. Given such a plethora of investment opportunities, a minimum internal rate of return of 25% is demanded for all lumps of investment by such companies and, in present circumstances, the minimum acceptable rate may be as high as 40%. The UK government, on the other hand, does not have many chances to invest in ventures with high rates of return. Even if they were

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available, any UK government would also have to consider their employment, balance of payments, social welfare and political and strategic implications. The public would not wish its security and future to be put at stake by a government deciding that investment in 'candy floss' production, with a possible rate of return of 20% is 'better' for the country than investment in offshore oil, deep-mined coal, or nuclear power stations from which 20% returns are more difficult to generate. Our study showed that the UK government can make acceptable 'rates of return' on 'investing' money in the North Sea, if it can persuade companies to push the development of an oilfield beyond the strictly commercial limit (when 'acceptable' is defined as a rate which exceeds its costs of medium-term borrowing). Such opportunities for government interests in oil developments do appear to be more favourable than most current alternatives open to the government in other parts of the energy sector of the economy. For example, nuclear power stations barely 'pay out' with a 9-10% cost, and, from calculations we have made recently, it seems that the best that can be expected from the investment of over £400 million in the Selby coalfield is a return of 15.3%. This would hardly be an investment opportunity of interest to any international oil company, but would Wall et al suggest that it should not, therefore, be undertaken, given what they and all of us know about the uncertainties of the world's energy supply in the 1980s and the 1990s. Such considerations mean that there must be investment now in energy producing potential by any government with the longer-term interests of the nation at heart.

We are also taken to task by Wall et al on the question of speed of development of the UK's oil resources for allegedly advocating their accelerated production. We did not such thing, but indeed dealt specifically with the issue in Chapter5 on 'Policy implications':

We ... accept that a country may wish to prevent the discovery or the development of a field or fields because it wishes to save the potential reserves for the future.

This is an issue which can perhaps be resolved by the 'full cost-benefit analysis of government policy' which Wall et al say is needed. But our study was not directly concerned with that issue. Instead, we tried to evaluate the significance of contrasting rates of production from individual fields, and we showed how the government can benefit by getting more oil more quickly out of each field in return for creating conditions in which the most intensive and extensive production system is also profitable enough for the oil company concerned. If it does this with each field which is to be developed, then the government enhances, rather than reduces, its opportunities

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to consider the question of the overall 'best' rate at which the North Sea's reserves should be produced. If one or more field(s) can be developed so as to produce 20% or 50% more oil over the next 15 years, and this higher rate of production then satisfies the government's evaluated need of the total amount of oil the country 'ought' to produce, then the potential for oil production from other fields can be saved for the future. If, on the other hand, each company decides for itself what part of a reservoir it shall develop only in relation to a rate of return which it finds acceptable vis-a-vis alternative opportunities, then the country risks having all its lowest production cost fields only half-depleted in the short term, so opening up dangers for the supply and price of oil in the UK over the longer term. There is a real conflict of interest here which can only be avoided by the reconciliation which remains to be worked out between government and companies for the benefit of the society at large. The issue is important - perhaps even critical - to the UK's development strategy, and we hope that debate will be continued.

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Source: Energy Policy, December 1977.

3.4 GROWING IMPACT OF NORTH SEA OIL SUPPLIES

Despite delays, mishaps and bad weather, North Sea crude oil output last year doubled to over 51 million tonnes and began to make an impact on Western Europe's oil demand estimated at 595 million tonnes (itself 2.2 per cent less than in 1976). The big boost came from trebling of production in the UK sector to over 37 million tonnes (although this was down on the officially predicted 40-45 million for the year). Norwegian output at 13.5 million was actually slightly below the 1976 level as a result of the Ekofish Bravo well blowout.

Although it has taken some years for production to build up - Ekofisk began with tanker loading in 1971 and Denmark's small Dan field came on stream in 1972 - the North Sea during 1977 became Western Europe's key hydrocarbons province, with the UK taking the lead over other sectors (see Table I A). Efforts in the Dan field to improve the flow from the tight chalk reservoir finally resulted in output reaching the 500 000-tonne level.

Table 1 A

Western Europe: Crude Oil Production

	Total				Million Tonnes Of which Offshore			
	1970	1975	1976	1977	1970	1975	1976	1977
Austria	2.8	2.0	1.9	1.9	-	-	-	-
Denmark	-	0.2	0.2	0.5	-	0.2	0.2	0.5
France	2.3	1.0	1.1	1.1	-	-	-	-
Germany	7.5	5.7	5.5	5.4	-	-	-	-
Italy	1.4	1.0	1.1	1.0	-	-	-	-
Netherlands	1.9	1.5	1.5	1.6	-	-	-	-
Norway	-	9.3	13.7	13.5	-	9.3	13.7	13.5
Spain	0.2	2.0	1.8	1.0	-	1.8	1.7	0.9
United Kingdom	0.1	1.5	12.0	37.4	-	1.4	11.9	37.3
Total	16.2	24.2	38.8	63.4	-	12.7	27.5	52.2

Last year also marked the start of natural gas deliveries from Ekofisk to Emden, whence to consumers in Germany, Holland, Belgium and France; and from Frigg to St Fergus, whence to consumers in Britain. Together with the build-up of Dutch offshore gas (the L fields came on stream in summer 1975 and the K fields in spring 1976), the North Sea has also become an important supplier of gaseous energy with supplies rising from 39.2 billion to an estimated 49.4 million cubic metres (or42.5 million tonnes oil equivalent, see Table I B).

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Table I B

WESTERN EUROPE : NATURAL GAS PRODUCTION

Billion cubic meters (15°C, 1013 mbar)

	Total				Of which offshore			
	1970	1975	1976	1977 a)	1970	1975	1976	1977 a)
Austria	1.9	2.4	2.1	2.4	-	-	-	-
France	6.9	7.4	7.1	7.6	-	-	-	-
Germany	13.4	19.3	19.9	20.3	-	-	-	-
Italy	13.2	14.1	14.4	13.3	4.8b)	7.6b)	8.8b)	7.8b)
Netherlands	33.3	94.8	102.7	100.9		0.9	3.1	6.6
Norway	-	-	-	2.6	-	-	-	2.6
United Kingdom	10.9	32.5	36.1	40.2	10.9	32.5	36.1	40.2
Total	79.6	170.5	182.3	187.3	15.7	41.0	48.0	57.2
Total million toe c)	68.5	146.6	156.8	161.1	13.5	35.3	41.3	49.2

a) Estimated
b) Agip's only
c) Converted at one billion cu m approximates

Thus, the North Sea last year contributed an estimated 94 million tonnes oil equivalent towards Western Europe's primary energy demand estimated at over 960 million toe for the European Community only. Theoretically, North Sea supplies met about 10 per cent of the EEC's primary energy needs, but in practice North Sea oil is, of course, also exported to non-European destinations - mainly to North America.

Many forecasts have been made about the offshore We-stern Europe hydrocarbon potential, with particular emphasis on know-n and hoped for oil and gas reserves in the North Sea. Inevitably, only the drill bit can provide the final answers - at greater cost and effort than computer model exercises. Beyond proving reserves, the governments of Great Britain and Norway will increasingly hold sway not only over depletion (thus overall production) but also over opening up prospective search areas. However, a reasonable estimate of the combined offshore oil and gas production potential over the next eight years is given in Table II.

In the UK sector where Argyll was the first field to come on stream during June 1975, followed by Forties in Novembe-r that year, the total production from the eight fields on stream (see field summaries) should soon go through the si-gnificant 1 million barrels a day level, particularly with the aid of output from Thistle about to come on stream, initially at 40 000 b/d. Stormy weathe-r has affected production from fi-elds dependent on tanker loading; however, the coming on stream of Claymore in November 1977 with its pipeline connection to Flotta in the Orkneys helped to boost total output in December to 3.5 million tonnes, compared with 3.2 million tonnes in the previous month.

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Table II

Western Europe: Estimated Offshore Oil and Gas Production to 1985

	Million tonnes oil equivalent		
	1978	1980	1985
North Sea*: British	110	135-160	425-175
Norwegian	35	55-65	65-70
Dutch	8	11-13	15-17
Danish	0.5	0.4-0.7	3.5-5
Spanish waters	0.8	1.5-2.5	2-4
Italian waters	n.a.	n.a.	n.a.
Greek waters	-	0.5-1	1-1.5

* South of the 62nd parallel.

Development work on Ninian - third largest in the UK North Sea sector - has been delayed and the field is now expected to come on stream in the autumn (instead of May) at an initial rate of 50 000 b/d, to be pumped through a 36-inch pipeline to Sullom Voe in the Shetlands. Heather is due on stream in August, and Dunlin might also be started up during mid-1978 depending on the current negotiations to load the oil into tankers via Thistle's single-anchor leg mooring system (SALM).

These four fields due on stream during 1978 should help to increase the total output from the UK sector this year to 65-70 million tonnes (1.3-1.4 million b/d) from last year's 37.3 million (746 000 b/d), provided there are no major mishaps or further delays. The volume compares with an estimated UK inland oil consumption of about 79 million tonnes in 1977 and an overall energy use estimated at 198 million toe, with a forecast of 79 million and 201 million, respectively, for 1978.

Production from UK fields next year might reach 90 million tonnes (1.8 million b/d) with output rising from such fields as Brent, Claymore, Heather, Ninian and Thistle, and the start-up of Cormorant and Buchan. Other fields under development or for which development permits have been field are Anglo-Norwegian Statfjord, Tartan, Murchison, Beatrice, Fulmar and North Cormorant.

Although UK exploration and appraisal drilling last ye-ar was at a higher level than in 1976, no major new oilfield discoveries were reported. Three socalled 'significant' discoveries are listed: Conoco's 211/19-6 (January 1977), BP's 206/8-1 (August 1977), and Phillips Petroleum's 210/15-2. The BP discovery is west of the Shetlands, where Texaco also struck hydrocarbons in 207/1-3 and more recently Elf Aquitaine in 206/7-1 (1700 b/d of 23° oil from three zones and 110 000 cu m/day of gas through a 3/8th inch choke). Other oil strikes re-po-rted in 1977 were: Esso's 206/12-2, Hamilton Brothers' 30/24-8 (near Argyll), Texaco's 15/23-4B, and Shell's 30/16-8 (near Auk). Fields confirmed by official announcement were: Phillips Petroleum's Toni, Marathon's Brae, Shell/Esso's Fulmar, and Conoco's northerly extension of Lyell.

Source: Petroleum Economist, March 1978.

4. TANKER AND OTHER TRANSPORTATIONS

4.1 SHORT TERM TANKER MARKET OUTLOOK

1. Summary

Estimated tanker demand during the first half of 1978 remained at the relatively low level of around 238 million dwt, principally because of a large oil stock drawdown in the first quarter and low seasonal oil consumption in the second quarter. A significant increase of some 40 million dwt in tanker demand is expected to occur by the fourth quarter of 1978, which will be attributable in part to replacement of oil stocks in the second half of the year and high seasonal oil consumption in the fourth quarter. This is expected to be followed by a period of lower tanker demand in the first two quarters of 1979.

It is thought that part of the rise in tanker demand in the latter half of this year will be met by a speed up of the fleet but that some withdrawal of tonnage from lay up may also be required. In order that owners will be provided with sufficient incentive to reactivate tonnage during this time, it is expected that rates for VLCCs will need to rise for short periods to around WS 35 and for 90,000 dwt tankers to about W57½.

The estimated development of quarterly tanker demand and supply and charter rates can be summarised as follows with changes from our previous report shown in brackets:-

	Tanker Demand & Supply (Mn. Dwt)			Single Voyage Charter Rates (1978 Worldscale)	
	Tanker Demand	Tanker Supply	Net Surplus	90 mdwt	250 mdwt
1978					
First Quarter	239(+1)	359 (-1)	120(-2)	40	20
Second Quarter	236(-3)	355 (-3)	119(-)	42½ (+2½)	20
Third Quarter	254(+11)	355(-4)	101(-15)	47½ (+5)	27½(+4½)
Fourth Quarter	279(-9)	357(-2)	78(+7)	52½	32½
Year	252(-)	357(-2)	105(-2)	45 (-)	25 (+2)
1979					
First Quarter	261	356	95	45	22½
Second Quarter	262	354	92	45	22½

It is considered possible that the rebuilding of stocks in the third and fourth quarters of 1978 may not occur to the extent assumed, in which case the overall increase in tanker demand during the latter

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half of the year could be no greater than 30-35 million dwt. However, such a development would not be expected to have a significant impact on the charter rates projected in this report.

It will be appreciated that there are also factors which could result in an increase in tanker demand above estimated levels, towards the end of this year. These could include the possibility of an early cold winter, higher than expected liftings in anticipation of a January 1979 OPEC crude oil price rise and the transfer of part of the estimated third quarter stockbuild to the fourth quarter.

2. Results of Analysis

a) World Oil & Energy Demand and Supply (Table 1)

Changes from our last report are detailed in Table 1 and are mainly due to slightly higher rates of consumption and lower stock levels during most of 1978 than previously anticipated for the main consuming areas.

World oil consumption (excluding stock changes) during the period is expected to follow a seasonal pattern, reaching high levels in fourth quarter 1978 and first quarter 1979, relative to consumption in other quarters.

Estimated changes in world oil stock levels in some periods offset the seasonal pattern of oil consumption, being run down in the first quarter and rebuilt in other quarters. It should be pointed out, however, that owing to the exceptionally large stock drawdown in the first quarter of 1978 (-66 million tons) and having regard to the possibility of some pre-emptive liftings in the fourth quarter of 1978 in anticipation of a possible OPEC price increase, it has been assumed that there will be considerable rebuilding of stocks in the third quarter and, notably, some further stockbuild in the fourth quarter of this year.

Following from the assumptions on oil consumption and stock changes, world oil supply is expected to grow considerably in the latter half of 1978 compared with the first half of the year. Although liftings are expected to diminish substantially from fourth quarter 1978 levels in the first half of 1979, it is anticipated that production during this period will be significantly above that of first half 1978. Production in Africa, the Caribbean and S.E.Asia is shown to increase steadily in 1978 and to fall only moderately in first quarter 1979 with the bulk of the fluctuation in oil supply expected to affect the Persian Gulf producers. Production from the North Sea and Alaska is shown to increase throughout 1978 which is significant for tanker demand to Europe and the USA.

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b) Main Oil Movements and Tanker Demand (Tables 2 & 3)

Assumptions on transportation logistics are set out in Table 2 and detailed oil movements and 'base' tanker demand (i.e. before allowing for operating flexibility) are shown in Table 3.

The main changes in oil movements and base tanker demand since our last report result from the changes in oil consumption, production and stock levels shown in Table 1 and the reallocation of estimated stock changes between geographical areas. The more significant changes can be summarised as follows :

Main Changes to Estimated Oil Movements and Base Tanker Demand in 1978

Million Tons

Source	First quarter		Second quarter		Third quarter		Fourth qr.	
	Persian Gulf	Others	Persian Gulf	Others	Persian Gulf	Others	P. Gulf	Othrs.
Destination								
N.America	+3	-17	+3	+8	+10	-2	-13	+1
N.Europe	+4	+ 1	+3	+2	+ 2	+2	+ 3	+1
S.Europe	+2	+ 1	-3	-4	-	+3	- 2	+1
Japan	+4	-	-4	+1	- 2	-	-	-1
Others	-6	+ 5	-8	-	-	-	+ 4	-
Total	+7	-10	-9	+7	+10	+3	- 8	+2
Million Dwt	+5	- 4	-5	+2	+ 9	+1	- 8	-

The estimated development of tanker demand, after allowing for operating flexibility, can be summarised as follows with changes from our previous report shown in brackets :

Million Dwt

	Base Tanker Demand	Operating Flexibility	Adjusted Tanker Demand
1978			
First Quarter	218 (+ 1)	21	239 (+ 1)
Second Quarter	215 (- 3)	21	236 (- 3)
Third Quarter	232 (+10)	22 (+1)	254 (+11)
Fourth Quarter	255 (-8)	24 (-1)	279 (- 9)
Year	230 (-)	22 (-)	252 (-)
1979			
First Quarter	238	23	261
Second Quarter	239	23	262

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The low level of tanker demand in the first half 1978, although partly due to increased production from Alaska and the North Sea , was primarily a function of the large stock drawdown in first quarter 1978 and the relatively small stockbuild, accompanied by low seasonal consumption, in the second quarter. This in turn resulted in a low level of liftings from the Persian Gulf in the period.

Increasing tanker demand in the third and fourth quarter of 1978 is largely dependent on the assumption that significant rebuilding of stocks will take place in the second half of the year resulting in a small rise (+3 million tons) in world stock levels for 1978 as a whole. Higher oil consumption levels in first half 1979 compared with first half 1978, combined with the seasonal stock changes shown in Table 1, imply that tanker demand in the first two quarters of 1979 should be considerably higher than in the first half of 1978.

c) Tanker Supply (Table 4)

Average tanker supply, which was just under 360 million dwt in the first quarter of 1978 is estimated to be currently around 355 million dwt and is expected to remain at about this level through to mid 1979.

This development represents a marginal decrease in tanker supply du-rig 1978, in comparison wi-th the previous quarterly estimates , following the increasing slippage which has been observed in the tanker de-livery schedule and the higher than anticipated level of scrapping in the second quarter. The rate of scrapping is expected to slow down during the latter half of the year, however, as a result of congestion at shipbreakers' yards and the anticipated improvement in tanker rates in the fourth quarter.

d) Estimated Development of Tanker Demand and Supply Balances

The overall net tanker surplus, which is estimated to have remained at around 120 million dwt during the first half of 1978, is expected to decline by about 20 million dwt in both the third and the fourth quarters before increasing again by about 15 million dwt in the first half of 1979 :

		Million Dwt	
1978	Tanker Demand*	Tanker Supply	Net Surplus
First Quarter	239 (- 1)	359 (- 1)	120 (- 2)
Second Quarter	236 (-3)	355(- 3)	119 (-)
Third Quarter	254 (+11)	355(- 4)	101 (-15)
Fourth Qu-arter	279 (- 9)	357 (-2)	78 (+ 7)
Year	252 (-)	357 (-2)	105 (- 2)
1979			
First Quarter	261	356	95
Second Quarter	262	354	92

* Aft-er allowance for operating flexibility,

In very approximate terms, the surplus during the second quarter is thought to have been absorbed as follows :

	Million Dwt
Lay up	47
Slow steaming	50
Part cargo trading	14
Awaiting cargo/discharge	3
Storage	3
Other	2
	119

The average amount of tonnage in lay up during the second qu-arter was around 7 million dwt higher than in the first quarter. During July however, the total has remained at about 48 million dwt, and it is thought that a peak has now been reached and that some re-activation of tonnage may be required by the fourth quarter in order to satisfy some of the expected increase in tanker demand. However, a substantial part of this demand increase is likely to be met by a speed up of the fleet, which is currently estimated to be slow steaming on average by around 20%.

e) Estimated Development of Tanker Charter Rates

The expected development of short term tanker charter rates for selected vessel sizes, as shown in Table 6, is based on estimates of tanker operating costs (Table 5) and the distribution of the net surplus between the various tanker size groups. It is assumed that in conditions of surplus, rates will be influenced in particular by the economics of tanker lay up and reactivation although expectations regarding the effect on the market of crude oil price developments may also have some impact.

Estimates of si-ngle voyage, one year and three year period charter rates for 90,000 and 250,000 dwt tankers, together with chan-ges from our previous report, are summarised below :

1978 Worldscale

	90,000 dwt			250,000 dwt		
	Single Voyage	1 Year Period	3 Year period	Single Voyage	1 Year Period	3 Year Period
1978						
First Qua-rter	40 (-)	42½(-)	47½(-2½)	20(-)	23(+1)	27 (-)
Second Quarter	42½(+2½)	42½(-2½)	47½(-2½)	20(-)	24(+1)	27 (-)
Third Qua-rter	47½(+5)	45 (-2½)	50 (-2½)	27½(+4½)	26(+1)	28 (-)
Fourth Qu-arter	52½(-)	47½(-2½)	52½(-2½)	32½(-)	27½(-)	29 (-)
Year	45 (-)	45 (-2½)	50(-2½)	25(+2)	25(+1)	28 (-)
1979						
First Quarter	45	47½	60	22½	26	32½
Seco-nd Quarter	45	47½	60	22½	26	32½
First Half	45(-2½)	47½(-2½)	60(-2½)	22½(-2½)	26(-1½)	32½ (-)

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Average Single voyage rates for medium and large size tankers during the third quarter 1978 are now expected to be around 5 to 7½ points of worldscale above second quarter levels in view of the significant increases recorded on the spot market during July. It would appear that the recent increase in the de-mand for single voyage charters has been met through some vessel speed up and the employment of idle tonnage already positioned in loading areas. Rates during the fourth quarter are expec-ted to rise further, in line with the estimated increase in tanker demand which wi-ll necessitate additional speed up of the fleet together with some withdrawal of tonnage from lay up. During the first half of 1979 single voyage rates are expected to be below fourth quarter levels for all vessel sizes as a result of the expected renewed increase in the tanker surplus as compared with the last quarter of 1978.

One year and three year period charter rates are expected to remain more steady but reflect, to some extent, the higher single voyage rate expectations in the second half of 1978. Rates in the first half of 1979 are expected to be broadly unchanged compared with those for the fourth quarter 1978, although for the smaller tanker sizes a continued increase is assumed in line with the tightening demand/supply balance for these ves-sel sizes.

AFRA rates thr-oughout the period (Table 6) are expected to continue to reflect an upward trend for the smaller categories with little change anticipated for VLCC AFRA, although estimates for the size groups below 80,000 dwt have been marg-inally reduced compared with previous estimates to take account of recent developments.

* ** * * * *

Source: Petroleum Economics Limited, London, August, 1978.

Table 1

Estimated Development of World Oil & Energy Demand and Supply 1978 & First Half 1979 by Quarter

Million Tons Oil Equivalent

	1978 First quarter	1978 Second quarter	1978 Third quarter	1978 Fourth quarter	1978 Year	1979 First quarter	1979 Second quarter
1) Oil Consumption							
North America	254(+4)	235(+3)	240(+1)	257(+1)	986(+9)	261	243
North Europe	134(+3)	120(+7)	113(-2)	135(+3)	502(+11)	137	122
South Europe	54(-2)	45(+1)	47	58(+1)	204	55	46
Japan	71(+2)	61	63	68(-2)	263	72	61
Others	129(-1)	133(-3)	135(-2)	134(-2)	547(-8)	134	138
Total World*	642(+6)	594(+8)	598(-3)	652(+1)	2486(+12)	659	610
2) Stock Changes Etc.	-66(-18)	+11(-22)	+42(+2)	+16(-4)	+3 (-42)	-25	+35
3) Total Oil Requirement	576(-12)	605(-14)	640(-1)	668(-3)	2489(-30)	634	645
4) Oil Supply							
Middle East	258(-4)	265(-6)	280(+1)	297(-1)	1100(-10)	280	284
North Africa	35(-2)	36(-6)	39(-3)	43(-1)	153(-12)	38	39
West Africa	26(-1)	29	32(+1)	35(+1)	122(+ 1)	32	33
Caribbean	42(+1)	47(+2)	48	49	186(+3)	48	50
S.E. Asia	26(+1)	25(-1)	27	28	106	26	27
North Europe	17(-5)	19(-3)	24(+1)	26(-2)	86(-9)	26	26
US Lower 48	104(-2)	107	108(+1)	107(+1)	426	105	106
Alaska	12(+1)	15	17(-1)	18	62	17	17
Others	40(-1)	43	47(-1)	48(-1)	178(-3)	45	48
CPE Net Exports	16	19	18	17	70	17	15
Total World	576(-12)	605(-14)	640(-1)	668(-3)	2489(-30)	634	645
5) Non-Oil Energy Demand	587(-1)	519(-12)	509(-6)	587(-4)	2202(-23)	605	534
6) Total Energy Demand	1163(-13)	1124(-26)	1149(-7)	1255(-7)	4691(-53)	1239	1179

* Excluding CPEs.

Note: Changes from previous report are shown in brackets.

Table 2

Assumptions on Logistics of Main Oil Movements 1978 & First Half 1979 by Quarter

Million tons

	1978					1979	
	First quarter	Second quarter	Third quarter	Fourth quarter	Year	First quarter	Second quarter
1) Suez Canal Utilisation							
Oil Shipped - Suez/Suez	8(+3)	8(+2)	9(+1)	9(-4)	34(+2)	10	10
- Cape/Suez	7	12(-1)	14(+1)	22(-5)	55(-5)	15	15
2) Middle East Pipeline Throughputs							
Tapline	1	1	1	1	4	1	1
Iraq-Turkey	3	4	4	4	15	5	5
Israeli	7	7	8	7	29	7	7
Sumed	5	6	8(+1)	9(-1)	28	9	9
Total	16	18	21(+1)	21(-1)	76	22	22
3) US Oil Movements							
Via Transhipment Terminals	28(-2)	27(+3)	27(-3)	28(-6)	110(-8)	25	26
Via Ship to Ship Transfer (US Gulf)	7(-4)	8(-1)	9(-1)	11(-4)	35(-10)	8	10
Alaska to Gulf Coast	3	5	9	9	28	9	9
East Coast Products Imports	27(-3)	23(+3)	23(+3)	27(+1)	100(+4)	30	25

Note: Changes from previous report are shown in brackets.

Table 3

Estimated Main Oil Movements & Base Tanker Demand 1978 & First Half 1979 by Quarter

Million Tons

Destination/ Source:	1978 First quarter	1978 Second quarter	1978 Third quarter	1978 Fourth quarter	1978 Year	1979 First quarter	1979 Second quarter
North America							
Persian Gulf	35	32	38	33	138	30	35
East Med.	1	-	-	1	2	-	-
Africa	27	33	35	36	131	23	31
W.Hemisphere	32	27	26	34	119	35	31
S.E.Asia	6	7	6	6	25	8	6
Others	5	7	6	6	24	7	8
Total Imports	106	106	111	116	439	103	111
Other Movements*	60	54	56	67	237	61	54
Total	166(-14)	160(+11)	167(+8)	183(-12)	676(-7)	164	165
Million Dwt	65(-5)	64(+3)	71(+8)	72(-11)	68(-1)	67	73
North Europe							
Persian Gulf	54	60	59	70	243	64	63
East Med.	2	2	2	2	8	2	2
Africa	11	10	9	8	38	8	6
W. Hemisphere	3	2	2	2	9	2	4
Others	13	10	10	12	45	14	11
Total	83(+5)	84(+5)	82(+4)	94(+4)	343(+18)	90	86
Million Dwt	52(+4)	55(+4)	53(+3)	61(+3)	55(+3)	57	56
South Europe							
Persian Gulf	27	23	27	42	119	29	24
East Med.	14	19	22	19	74	22	23
Africa	18	16	19	21	74	18	18
Others	9	9	10	10	38	9	11
Total	68(+3)	67(-7)	78(+3)	92(-1)	305(-2)	78	76
Million Dwt	23(-)	20(-4)	25(-)	36(-1)	26(-2)	26	23
Japan							
Persian Gulf	50	47	48	50	195	50	49
S.E.Asia	13	15	14	14	56	14	13
Others	2	2	3	2	9	2	2
Total	64(+4)	64(-3)	65(-2)	66(-1)	260(-2)	66	64
Million Dwt	29(+2)	28(-2)	29(-1)	30(-)	29(-)	30	28
Others							
Persian Gulf	61	63	73	69	266	70	73
Africa	4	3	5	6	18	8	4
W. Hemisphere	5	5	5	5	20	5	5
S.E.Asia	5	2	2	3	12	2	3
Others	5	6	6	6	23	5	6
Total	80(-1)	79(-8)	91(-)	89(+4)	339(-5)	90	91
Million Dwt	36(-)	35(-3)	40(+1)	39(+3)	38(+1)	39	40
Minor Movements (mmdwt)	13(-)	13(-1)	14(-1)	17(-2)	14(-1)	19	19
Total Million Dwt	218(+1)	215(-3)	232(+10)	255(-8)	230(-)	238	239

* Intra-area shipments & movements from Caribbean transhipment terminals.

Note: Changes from previous report are shown in brackets.

Table 4

Estimated Development of World Oil Carrying Fleet 1978 and First Half 1979 by Quarter

Million dwt

	1977	1978				1979	
	Fourth quarter	First quarter	Second quarter	Third quarter	Fourth quarter	First quarter	Second quarter
Tankers							
Fleet at beginning of quarter		333.4	330.2	328.6	328.1	327.4	326.0
Deliveries		2.3	2.1	1.9	2.2	1.8	1.6
Deletions		5.5	3.7	2.4	2.9	3.2	2.9
Fleet at end quarter	333.4	330.2	328.6	328.1	327.4	326.0	324.7
Fleet trading in grain at end quarter	0.7	0.8	0.6	0.6	0.6	0.6	0.6
Fleet trading in oil at end quarter	332.7	329.4(-0.4)	328.0(-1.9)	327.5(-1.3)	326.8(-1.4)	325.4	324.1
Combined Carriers:							
Fleet at beginning of quarter		47.4	47.4	47.9	48.3	48.7	48.9
Deliveries		0.3	0.7	0.4	0.5	0.4	0.2
Deletions		0.3	0.2	-	0.1	0.2	0.1
Fleet at end quarter	47.4	47.4	47.9	48.3	48.7	48.9	49.0
Fleet trading in dry cargo at end quarter	17.6	20.8	22.0	20.0	18.0	19.0	20.0
Fleet trading in oil at end quarter	29.8	26.6(-0.8)	25.9(-3.1)	28.3(-2.0)	30.7(+0.1)	29.9	29.0
Total Oil Carrying Fleet at End Quarter	362.5	356.0(-1.2)	353.9(-5.0)	355.8(-3.3)	357.5(-1.3)	355.3	353.1
Average Oil Carrying Fleet		359.3(-0.6)	355.0(-3.1)	354.9(-4.1)	356.7(-2.3)	356.4	354.2

Table 5

Estimated Tanker Operating Costs 1978

1978 Worldscale

Vessel Size (dwt) a)	Breakeven Lay-up Costs	Breakeven Reactivation Costs	Total Direct Costs	Total Ownership Costs b)
20,000	100	135	125	190
30,000	75	100	95	145
50,000	55	72½	70	105
70,000	45	57½	57½	85
90,000	37½	50	50	72½
120,000	32½	42½	42½	62½
250,000	22½	30	32½	45
320,000	20	27½	30	42½
410,000	20	27½	30	40

a) Motorships up to 120,000 dwt, turbine tankers 250,000 dwt and above.

b) Including capital costs on a resale basis.

Table 6

Estim-ated Development of Tanker Char-ter Rates 1978 and First Half 1979 by Quarter

	Vessel Size (000 dwt)						1978 Wor-ldscale Equival ent		
	20	30	50	70	90	120	250	320	410
Single Voyage									
First Quarter 1978	130	105	72½	47½	40	30	20	18	17
Second quarter 1978	135	105	75	50	42½	32½	20	18	17
Th-ird quarter 1978	140	115	85	57½	47½	37½	27½	24	22
Fourth quarter 1978	160	135	100	70	52½	42½	32½	30	28
First quarter 1979	150	125	85	60	45	32½	22½	20	19
Sec-ond quarter 1979	150	125	85	60	45	32½	22½	20	19
1 Year Period									
First quarter 1978	140	115	80	55	42½	32½	23	20	19
Second quarter 1978	145	117½	82½	57½	42½	32½	24	21	20
Third quar-ter 1978	147½	122½	87½	62½	45	35	26	24	23
Fourth quarter 1978	150	127½	90	65	47½	37½	27½	25	24
First quarter 1979	165	135	95	70	47½	37½	26	24	23
Second quarter 1979	165	135	95	70	47½	37½	26	24	23
3 Y-ear Period									
First quarter 1978	170	135	95	70	47½	37½	27	25	24
Second quarter 1978	170	135	95	70	47½	37½	27	25	24
Third quarter 1978	175	140	100	72½	50	40	28	26	25
Fourt-h quarter 1978	175	140	100	75	52½	42½	29	27	26
First quarter 1979	200	155	115	87½	60	47½	32½	30	28
Second quarter 1979	200	155	115	87½	60	47½	32½	30	28

AFRA	Ge-neral Purpose	Medium Range	La-rge Range I	Large Range 2	VLCC
First quarter 1978	155.3	110.5	69.6	51.8	44.5
Second quarter 1978	151.5	111.4	68.2	51.2	44.5
Third quar-ter 1978	150	112½	70	53	45
Fourth quarter 1978	157½	120	77½	54	45
First quarter 1979	162½	127½	82½	55	44
Second quarter 1979	165	130	85	55	44

4.2 LIVING WITH THE SURPLUS - TANKERS

by Martin Beudell

With rising oil import needs and cargo preference support, the US tanker fleet is heading for expansion and active trading. However, the outlook for the international tanker market remains grim and, short of unexpected political happenings, the surplus capacity problem of the world tanker fleet is expected to stay until the early 1980s, if not beyond. Thus far, there is no international agreement on measures to alleviate the surplus.

However, several technical and economic factors have now checked both the rapid expansion of the world tanker fleet and the escalation of tanker sizes. During 1972 and 1973 expectations for increased tanker demand ran high, and oil companies as well as private owners placed orders for many newbuildings, particularly in the VLCC category, for delivery in two to four years. But since 1st January 1974 the high price of oil, world-wide economic recession and a series of mild winters have depressed the demand for oil and thus the need for tanker tonnage. The predicted rush for ULCCs (ultra large crude carriers of 300 000 dwt and over) was also checked by draught limitations in the receiving ports and in the world's shipping lanes, difficult handling of such very large vessels, and huge capital investments required for providing the necessary harbour and dry-dock facilities.

Ever since the 1973/74 oil crisis, the world tanker fleet has suffered from severe excess carrying capacity. According to John I. Jacob's latest World Tanker Fleet Review, the estimated surplus capacity at the end of June reached 137.5 million deadweight tons, at a time when the total volume of tonnage operating in oil transportation was about 315 million (see Table I). At end-December 1976 the surplus capacity was put at 68.6 million tons on the basis of laid-up tankers 29 million, laid-up combined carriers 1.5 million, slow steaming of tankers and combined carriers 23.1 million, and miscellaneous inefficiency 15 million. On the basis of the same factors considered, the surplus capacity at end-June this year totalled 100 million tons.

The surplus capacity compares with a total world tanker fleet strength of 3 584 vessels totalling 326.7 million dwt at 30th June, as against 320.7 million at the end of last year - a rise of only 1.9 per cent (see Table II). (The end-1976) figure was still 10 per cent up on the previous year.) The combined carrier fleet of 416 ships had a total capacity of 46.8 million dwt, with 22.7 million engaged in the oil trade.

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Table 1

WORLD TANKER FLEET SURPLUS*

Million deadweight tons at end-June 1977		
Laid-up tankers	..	32
Laid-up combined carriers a)	..	2
Slow steaming b)	..	56
Excessive port time	..	16
Deadfreight c)	..	6.5
Waiting cargo: Arabian Gulf	..	10
Elsewhere	..	5
Miscellaneous inefficiency d)	..	10
Total:	..	137.5

a) Say 50 per cent of 4 million total.

b) Of operational oil carrying fleet - tankers and 50 per cent combined carriers.

c) Amount of available deadweight not being used by resorting to partial loading.

d) Including cross-hauling, floating storage, scheduling delays, etc.

* Estimated by John I Jacobs

Table II

World Tanker Fleet of 10 000 dwt and over

	As at end-Dec 1976		As at end-June 1977	
	No.	Deadweight	No.	Deadweight
Oil Company	1425	114087621	1433	117257336
Private	2118	204231552	2059	206981628
Total commercial	3543	318319173	3492	324238964
Government	83	1801613	78	1631914
Miscellaneous	10	607367	14	799983
Total	3636	320728153	3584	326670861

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Shipping experts think that surplus capacity might persist into the 1980s because of the foreseen tardy demand for oil world-wide. Other factors influencing future tanker activity, particularly in the VLCC category representing about 45 per cent of the world tanker fleet, are the rising oil output from North Sea and Alaskan fields displacing long-haul imports, and the pumping of oil through the new Kirkuk-Dortyol and Sumed pipelines reducing tanker transports around the Cape of Good Hope.

The surplus capacity problem may well be exacerbated by the American government's attemps to enlarge the US tanker fleet by adding American-built vessels and newbuildings, incorporating such advanced safety standards as double bottoms and segregated ballast tanks (SBT), so that more oil will be carried in US bottoms, specifically oil from Alaska and 4.5 per cent of US oil imports, starting in 1978 and rising annually by 1 per cent to reach an ultimate 9.5 per cent. Cargo preference for American-built ships flying the US flag would also extend to oil transshipeed in the Caribbean on route to America, where ports on the east coast are not deep enough to receive VLCCs.

Already, 50 per cent of the crude oil moved by sea from abroad for enlarging US strategic oil stocks must be carried by US flag tankers during the five year period starting this year. Furthermore, the Jones Act reserves American coastal trade for American ships, including intercoastal trade between US territory separated by seas or oceans (eg US mainland and Hawaii).

The US tanker fleet totalled 242 vessels with a combined carrying capacity of 10.7 million dwt at the end of June; it has a high percentage of vintage ships which, of course, do not meet the proposed safety standards (see Table III). Significantly, the US heads the world list of tanker tonnage on order with 26 vessels totalling 4.1 million dwt at the end of June, which compares with global newbuildings on order of 243 tankers totalling 27.5 million dwt.

Obviously, strengthening cargo preference legislation with the proviso that foreign flag ships cannot be added to the US fleet, even if originally built in the US and retrofitted with SBT, would lead to a massive newbuilding programme in the US which would do nothing to lessen the world-wide tanker surplus. On the other hand, an international agreement on adopting SBT for 70 000 dwt and over could, according to Jacobs, remove effectively up to 63 million tons of carrying capacity because the cargo-carrying capacity of tankers would be reduced and older tankers would not be worth converting.

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Table III

US COMMERCIAL TANKER FLEET*

Size group Deadweight tons	1958 or before		1959/70		1971		1972		1973	
	No.	DWT	No.	DWT	No.	DWT	No.	DWT	No.	DWT
10,000/34999	108	2821350	20	592921	2	67684	2	48907	-	-
35,000/79999	8	345351	42	2137458	4	239537	5	285000	2	109904
80,000/99999	-	-	2	161703	2	161342	-	-	1	80983
100,000/199999	-	-	1	114668	-	-	1	129917	2	241061
200,000 & over	-	-	-	-	-	-	-	-	-	-
Total	116	3166701	65	3006750	8	468563	8	463824	5	431948
Percent of total fleet		29.48		27.99		4.36		4.32		4.02

Size group Deadweight Tons	1974		1975		1976		1977		Total	
	No.	DWT	No.	DWT	No.	DWT	No.	DWT	No.	DWT
10000/34999	4	109520	5	136900	-	-	5	189941	146	3967223
35000/79999	1	39675	4	159769	4	150141	1	89700	71	3556535
80000/99999	2	183688	1	89700	5	452798	-	-	13	1130214
100000/199999	2	241170	-	-	1	118300	-	-	7	845116
200000 & Over	2	450562	1	264073	2	529074	-	-	5	1243709
Total	11	1024615	11	650422	12	1250313	6	279641	242	10742797
Per cent of total fleet		9.54		6.05		11.64		2.60		100.00

The figure compare with scrappings, conversions and losses totalling 4.5 million dwt (144 ships) during January-June this year, as against 5.8 million dwt (160 ships) in the preceding six months (July-December 1976).

Other uncertainties hanging over the international tanker market are the ambitions of the OPEC nations to expand their tanker fleets and their export refinery capacities. The combined OPEC tanker fleet is growing rapidly, its capacity doubling to about 8.7 million dwt by 1st January 1977 compared with a year previously (see Table IV). The combined fleet was bigger than that of Italy and came close to the deadweight capacity of Panama, ninth in the world tanker fleet league.

With governments of OPEC countries increasingingly favouring seaborne movements of oil andproducts in their own vessels, the combined OPECfleet is bound to grow bigger, wit the Arab fleets in the lead.

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Table IV

OPEC: TANKERS REGISTERED UNDER FLAGS OF MEMBER COUNTRIES*

	As at 1st Jan 1976		As at 1st Jan 1977	
	No.	Deadweight	No.	Deadweight
Abu Dhab	-	-	1	135510
Algeria	5	274421	9	699296
Ecuador	5	168710	5	167620
Gabon	1	138680	1	138680
Indonesia	5	62591	6	79490
Iran	5	545138	9	1023815
Iraq	10	383120	15	1206989
Kuwait	8	1296357	11	1955146
Libya		406154	10	1106401
Nigeria			1	272535
Qatar			1	135502
Saudi Arabia	7	704434	14	1338429
Venezuela	15	442595	13	424967
Total	66	4422200	96	8684380

* Of 6 000 dwt and above

Only to the extent that the OPEC countries are buying existing tankers and combined carriers will the surplus capacity problem not be aggravated. However, obsolescence is something those who are building new fleets will be keen to avoid. According to a survey by Arab Oil & Gas (published by the Arab Petroleum Research Centre) tankers on order by Arab countries at the start of 1977 totalled 1.8 million dwt, of which Algeria had on order 128000 dwt, Iraq 606000 dwt, Kuwait 261000 dwt, Libya 60000 dwt, and the OAPEC-sponsored Arab Maritime Petroleum Transport Company 704000 dwt. AMPTC was founded in 1972 under the joint ownership of eight Arab oil-producing states (Abu Dhabi, Algeria, Bahrain, Kuwait, Libya, Qatar, Iraq and Saudi Arabia), at the start of 1977 had six tankerstotalling 1.4 million dwt. The total Arab deadweight tanker tonnage in service was put at 6.6 million dwt.

The figures quoted cover only Arab government ownership of tankers. In addition, oil companies, private enterpreneurs and banking interests have formed joint tanker ventures in the oil-producing countries. During 1976 BP and NIOC formed a joint tanker company, to aim at 10-15 vessels with a total tonnage between one and two million dwt. Also last year, Saudinaft Tankers (Saudi Arabia's Naft Corp 53 per cent, Shell 23.5, and Britain's P & O 23.5) started operating, joining other Saudi shipping companies formed in compliance with government preference for oil exports

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in Saudi-owned or controlled tankers, eg Red Sea Saudi Maritime (Nippon Yusen of Japan 40 per cent, the rest private Saudi interests), the Arab Maritime Shipping Co (financed by Saudi and European banks), Saudi Arabia Shipping Co (Mitsui OSK Line of Japan 40), and the Saudi Martitime Co Ltd (Mobil and Fairfield Maxwell holding together 45 per cent).

OPEC nations are also eager to expand their export refinery capacities, which would increase tanker movements of products (thus requiring more product tankers), but decrease crude oil movements. Tankers of about 35000 dwt are at present generally considered the upper limit for the product carriers, and according to Jacobs the category of up to 35000 dwt at 30th June 1977 numbered 1367 vessels totalling nearly 31 million dwt. The most significant characteristic of the world's product carrier fleet is its advancing age, with 777 vessels totalling 16.8 million dwt built before 1963. If large quantities of products were to be lifted, it would seem likely that freighting economies could involve the use of tankersup to a maximum of 150 000 dwt, and such movements would be governed by the available draught of the Suez Canal (up to 53ft under Phase 1 development of the waterway), and the discharge ports involved.

Terminal Operators of London estimated in 1975 that if the projected target of 200 million tons/year of OPEC refinery capacity was reached by 1979, 53 million dwt of product tankers would be needed to move 470 million tons, compared with 240 million tons moved by 17 million dwt in 1973. Crude oil tanker needs would then be reduced from 176 million dwt in 1973 to 164 million in 1979, to move 1280 million tons instead of 1320 million.

As benevolent measures for solving problems arising from supply/demand imbalances are more difficult to agree on at international level, the world-wide tanker market business will probably be left to ride out the storm of inexorable market forces.

Source: Petroleum Economist, October 1977.

4.3 MIDDLE EAST - PIPELINES VERSUS TANKERS

by E. Stanley Tucker

To tanker owners it must seem sadly out of place that 1977, a year of continued tanker surplus, witnessed the inauguration of two major Middle Eastern pipelines to the Mediterranean - that from Iraq through Turkey to Dortyol, and the Sumed line across Egypt. Surely this was not the time to boost the oil trade's capacity to move Middle East crude to the main markets of the West.

The thinking is understandable. But the new transport facilities are a reminder of two inexorable realities. One is that long lead-times are entailed in translating expansion plans into operating units, whether producing wells, refineries or trunk pipelines: contracts for the new lines were finalised in 1973 (before OPEC's inordinate price increases), having been conceived much earlier. Secondly, in the oil business, political or strategic considerations often override the nice calculations of the economic planners.

Basic to a consideration of oil transport facilities in the Middle East is the fact that three-fifths of the crude oil that enters international trade originates in the area around the Persian Gulf, and that a high proportion of these exports moves westward to the voracious markets of Europe and the United States. To deliver this oil by pipeline to the Levant Coast (where this is possible) rather than to the Gulf entails a saving of about 3000 miles on the sea voyage to Northwest Europe if the Suez Canal is usable, and of about 8000 miles if it is not. How this economy of ocean transport translates into cents per barrel of oil at the port of delivery depends in the main on the relationship between pipeline charges and tanker freight rates. As we have been reminded in recent years, this relationship can change dramatically in a short space of time.

Economics and politics

Directly a trunk pipeline crosses an international frontier economic considerations are apt to be bedevilled by politics. International lines are vulnerable to sabotage, inter-governmental disputes and, above all, to war. One branch of the Iraq Petroleum Company's original pipeline system ended at the Haifa export terminal - which meant that it became useless for the transport of Arab oil as soon as the state of Israel came into being in 1948. Again, acrimonious disputes between the Iraqi and Syrian governments over transit fees led to various inter-

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ruptions to the flow of Kirkuk oil to Tripoli and Banias, culminating in April 1976 in the cessation of deliveries through the IPC system. If there had been no other obstacles, the tragic civil war in Lebanon would have jeopardised the continued operation of the IPC line to Tripoli and of Tapline from Saudi Arabia to Sidon.

Political and strategic considerations became dominant in Iraq well before the nationalisation of the oil business was completed at end-1975. The significantly named Strategic Pipeline was built to link the northern (Kirkuk) fields to Fao on the Gulf; it was opened in January 1976. The government also agreed with Turkey the construction of the Dortyol outlet through that country and, to keep the option open, it made the Strategic Pipeline reversible. In theory, therefore, oil from the Basrah fields in the south can, like that from Kirkuk, be delivered to the East Mediterranean coast. But it must be pointed out that Iraq's producing capacity is about 3 million barrels a day (1977 production was111 million tons), whereas the capacity of the Dortyol line, at present 500000 b/d, is planned to rise, by 1980, to no more than 700000 b/d (or 35 million tons/year).

Though the opening of the Dortyol line enables the Iraqis to snap their fingers at the hostile regime in Damascus, its operation obviously depends on the good will of the Turks. Turkey is reported to have paid about $ 600 million towards the cost of the line, and Iraq some $ 250 million. Besides receiving a transit fee of about 39 cents a barrel, the Turks are entitled to purchase 40 per cent of the throughput (ie about 10 million tons/year at present) for their own use; whether they have been promised a privileged price has not been revealed. The line was ready for use by mid-1977, but the flow of oil has several times been interrupted by technical factors or by disagreements between the two governments. However, pumping seems to have been continous since end-November.

If the line is to be used to export Kirkuk oil to countries other than Turkey, Iraq must presumably make it worth the buyer's while to take delivery at Dortyol rather than in the Gulf. Though no official information is available about the East Mediterranean price, a rough calculation suggests that it would be difficult in present circumstances to make this attractive to buyers.

At the rock-bottom freight rate of W20 for VLCCs, the 8000-mile saving offered by shipments from the East Mediterranean to Rotterdam, as compared with a voyage round the Cape from the head of the Gulf, is

worth about $ 2.35 a ton or 33 cents a barrel. It might indeed be less than this : because VLCCs are not normally programmed into the Mediterranean, shipments from Dortyol might have to be made in smaller vessels at considerably higher cost. But if Iraq charged a premium at Dortyol of only 33 cents a barrel over the Gulf price, this would not cover the transit fees payable to Turkey; it would contribute nothing to meet the amortisation charges on Iraq's section of the line. Some observers have suggested that Iraq needs a premium of at least 60 cents a barrel to make the new line commercially viable - but, of course, political considerations could dictate a different balance. At all events, if freight rates were to double, the buyer would surely find such a premium worth paying.

The Suez-Mediterranean line

Very different in conception is the Suez-Mediterranan pipeline (Sumed), which was opened early last year. With a capacity shortly to reach 1.6 million b/d (80 million tons/year) this new link is designed, not to serve an oilfield or fields, but to enable large tankers to be used on the short sea-route from the Gulf to Europe but by-passing the Suez Canal. The terminals at Suez and Alexandria can accommodate VLCCs upto 250000 dwt, whereas the Canal cannot at present accept laden tankers above some 60000 dwt - rising to about 150 000 dwt by 1980.

The use of this link for shipments from the Gulf to importing ports in the eastern Mediterranean may possibly be commercial even at the present level of tanker freights, since the alternative is to travel right round the Cape and through the Straits of Gibraltar. Until end-1977, however, it certainly did not look economic for shipments to Northwest Europe. The reason is that the 5000-mile saving of distance on a journey from the Gulf to Rotterdam would be worth little more than $ 1.33 a ton with freights at around W20, whereas the cost of transshipping and using the Sumed line was reckoned to be of the order of $ 2 a ton.

From the shipper's point of view, however, the position has been eased by the publication in late December of the new Sumed tariff. The basic transit fee (originally $1.60 a ton plus 25 cents for deballasting, etc) now starts at $ 1.52 a ton for the first million tons put through annually but is progressively scaled down to a minimum of $ 1 a ton for users whose throughput exceeds 14 million tons/year. For the biggest users of all, therefore, the total cost per ton, including deballasting charges and transshipment costs, would be much the same as the saving of freight

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on a voyage to Northwest Europe. And, of course, the saving would increase with every rise in tanker freights above present depressed levels.

Trimming rates

In view of the present tanker position, one might doubt whether the reduction in the tariff was sufficient to attract much business. However, a Sumed official claimed in December that the decision to lower the tariff resulted in the conclusion of contracts sufficient to utilise almost all of the initial capacity of 40 million tons/year. Earlier, the Sumed company was reported to have signed contracts with only three important oil companies for lessthan half this tonnage - with Exxon for 5 million tons/year, rising to 7½ million; with Mobil for 5 million tons/year to 1980 and then 10 million, and with Petrofina for 3 to 5 million tons/year. The decision to behave commercially and to trim the rates thus appears to have been justified from the Sumed company's point of view, for pipeline costs per ton fall sharply as the throughput rises to the maximum. But it will not have been welcomed by tanker owners.

Nor can the completion of Sumed have been welcome to the Israelis, who have hitherto had a monopoly of pipeline transport for the Red Sea into the Mediterranean. Israel's 250-km, 1 million b/d Tipline from Eilat on the Gulf of Aqaba to Ashkelon on the Mediterranean has for years provided a short cut for shipments (particularly from Iran) to ports in the eastern Mediterranean. But its trade has been hit by the reopening of the Suez Canal as well as by the slump in tanker freights; and, of course, it suffers a political disability in an Arab world.

Thus the present position is that the international oil trade has a huge surplus of crude oil carrying capacity, in the form not only of tankers but of trunk pipelines as well. The idle ex-IPC lines from Kirkuk to Tripoli and Banias and Saudi Arabia's Tapline* to Sidon have a combined capacity of over 1.5 million b/d, while Israel's Tipline has about 1 million; Iraq's Dortyol line and Egypt's Sumed will have capacities of 0.7 and 1.6 million b/d respectively - altogether sufficient to shift nearly 5 million b/d or 250 million tons/year into the East Mediterranean.

That is not all. The ability to move Middle East crude westward will increase from about 1980 by the completion of a 1300-km, 48-inch crude oil line - eventual capacity 2.0 to 2.3 million b/d - across

* Tapline is at present being used, not to export Saudi crude to the West, but merely to supply the Jordanian refinery at Zarqa (25 km from Aman) and the Lebanese refinery at Tripoli.

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Saudi Arabia from the Ghawar oilfield in the east to a point near the port of Yanbu on the Red Sea. This new line, for which the construction contract has been awarded to Mobil Overseas Pipeline Co, will supply raw material to the projected refinery, petro-chemical complex, LPG plant, etc. at Yanbu, as well as crude oil for export. This short-cut crude could be shipped northwards from Yanbu into the Mediterranean, either through the Suez Canal or the Sumed pipeline. Refined products could also be exported via the Canal.

The existence of reserve pipeline capacity will obviously prolong the period during which tanker freight rates will be held down by over-supply. The length of this period of depression will depend largely on the level of demand for oil - governed, in turn, by price in relation to other forms of energy, and by the rate of economic activity in general. But it is safe to predict that some years must elapse before any significant pressure is put on the oil trade's long-distance transport facilities. When that time comes, consumers must expect a sharp increase in the cost of bringing Middle East oil to market.

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Source: Petroleum Economist, February 1978.

5.GENERAL

5.1 HOW MUCH OIL IN THE WORLD?

The standard reply "it all depends on what you mean" with which a popular British philosopher and controversialist used to parry his questioners would have been sigularly appropriate had he been asked for an estimate of the world's oil resources. A recent study conducted under the auspices of the World Energy Conference* shows that ultimate resources may be in excess of 1 000 billion tonnes, or at least 10 times the current figure for proven and probable reserves of conventional oil; but the same study underlines the great difficulties of actually utilising all the petroleum that may be in existence. The study provides no ground for complacency.

It emerged from the study that ultimately recoverable resources of "conventional" oil are believed to be of the order of 260 billion tonnes, or 300 billion tonnes if oil from the polar regions and the deep sea is include. The calculations are based on the assumption that technical production costs + will tend towards $20 (in 1976 dollars) per barrel by the year 2000, that operators will retain the corresponding receipts, and that it will therefore be possible to make use of "the best present and future technologies of exploration, production and recovery". Shale oil, tar sands and heavy oils of the "Orinoco Belt" type are the main categories of oil classified as unconventional.

Estimates of partially undiscovered resources are naturally subject to some doubt but the figures for conventional oil (both those excluding and including deep sea and polar oil) represent the arithmetic averages of estimates obtained from 18 leading oil companies (all the majors among them) and from 11 highly reputable consultancies, independent experts and public authorities. It is noteworthy that two-thirds of the estimates obtained were remarkably close to one another, fluctuating around 240 billion tonnes (excluding deep sea and polar oil). About 25 per cent of the replies were more optimistic (with figures of around 350 billion tonnes+), and 10 per cent more pessimistic (around 175 billion tonnes).

The Middle East and North africa were credited with a share of at least 42 per cent of all conventional oil resources (excluding deep sea and polar oil)- an estimate which sounds conservative in view of the fact that the

*Pierre Desprairies(Institut Francais du Petrole).World-wide Petroleum Supply Limits. In World Energy Resources 1985-2020 Published for the World Energy Conference by IPC Science and Technology Press, Guildford, Surrey,England. Price £9.50/ $24.00)paper);£16.00/$43.00(cloth). The book also contains chapters on natural gas, coal, water power,nuclear power, unconventional energy resources, energy conservation and world energy demand.

area accounts for 60 per cent of all proven reserves at present and that there seems to be considerable scope for upgrading some of the existing local reserves figures.

The Communist countries (USSR, East Europe and China) take second place with an estimated 23 per cent, though internal demand in these countries is rising and their combined export potential appears to be correspondingly small. For the rest, about 15 per cent is believed to be in the remainder of the Eastern Hemisphere, 11 per cent in North America, and 9 per cent in Latin America and the West Indies. As much as 135 billion tonnes of oil are believed to lie off-shore, by far the larger part of it at relatively modest depths.

DISCOVERIES AND RE-EVALUATIONS

Prospects for the discovery of new giant oilfields are apparently receding, and most of the hoped-for increase in established reserves during the remainder of th s century will probably come from re-evaluations of old deposits. At present, only 25 per cent (or, at the utmost,30 per cent, of the petroleum in the ground can normally be extracted; but there has recently been considerable progress in the development of enhanced (or tertiary)recovery methods- including thermal processes, miscible displacement and chemical flooding- and their large-scale application,though costly, is expected to raise the recovery rate to 40 per cent by the end of the century, and perhaps to 45-50 per cent eventually. Nevertheless, most experts think that the cost of production and development will remain at a reasonable level though they envisage big increases in discovery costs.

The 300 billion tonnes figure for recoverable conventional resources, onshore and offshore, looks satisfactory at first sight in comparison with the annual rate of oil production (and oil demand) which is now of the order of 3 billion tonnes and may rise to at least 4-5 billion tonnes by 1990. Two important considerations have to be taken into accou t, however: first, all the experts say, or imply, that the indicated reserves will only be established during the remainder of this century if there are commensurate capital investment; secondly, production is bound to decline long before the time when the reserves are approaching final exhaustion.

There seems to be widespread agreement that it may be technically possible to raise the annual over-all rate of gross additions to proven reserves (through discoveries and re-evaluations) to between 4 and 5 billion tonnes by about 1990. It is, however, by no means certain that capital investments of the right size and at the right place

+ = Defined as amortisation of exploration and production expenditures plus the direct production cost.

‡ = The highest single estimate is 470 billion tonnes, the second highest only 343 billion tonnes.

will be made in good time, though failure to do so could lead to a world-wide supply crisis.

It is an ominous fact that the quadrupling of oil prices in 1973 has not been followed by any substantial rise in proven reserves-mainly because the price rises were absorbed by the treasuries of OPEC countries instead of swelling capital resources for oil development-and it would be optimistic to assume that conditions in this respect will improve to any great extent in the near future.

The author of the new oil reserves study- who has no axe of his own to grind-stresses that the required capital investments can only be expected to materialise if the companies obtain adequate financial resources, if there is Government assistance for the improvement of exploration and production technology, and if international agreements are concluded to ensure that some of the promising deposits in Third World countries do not remain unexplored.

Furthermore, the author makes the shrewd comment that "among all the obstacles separating the technical possibilities of petroleum production from their effective realisation, the most difficult to surmount is failure to believe that they exist;" he adds that it is essential, in view of the enormous scale of the required investments, that the general public is made aware of the reality of these problems, and of the need to assist in their solution. Unfortunately, recent public warnings about impending shortages have coincided with a temporary glut of oil, and this has helped to create a widespread attitude of scepticism which will not be easy to dispel.

Perhaps even more perturbing, from a long-term point of view, is the fact that the additions to proven reserves could not possibly stay for very long at the proposed high rate of 4-5 billion tonnes annually. There is general agreement that, on the basis of the assumed resources figures, a temporary upsurge in the 1980s would inevitably be followed by a fairly steep decline towards the turn of the century.

Exact forecasts are difficult to make but an assessment of the views of the various experts points to the probability of a fall-back to well below 4 billion tonnes in the year 2000 and 2.5 billion in 2020. A cutback of this order of magnitude would be bound to lead to a general energy crisis of serious proportions-unless great progress has meanwhile been made with the development of fuels other than oil.

What contribution could be expected from the so-called unconventional types of petroleum? Virtually all these fuels (including deep sea and polar oil) are at present difficult or, at best, expensive to produce, and additional constraints to their full-scale development arise from

ecological considerations and, in some cases, from inadequate public support. Not only are the reserves, as a rule, inadequately evaluated but it is estimated that no more than 5-10 per cent of the world's oil shales, tar sands and heavy oils could be produced on the basis of established technologies. Against this, there are now reasonably good prospects for forthcoming technological break-throughs, perhaps by the successful use of in situ (or semi-in situ)techniques which would make it possible to produce most of the fuels at a lower cost and with less disturbance to the environment. Interest also attaches to new experiments for the extraction of hydrocarbons from coal, with the use of solvents in the presence of hydrogen.

GOVERNMENT SUPPORT

The report published for the World Energy Conference stresses that government support will be required to inaugurate the production of non-conventional oils on any substantial scale but that, once the technology has ceased to involve undue risks, it might well be possible to reduce their costs (including normal profits) to perhaps $ 15 per barrel, or only slightly more than the current selling price of crude. The report concludes, somewhat vaguely, that these fuels could therefore, in ten or fifteen years, become a useful stabilising element, helping to keep down the world market price of oil. Their exploitation on a very large scale, however, is not expected to start until the 21st century when they are likely to succeed conventional petroleum in its specific application, ie in the fields of transportation and petrochemicals.

Superficially, there seems to be some attraction in the idea of holding back the full development of the world's resources of conventional petroleum so as to postpone the time when its output is bound to decline. However, world energy demand is certain to increase in the course of the next decade and will then have to be covered primarily from conventional oil resources, probably with the support of natural gas Given the long leadtimes required for most energy developments, there is little chance of filling any possible supply gap in the period up to about 1990 with supplies of coal, nuclear power or other alternatives, and ashortfall in the availability of conventional hydrocarbon fuels would therefore have the most serious consequences. It seems more fruitful to inaugurate major efforts for the development of alternative energy resources-including unconventional oils-for their large-scale use towards the end of the century and beyond.

5.2 A CONSPIRACY TO CONTROL OIL?

MYTHS, if repeated often enough, have a dangerous tendency to become accepted as reality, certainly to the uninformed. So it is in the case of oil and the assertion, not only that no real shortage was caused by the Arab oil embargo in the winter of 1973/74, but that it was contrived by the major oil companies and OPEC actingtogether as a means of raising crude prices.

Such claims were made in a number of consumer countries after that traumatic period and were the subject of governmental investigations. The overwhelming evidence was against the conspiracy theory and most government turned their attention to more important issues concerning oil and energy policy. It is depressing that in the United States, however, the companies continue to be subjected to attack on the same lines; depressing because it diverts attention from the real economic problems that confront the world.

The extraordinary groundswell of opposition to the oil companies that exists in the USA is continually fed by the sweeping charges made against them in Congressional investigations and in the publication of books reiterating those charges as if they were proven fact. A recent example of the latter is The Control of Oil* by the late Dr. John M. Blair, the American economist who was for many years involved in the politics of oil in Washington. It is sad that Dr. Blair died shortly before publication of his book. It is also sad that it will be his last testimony, since there is much he could have contributed to the current vital energy debate in the USA.

Although Dr Blair pays tribute in his book to the "knowledgeable and thoughtful" analyses of contemporary developments which have appeared in Petroleum Economist, and quotes these at some length, we have to take issue with many of his interpretations and conclusions. As one of the oil industry's most persistent critics for many years and director in 1952 of the famous Federal Trade Commission report on The International Petroleum Cartel- Dr Blair's charges have been taken up by others seeking to attack the industry and should be answered.

Dr Blair starts from one basic premise: that the oil industry is largely in the hands of a few companies-sometimes the seven majors are the culprits, elsewhere the other leading integrated companies are included- who control the supply, marketing, and thus the price of oil by what is virtually a cartel. As such he believes that they are already actionable under existing US antitrust law. It

*The Control of Oil.John M Blair,Published by Macmillan Press, London & Basingstoke,1977.xxii,441 pages;26 tables; 29 charts; Price £ 12.00.

is not that antitrust legislation has failed in the past; he reasons that for over sixty-five years it has not been tried. But his main remedy is that the integrated companies should be broken up so that no single company could operate in more than one of the four sectors of production, transportation, refining or marketing. Every argument in the book, every interpretation of past and current events, is aimed at proving the conspiracy theory and thus justifying the call for divestiture. This leads to a one-sided and sometimes conflicting view of developments.

IMPORT QUOTA SYSTEM

A case in point is the crude oil import quota system which operated from 1959 to 1973 and which Dr. Blair saw as a conspiracy by the companies to maintain high product prices by keeping out cheap Middle East oil. In fact, the companies were by no means in agreement over their attitude to quotas. The system was certainly favoured by those with domestic production available, but for others with large foreign reserves it would have been much more advantageous to import cheaper oil. Dr. Blair's main argument against quotas, other than seeing them as another example of the cartel in operation, is that they led to the production of more domestic oil which should have been conserved. But then he also argues against the prorationing system-which had the effect of conserving domestic oil- because it prevented more crude from reaching the market and thus reducing product prices. There is a valid argument that the prorationing system as it was implemented led to wasteful production methods and impeded the adoption of advanced recovery techniques. But would not an even greater flood of cheap foreign oil have had the latter effect? And in any case, looking at the current situation, would it have been of any real advantage to American consumers to have paid even less for oil products which would have encouraged more wasteful consumption and increased the nation's dependence on oil? Not only do some of Dr. Blair's arguments conflict with each other, but there is a continual failure to consider the wider implications, other than the criticism that any attempt at stability or regulation is equated with evidence of cartelisation at work.

A very revealing complaint by Dr. Blair is that regulation by government fails because officials not only become knowledgeable about the oil industry but also learn to understand and sometimes sympathise with its problems. The corollary seems to be that it is preferable to have controls imposed by an ignorant bureaucracy that does not even wish to understand- a situation indeed that has sometimes seemed to be

the case in recent years. In fact, what Dr Blair argues for is perfect competition which will solve all ills in the classical economic manner letting the market decide price and supply. But this disregards the problem, if even more damaging shortages are to be avoided, of the very long lead times required to develop both new oil sources and alternative forms of energy.

Two fundamental questions have to be asked. Firstly, is there not already a sufficient degree of competition? And secondly, what real benefit is to be obtained from the allegedly greater competition that would result from breaking up the integrated companies? Regarding the former, some of Dr. Blair's book dwells predictably on such past misdeeds of the industry as the Rockefeller Trust and the Achnacarry Agreement. Few today would want to defend these examples of restrictive practices, but it is Dr. Blair's contention that the system the companies invoked is still at work, at the very least in the form of common aims through an oligopolistic structure. They are charged internationally with controlling the market supply of crude, and thus its price, and in the USA domestically with a concerted effort to squeeze out the independent producers, refiners and marketers.

If this is the case, one can only conclude that the majors have failed abysmally. There is not sufficient space in this review to consider all Dr. Blair's accusations. But on one point alone - the accusation that the majors ruined the private-brand gasoline marketers in the USA by denying them supplies and imposing price squeezes- the fact is that the independents have increased their market shares to the detriment of the majors. (Dr Blair does not give the figures, but according to the Lundburg survey the independents selling unbranded or private-brand gasoline in the USA increased their share from 19 per cent in 1967 to 31 per cent in 1975.) Then again, the majors are accused of agreeing market shares between them so as to avoid competition; but later Dr Blair argues against his own case by correctly citing the erosion of the USA domestic earnings of the majors which began in the mid-1960s-"with the exception of Exxon, which for most of this period was enjoying the fruits of a highly successful advertising campaign, incessantly importuning motorists to 'put a tiger in your tank'". Was this not competition, and directed, what is more, against other major companies?

From the viewpoint of crude oil production, Dr. Blair accuses the major of controlling supply according to a pre-determined growth rate of consumption- and then refers to the periods of shortages and surpluses which did, in fact, occur. Sometimes these were caused by the very kind of competition he espouses, such as

the entry of independents into the Middle East during the 1950s. The "cartel" was not apparchtly successful in keeping them out; what is more, it led to a flood of cheap oil which brought down prices. This is the kind of competitive situation favoured by Dr Blair. But what was the final result? Resentment on the part of the exporting countries, leading directly to the formation of OPEC, and increased dependence of the consumer countries on oil that gave OPEC the means of taking power. In retrospect, one could argue that in any case the price of oil was too low for too long, resulting in the habit of wasteful consumption and hastening the depletion of the worlds resources. But however one looks at it, surely this is the clearest proof that there was no industry cartel.

JOINT VENTURES

Joint ventures, of course, come in for criticism, especially in the area of offshore leasing where Dr. Blair quotes a view that the US offshore leasing programme is "one of the most onerous anticompetitive cartelization devices at work". There is no recognition of the fact that various joint venture groupings, economically necessary because of the vast capital financing required, are often in competition with each other, as in the North Sea. And if joint ventures have such an "inhibiting effect on competition", it is remarkable that the bids put forward at leasing auctions vary so widely. The truth is that US lease sales in particular are powerful evidence of competition.

Again, if the cartel did in fact exist and was able to operate with the tacit support of the US government, how was it that the companies were so unsuccessful in the one attempt they did make at a joint approach, in their confrontation with Libya and Iran in 1971? The result was an inability to stand together, and eventual capitulation which paved the way for OPEC to assume power over pricing. Dr. Blair himself sees this as an apparent flaw in his cartel argument- as did Senator Church's Senate Subcommittee on Multinational Corporations in its later investigations. The only answer he can give is that either their approach was "an incomprehensible blunder" or "an elaborate charade, deliberately designed to divert attention away from policy decisions that had already been made at higher levels" (wherever they were). In other words, the companies were either incredibly inept or extremly clever; Dr. Blair is not sure which but it is hardly evidence of the conspiracy theory.

Coming to the Arab oil embargoes of 1973/74, Dr. Blair concludes there was no real shortage; it was only imposed artificially by the major to cripple the independents and lead to higher prices. He instances the fact that stocks were high and that total production for 1973, as it later transpired, was higher than in the

previous year. It is very tempting to argue from hindsight, but the fact is that the Arabs did curtail their production and neither they nor anyone else knew at the time for how long it would last; it was only prudent that the oil companies maintain adequate stocks, having experienced the volatility of Middle East politics; and for want of inter-government action, the oil companies themselves had to ration out available supplies in order to avoid total chaos in some countries. As it happened, the embargo was not to last long, but no-one knew that at the time. Indeed, it was the action of both governments and independents in making incredibly high bids for oil, fearing even greater shortages, that gave OPEC a lead as to the level at which it would set its own prices.

It is Dr Blair's belief that the OPEC cartel will fall apart when "the moment of truth arrives when demand begins to undergo a serious contraction". Demand did fall in 1974 and 1975, but the collapse did not occur, simply because some OPEC oi-producing countries were quite willing to allow production rates to fall as they increased the price. Dr Blair sees this as evidence of connivance between the countries and the companies, but the real truth is that, even if OPEC did not exist, some individual exporters would be willing to reduce their production and even their revenues because there is an economic advantage in keeping what is a wasting asset in the ground. This is the same argument Dr Blair applies to US domestic reserves. But then he sees one law for the USA and one for the rest of the world- the Middle East should supply cheap oil for energy-profligate American consumers, while the US keeps its higher cost oil in the ground to use when the rest has been depleted. Thankfully, this does not represent official American policy.

The companies, naturally, are accused of abetting OPEC by cutting back production to match market demand. "Had it not been for the cutbacks, the market would have been flooded with 'distressed oil', OPEC indeed would have broken down, and oil prices would have fallen sharply." In order to achieve this situation, Dr. Blair recommends that the majors be broken up so that a host of smaller companies can bid individually for OPEC's oil. Disregarding for the moment whether a case can be made out for divestiture on antitrust grounds, it is extremely doubtful whether this would be the result. It implies a remarkable belief in OPEC's lack of sophistication. Would it not more easily be able to set one vulnerable independent in competition with another, without the (in any case diminished) power of the majors to switch supply sources from one to another? Does Dr. Blair really believe that the exporters, either acting through OPEC or independently, would be willing to market "distressed oil" just because a company sent the "necessary tankers to the Gulf"? And ultimately,

is it desirable that oil prices should collapse, encouraging even more wasteful consumption, postponing the development of alternative energy sources and at the same time increasing the the consumer's dependence on oil?

Concluding the case against the majors, Dr Blair states that they "must clearly bear the responsibility for curtailing supplies to the American private branders"-(whose share of the market has risen substantially)-" for raising prices more than any increase in costs incurred by the OPEC actions" -(seemingly in spite of price restrictions imposed by the government of most consumer nations)-" and forbringing about a curtailment in supply during the subsequent recession sufficient to maintain the price at its new and sharply higher level"-(in fact, a reduction imposed on them, not by OPEC itself acting as a cartel, but by individual exporting countries such as Saudi Arabia, Venezuela and Libya). Unable to find any evidence that the companies connived in the OPEC price explosion and earlier in what he paradoxically calls "evisceration" of the Libyan independents, Dr. Blair condemns them by inference with the remark that their role in these areas "remains obscure".

Having stated the proposition that divestiture is warranted on antitrust grounds, Dr Blair argues against the points raised in Congress last year that resulted in its defeat; that size is inherent in the oil industry but not significant since other industries are even more concentrated; that long-term profits show no evidence whatsoever of any market control; that it would be enormously difficult, costly and disruptive of the economy to break up the majors; and that only inefficiencies would be caused by the loss of economies of scale which in the end would mean much higher prices.

ANTITRUST ACTION SOUGHT

As regards current antitrust laws and Dr. Blair's contention that the oil industry has been violating these to the extent that they are actionable, he cities US domestic refining as an example. "The failure since the price explosion to construct a single new domestic refinery can be regarded as evidence of collusive restriction of production." This is an excellent illustration, typical of the oil industry's detractors, of total misrepresentation. Setting aside the large expansion projects at existing refineries and the fact that one major new refinery (Marathon's Garyville plant) has recently come on stream, it totally ignores other factors which have held back new projects, such as opposition by environmentalists (largely responsible for delaying the Machias refinery in New England and others) and the federal Govt's own regulations which discourage investments in major new

plant by subsidising the small independent refiner. And what is the economic case for building large new plants anyway when commonsense, now shown in President Carter's energy policy, dictates that oil's share in energy consumption should be reduced? US refineries are already operating at below capacity, while depressed demand in Europe has also led to a large surplus of refining capacity, with the result that refineries are operating at a loss-and it is the smaller marketers who stand to lose most.

Dr. Blair also recommends recourse to existing law as a means of enabling independents to bwy more crude directly from OPEC governments. If the governments refuse, then "relief under existing law might be obtained by a judicial finding that the withholding of foreign crude from independent refiners was the consequence of collusion among the majors". In other words, the majors would be compelled to cut back on their purchases so that OPEC would have to sell more oil to the independents, sufficient apparently to bring down prices. What kind of reaction this would prompt from the OPEC government is anybody's guess. Apart from bringing the law into disrepute, it is extremely doubtful whether Dr Blair's objective of abundant "distressed oil" would be achieved. And it has to be asked whether that is a worthy goal in any case, when the US and other governments are trying to reduce the growth in oil consumption.

Dr Blair himself comes to a final conclusion that measures must be adopted to increase supply and lessen demand-precisely the opposite, in fact, of the likely effect of his earlier recommendations for divestiture and the like. He looks to the development of new technologies and alternative sources of energy but makes little mention of where the vast amount of capital required is to come from, a big enough problem now but one which would be even greater if the companies were broken up.

It is with considerable regret that this journal has felt it necessary to be so critical of Dr Blair's book. We would certainly not disagree with the need for safeguards against restrictive practices. But these safeguards already exist-indeed, the mere threat of antitrust action is a powerful deterrent on its own. The cartel case against the companies just does not stand up. Beyond that, however, our prime concern is with the health of the industry as a whole, not just in the United States but worldwide and including the interests of producers as well as consumers. Only by a just and reasoned approach can the world overcome its energy problems, and these again must be related to broader economic issues in which only governments acting responsibly can give a lead. Even if divestiture did give some benefit to the American consumer-and it is our conviction that it would have the opposite effect-the years of uncertainty and instability caused by such a measure would be felt far beyond the confines of the United States alone.

Source:-Petroleum Economist June 1977.

5.3 STRATEGIC OIL STOCKS GOING UP I

by Andrew Lunsden

The most logical body to decide what stocks of crude oil and products should be held in any given oil importing country would be the oil industry, which has the greatest expertise in avoiding disruptions to supply. This simple view, however, which was accepted in many western nations except in wartime, has now been overtaken by the memory of the Arab oil embargoes of 1973/74, coupled with fears that OPEC may be unwilling or unable to meet the levels of oil demand anticipated for the 1980s. The USA, Japan, and the International Energy Agency have all lately formulated "strategic" levels of oil stocks which they wish to see reached in their countries. The dollar cost will be formidable.

Stocks control is vital to the running of any business and it follows that excessive stocks will add to the eventual price of the relevant goods in the market place-unless the stocks turn out to have been bought remarkably cheaply. There are, indeed, clear signs that the strategic oil stockpiling programmes are going to have a marginally inflationary effect on product prices to the ultimate consumer. How inflationary depends on how the costs of strategic purchasing and storing are going to be apportioned between governments making the rules and companies carrying them out (ie between taxpayer and either oil company margins or oil consumers) or, in the case of the USA, how the government intends to finance the proposed Federal stockpile. It is possible, of course, to view any steps that make the ultimate consumer pay for strategic stockpiles as a useful blow for conservation (via higher pricing), while making taxpayers pay would subsidise the oil consumer, a retrograde step. Making oil industry margins bear the cost would be an artificial distortion of their efforts at conventionally efficient management.

Government intervention in leading consumer nations takes two forms: the setting of minimum levels of stocks to be held by the oil industry, or the formation of government-owned oil stockpiles. The US government is the only one to be proposing the latter method, which has the advantage that it avoids problems about how much government finance should be advanced to private industry for creating new storage and/or buying stocks superfluous to ordinary commercial needs, an especially acute difficulty in Japan. The customary yardstick for reckoning stocks is to divide them by consumption levels, as in the recent agreement between members of the IEA that their national stocks should equal at least 90 days' imports by 1980. (Except in the USA IEA consumption levels and imports levels are near to being one and the same thing.)

As in comparable commodity transactions by other industries, the oil supply departments of major oil companies have to place their buying orders well in advance of predicted upswings in consumption in oilconsuming markets, to allow for the time-lag in transport of crude, refining and distribution of products. Types of crude to be ordered vary also according to seasonal fluctuations in product requirement (eg the upsurge in demand for heating oils in winter). As a commercial operation this is conducted using highly sophisticated forecasting techniques, but fundamentally depends on accumulated historical experience and short-term economic growth (or decline) forecasts. As already noted, the more efficiently this is done by the oil industry overall, the lower the stock financing costs that will be passed on to consumers, and the less risk that particular products will be in short supply.

Government practice of imposing minimum stock-pile levels on the oil industry differs from the ordinary commercial approach in two respects. One, that these minima disregard seasonal ups and downs, setting targets to be held through the year. And two, by using historic consumption levels for setting targets, rather than by forecasting the likely demand in the coming year. Thus, a target of 90 days' stocks to be permanently held within a a given consuming nation means 90 days of consumption in the preceding fiscal or calendar year. It may be taken for granted that if the oil industry foresees a sharp rise in demand, it will order extra volumes of crude even if this means greatly exceeding the target laid down by government. It is in the reverse case, if the industry foresees a slump in demand, that the statutory requirement to keep stocks up to government target levels could lead to commercially uneconomic stock levels, with consequent disputes about who should pay the cost.

Broadly speaking the largest expenditures on oil stocks over & above what was formerly considered commercially necessary are going to arise in Japan and the USA. Japanese officials have put a price tag of US $7 billion on the cost of raising oil stocks from 45 days' supply to 90 days' by 1980(further details will be given in the concluding article in later issue). A similar figure has been put on the cost of creating a 500 million barrel Federal-owned strategic reserve in the USA should this programme be by fully carried out. Expenses include estimated costs of crude, capital costs of creating storage (conventionally above ground or - as in the USA - in underground caverns), and running costs.

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It is generally reckoned that storage tanks at a terminal should be adequate to hold between five and then days of the normal rated throughput of the site. Just how much storage capacity is built, and how full the capacity is at any given time, depends on the size and frequency of vessels arriving(making allowance for weather delays), and the consistency of crude deliveries to the terminal. It follows that the stocks which oil terminals are capable of holding soared during the postwar boom in western oil consumption and imports, and especially in response to increases in the size of individual tankers. At one time 20-25,000 ton storage tanks were considred a normal maximum, but tanks of up to 100 000 tons capacity had to be constructed in response to VLCCs. Computer-aided logistics attempt to coordinate the rates at which crude is delivered with the rates at which it can be taken on to refineries, but periodic logjams must be taken for granted (for example, when extra volumes are required in anticipation of a possible OPEC price rise).

At refineries, the usual average for crude stocks is 20 days' supply, eg a 400 000 barrels a day refinery throughput would require some 1.3 million cubic metres of storage capacity for crude, and at least as much tankage again to hold perhaps a month's output of finished products. Further stocks are also held at depots along with distribution network.

The above are the operational stocks, added up and expressed in terms of numbers of days consumption or net imports, that governments being with when making their strategic calculations. It should be emphasised, however, that no oil importing nation could afford wholly to exhaust stocks in attempting to sit out an embargo (a reduction in real ability to resist), while on the other hand in an emergency governments will forcibly curtail energy consumption(an increase in the real effectiveness of oil stocks). Left out of government stipulations about the levels at which stocks should be maintained in any given year are huge volumes in transit, including the crudes or products that represent pipeline fill, and oil at sea, mainly crude moving from the Middle East to consuming cnetres. The first of these categories (pipeline fill, to which may be added oil that is permanently lost to the consumer through being retained in the refining process-so-called "dead" stocks or "unpumpables") adds nothing either to operational or strategic stocks. But supplies of oil actually at sea are integral to the industry's calculations of its supply position, and provide strategic resistance to any sudden stoppage in oil exports from producer states.

Pipeline fill and "dead" stocks represent a significant financial investment by the oil industry, but are retrievable for consumer purposes only as the final stage

before total shutdown of the whole oil supply process. The last official statistic on US crude pipeline fill was for September 1973 (the last month before the Arab oil embargo of that year), estimating that 57.1 million barrels were "locked up" in pipelines. We estimate that the main free world crude and product pipelines (excluding spur lines) may have had a fill of some 110 million barrels in 1974 (equal to three days of OPEC crude output) with another 47 million barrels of crude and 4 million of products due to be needed for filling major pipelines under construction of planned.

TABLE:
WORLD: ESTIMATED MAIN SEABORNE OIL MOVEMENTS a)

Million barrels daily

To	From Middle East	From Africa	From elsewhere	Total trade
W.Europe	11.02	2.92	1.24	15.18
North America	1.40	1.04	3.74	6.18
Japan	3.88	.20	1.16	5.24
Others	3.96	.88	.56	5.40
Total daily	20.26	5.04	6.70	32.00

a)Estimates are for 1974, when world crude production was some 2½ per cent lower than in 1976, and before the US started raising its imports of Middle Eastern and African crudes. Included in totals are imports into North America via transshipment terminals.

Volumes of oil at sea are far greater, of course. Our accompanying table gives an estimate that some 32 million barrels of oil, mainly crude, set sail every (average notional) day in 1974, when world oil production was only fractionally below last year's levels. One estimate is that at 1st January 1977 total seaborne crude may have been of the order of 850 million barrels, to which might be added a further 50 million barrels or so of coastal trade and seaborne products. A rule of thumb is that at any given time some 30 days of curde oil production is at sea.

Source:- Petroleum Economist June 1977.

5.3 POLICIES ON STRATEGIC OIL STOCKS II

by Andrew Lumsden

Intervention by governments in the levels of crude oil and products stocks held by the oil industry is not in itself new, but the current proposed scale of intervention certainly is. The EEC set a precedent some years ago of multinational co-operation in agreeing minimum oil stocks objectives, and now the International Energy Agency, comprising nineteen industrialised oil-importing member states, has also agreed that members' oilstocks should equal 70 days net oil imports, rising to 90 days by 1980. Two prominent IEA members, the USA and Japan, have set objectives well in excess of this agreement.

As described in the previous article, the usual measurement of oil stocks is crude oil and products held onshore within a given nation's territorial boundaries (though stocks at a transshipment station on someone else's territory might be an exception), expressed as equal to so many days national consumption - or imports- of oil. Left out of account when we refer below to the various governmental stipulations about oil stocks are supplies of oil still at sea. These are generally under the control of the major international oil companies and it is understood that in an emergency they would be allocated to different consuming centres according to the degree of urgency (in the case of IEA members under the rules now being formulated).

EEC's INITIATIVE

Even before the 1973/74 Arab oil embargo (the fear of a renewal of which, as also of a general shortage of crude supplies a decade from now, underlies current government action on oil stocks) the EEC members had agreed that as from 1975 each country's oil stocks should equal 90 days inland sales of oil for energy purposes. This target was achieved by most members on time, and by all in due course. Physically, considerable use is made of underground storage (see Petroleum Economist, July 1972, for the technical factors involved). West Germany, for example, held 9.5 million tons of crude and products underground at end - 1976, mostly in leached out salt domes.

The EEC agreement on oil stocks, in fact, only regularised a variety of stipulations about oil stocks levels that were already in force in individual member countries. Thus West Germany had legislated as early as 1965, requiring that oil companies hold continuously

by the oil industry, almost entirely above ground (apart from some minor military underground stock-piling). The Japanese government is now in the middle of a second-stage plan to raise stocks to the 90-day level by 1980 and 120 days supply sometime thereafter is proposed in the latest draft energy plan. Under a Petroleum Stockpile Law of 1975 officials each year revise projections of the actual volumes of oil that will have to be imported and stored to meet the target. Under the most recent regulations volumes of oil held continuously as stocks in Japan are to rise from 268 million barrels in March 1975 (60 days) to 433 million barrels in March 1980 (predicted to equal 90 days inland products consumption by that date). New tanks with a capacity of some 200 million barrels, it is estimated, will have to be constructed over 1975-80 (with a tank capacity utilisation of 80 per cent). Overall cost of the two stages (1973-5 and 1975-80), including spending on land and storage facilities and on additional crude oil, is put at $6500 million, and it has also been estimated that if passed straight to the consumer the running costs of the "strategic" element in Japanese oil stocks (some 45 days supplies)could and 60 cents a barrel.

The most noteworthy aspects of Japan's effort to raise the volumes of oil normally held in stock are the particular difficulty of finding land space for storage, and the clearcut attitude of the loss-making Japenese-owned refining industry as to who should bear the cost. Meeting the stocks targets for 1980 could involve constructing as many as 329 tank units,each with a capacity of some 630 000 barrels, on 4 100 acres. (Each unit is expected to cost at least $8.7 million including the cost of the land, plus the purchase cost of the crude oil). Such are the environmental objections of local communities in Japan that the government has offered subsidies to any community which will allow construction of new oil storage tanks. Meanwhile, Mitsubishi is investigating the*/idea of storage tanks fixed to the seabed. On costs, Kaidanren (the Federation of Economic Organisations) has advised flatly that the government (ultimately the taxpayer) should pay for the difference between the 45 days which the oil industry would have carried anyway, and the 90 days required by government. So far, officials have responded by offering to form jointly-owned stockpile companies with private industry, but have not offered to form wholly government-owned stockpiles. The government is,however, offering low-interest loans to refiners buying"strategic" oil.

The US strategic oil stockpile differs sharply from any of the arrangements yet made in Europe or Japan, and has been described in Petroleum Economist, August 1977, page 302. In essence it is an extension of the other raw material stockpiles that have been maintained by Federal authorities for decades. The oil industry is to be involved to the extent that in an emergency the government would require companies to retrieve the strategic crude oil from its emergency locations and distribute it to refining centres.

*/possibility of a floating offshore storage base, and Govt. departments have been investigating the

stocks of refined products equal to 65 days throughput in the previous year. In France the government controls storage facilities (although the oil industry owns and operates them) and has for many years insisted on 90 days throughput, rising as high as 113 days in 1975. Both in France and Italy additional costs arising from the government's rules about minimum oil stocks levels are included in the ceiling prices permitted for oil products, so effectively shifting stockpiling costs to consumers.

Negotiations are currently going on between the oil industry and officials of the EEC about a clear method of financing the "strategic" element-put at some 30 days supply-in the 90 days target. Community officials have proposed that member countries create non-profit storage organisations to which the oil companies could entrust any part of their strategic holdings of curde or products, financing to be provided pro rata by the companies and recovered from increased product prices. Oil companies have agreed that / organisations need to be created, /non prof: but without financial participation from the private sector; stora they should be financed by a specific "strategic element" tax on all refined products, putting the burden directly on the final user. In short, the private sector is suggesting that the EEC should follow the US example and keep strategic stocks in the public sector.

In Europe, but outside the Nine, Switzerland has for many years required that the equivalent of at least six months petroleum products be kept as stocks. In Sweden, where self-defensive neutrality is also a major preoccupation underground storage is being extended. What is said to be the largest rock chamber storage facility in the world, near Gothenburg refinery, is to contain 7.5 million barrels of crude, as part of a plan to give Sweden total reserves of some 25 million barrels. Crude and products imports in 1976 were about 220 million barrels, implying that the planned reserve may be equal to an extra 40 days combined crude and products imports. In the early '60s the European oil industry's above ground storage capacity was equal to some 40-60 days' supply of crude oil, and some 40-80 days' supply of products. Since about a decade ago there has been a large investment in underground capacity, in France and West Germany as well as Sweden already cited, mainly involving abandoned mines and salt and rock caverns.

JAPAN's TARGETS

Until the 1973 oil crisis Japanese oil stocks generally equalled some 45 days inland products consumption, held as crude oil. This was on purely commercial grounds, but a first-stage government intervention raised volumes to 60 days by 1975. Stocks are held

DOUBTS OVER STRATEGIC VALUE

Taken as a whole, the moves by the USA, Western Europe, and Japan to carry in future far higher oil stocks than had been found commercially desirable in the past cannot be expected, in the view of a special study of oil imports prospects world-wide just published by the International Institute for Strategic Studies*, to "long delay significant losses in employment and production if OPEC or the Arab states were determined to cause them". This view must be correct considering that reactions to an embargo would include emergency energy conservation measures to prolong the resilience given by strategic stocks. Recession would be implicit in any response to such an embargo, as it was in 1973/74. However, stocks adequate for 90 or even 120 days' demand or imports substitution(whichever appropriate) at normal levels of demand might, depending on how unified and protracted an OPEC shut-off turned out to be, appreciably cushion the impact when compared with the mere 45 days or so of stocks formerly adequate for commercial stocks purposes, before widespread government intervention began.

Side-effects of the strategic stockpiling programmes include a general consensus that the consumer should meet the cost (though details have by no means all been worked out), and an "artificial" increment to crude oil purchasing by the main importing blocs. Thus the forecast US stockpile purchases along next year are roughly equivalent to the current combined output of Dubai and Qatar. So far, however, there has been no indication that OPEC countries will be unwilling to provide the extra crude at the prevailing market price.

* Oil and Security:Problems and Prospects of Importing Countries. By Edward N. Krapels, formerly of the US Federal Energy Administration. . pp; six tables;five appendices. Published by the International Institute for Strategic Studies.

Source:-Petroleum Economist October 1977.

5.4 CHOICES FOR THE OIL EXPORTING COUNTRIES

by Edith Penrose

(The following article by Professor Edith Penrose- of the School of Oriental and African Studies, University of London, and INSEAD, Fontainebleau, France- is based on a paper delivered by her at the Fourth International Conference of the International Center for Energy and Economic Development, University of Colorado, 17-19 October 1977. Professor Penrose is the author of 'The Large International Firm in Developing Countries: The International Petroleum Industry'.)

I take it as exiomatic that it is not reasonable to ask any group of people deliberately to take actions against their own interest as they see it. I assume that governments, as well as private companies act in their own interests; the positive social justification for a system which permits private companies to dominate economic activity is that the "market"- competition - will enforce a coincidence between the private and public interests. Where it does not do so for any reason, government is expected to intervene and the mere prospect of government intervention is often sufficient constraint on governmentally disapproved actions of business firms.

The common denominator providing the basis for the organization of the activities of multinational corporations, including the international oil companies, is their own overall profitablity and growth. Their horizon is international and although they have to accommodate individual national interests so far as possible, they cannot be governmed by them partly because these interests are often in conflict one with the other. The cross-currents may be numerous and intricate. In the oil industry, the most prominent conflict of national interest has been that between crude oil importing and exporting countries, but the corss-currents are, of course, even more complicated than this. Among consuming countries, some are rich, others are poor; some are important producers in their own rifht, others have no oil; some have other significant sources of energy, others do not. Among exporting countries, some are high cost, some low cost; some have adopted policies more costly to the companies than others; some are politically more acceptable than others. Moreover, some international companies have been more willing to walk the tightrope of conflicting national interests than others, attempting to maintain a genuine political and ideological neutrality; others have openly taken positions which tended to favour the political interests and ideological views of their home governments.

In this ebb and flow of strong and conflicting currents, companies endeavored to conduct the international oil business, but even the most 'non-aligned' company could hardly please everybody and all ended up pleasing none. Precisely because multinational companies cannot proclaim their adherence to the interests of any particular nation, but rather have to seek shelter under the unconvincing proposition that au fond all nations have the same common interest, they are attacked from all sides. One of the chief criticisms of the oil companies in the United States, for example, seems to be that they failed in the 'oil crisis' to serve the United States' national interest and the interest of the American consumers. Outside the United States exactly the opposite charge was made: the companies served United States interests and those of consumers instead of those of the oil exporting countries or of the poorer importing countries. Of course, both propositions may be true- it seems more likely that neither is. But in any case the decisions of the international companies to a large extent determined supply and prices, and these decisions were taken in their own interests. This is not to say that they were necessarily incompatible with the general interest of some "public".

I make these points because I think that it is important to recognize that the shift of control from private corporations to governments is not a shift from market-controlled to politically-controlled (or arbitrary) decision-making, but from one group with particular views of the relevant markets, with their own economic objectives and subject to a particular set of constraints, to another group with different views, objectives and constraints. And I can see no sound reason for the proverbial man from Mars to choose one over the other. In the past the less developed countries of the world have by and large been required to adapt to the requirements of the more developed and stronger. Now, perhaps, it could be the other way around- if for no other reason than that the rich and so-called liberal countries for the most part no longer think that force is an appropriate solution to conflicts of interests with other countries.

Let us now examine the choices facing the oil exporting countries with respect to the supply and price of oil. We shall examine these in the light of the self-interest of these countries, that is to say, their assumed objectives, and in the light of our own appraisal of prevailing constraints on their actions.

The Background

The immediate panic of the industrialized world after the 1973 war was related to prices, but, contrary to widespread predictions, the world adjusted remarkably easily to the sharp jump although, largely due to perverse policies of the great industrialized countries, both inflation and

and unemployment continued to increase. Predictions now are that the world is coming out of its recession, and that inflation is declining but that the situation is still extremely precarious. Partly because of this very uncertain balance, the industrial world still fears further increases in oil prices. The other issue of concern, and in the long run the most important, relates to the supply of oil. Prices and supply are traditionally considered as two sides of the same coin. But the assumed 'normal' economic relationship between the two is complicated in the oil industry by the interventions of governments.

As in competitive markets, the price of oil is set by collective action; but the action is taken by OPEC, and not by competitive producers in the market. Individual member countries adjust their output to what they can sell at the prices decided upon. Since oil is not a homogeneous commodity and OPEC does not attempt to determine in detail the relative prices of different types of oil but only a price for a 'reference' crude, individual countries make their own price decisions for their own crude in the light of market reactions and their own situations. Since each country sees clearly the relationship between its prices and its sales, any country desiring to increase its sales can easily (and indeed on occasion some do) evade the OPEC guidelines. Many observers have predicated a fall in oil prices as a result of this type of competition. But it has never proved serious, partly because most countries perceive a grave danger to all, including themselves in price competition, but perhaps primarily because the only countries that believe that they have enough oil significantly to affect the market have little incentive to indulge in such competition.*

Thus, output decisions are made by individual countries within a framework of prices related to a standard price set by OPEC. Only the Saudies have looked on their own output as an instrument for affecting market prices, and this not to push prices up but rather to keep them down in what they believed was the interest of all and in accordance with OPEC's "agreement to disagree".

THE ROLE OF EXPECTA-TIONS

OPEC decisions, the policies of the individual exporting and importing countries, and of the international oil companies, are all governed by expectations, which in general seem to be destabilizing influences in the oil

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* For this reason, OPEC has not much cause to fear the usual threat to the survival of cartels which arises from the fact that each member, though realizing the advantages of the cartel for himself as well as for others, nevertheless feels he cannot take the risk of being left out on a high-priced limb if the others in fact surreptitiously capture his markets through price cuts. It was this reaction, of course, that Professor Adelman was relying on in putting forth his proposal that sealed bids to supply the United States market should be required.

industry. In the first place, there is ahigh degree of uncertainty with respect tofsupply conditions. Estimates of reserves are of necessity rough and change frequently and quickly, whether they be estimates of proved reserves, probable reserves or oil in place. In other words nobody knows much about production capacity except in the short term. In addition, there is a tenuous relation between exploration and the production of reserves, and often a long lead time between the decision to explore and the results. In consequence, the confirmation or disconfirmation of expectations may be long in coming, and the decisions of all connected with the industry may for a long time be based on inappropriate expectations- and be very wrong. Because expectations are contagious and confirmation often difficult, they can often be manipulated by governments or companies to serve their special interests. Expectations, like speculation, are stabilizing only if they are on balance correct, and are quickly corrected if wrong.

Prevailing expectations today are that scarcity is looming just over the horizon and that oil supplies will be increasingly concentrated in the Middle East. On this view the 1973 price rise merely anticipated the market by a few years, which, in view of the lead times, was fortunate. Some are predicting that very soon the oil exporting countries will not have to concern themselves with prices, for the market will be pushing them up even higher as the underlying scarcity makes itself felt. Yet only seven years ago the prevailing expectation was for surplus supplies well into the next century. This view changed within less than one year. In other words, the informed evaluation of the 'real'situation changed virtually overnight. Butof course underlying conditions could not have changed so quickly- especially since there was not a great change in the long-run rate of increase of demand.

With these expectations, market pressures and government policies should have led importing countries to use oil as efficiently as possible (conservation) and to develop substitute sources of energy, and exporting countries to conserve their own supplies in the expectation of higher prices in the future, for ceteris paribus such expectations reduce the optimum rate of depletion. But, as we all know, the importing countries are resisting conservation measures and are developing substitutes only slowly, while at the same time exhorting the exporting countries to validate this resistance by holding steady or reducing prices and by refraining from controls on production- an exhortation so far heeded by them with remarkable patience.

POLICIES OF THE IMPORTING COUNTRIES

The problem for the importing countries, of course lies in the nature of demand. The deamd for oil is

apparently inelastic with respect to price and also inelastic with respect to exhortation. But there is a greater elasticity with respect to income. Hence the recession in economic activity has reduced demand, but a variety of attempts to reduce it through conscious conservation measures, such as a rapid move towards smaller automobiles, much slower speeds of travel, less wasteful lighting, heating and air conditioning of buildings, industrial shifts to coal, etc. meet much resistance from both the industrial community and the general public. This is reflected in the unwillingness of politicians to accept government proposals to enforce conservation measures of this kind. The price inelasticity of the demand for oil meant that the change in the terms of trade with the oil exporting countries as a result of price rises did not lead to a fall in total payments to them, but rather to a rise, and this necessitated a much larger transfer of income putting the burden of adjustment on income movements.

To avoid aggravating already existing inflationary pressures the government of the major oil importing countries would have had to enforce a fall in real income commensurate with the change in the terms of trade by permitting a rise in the price of oil and other products affected by it without a corresponding rise in money income. Instead, they permitted a rise in money income, and the unavoidable adjustment in real incomes had to be made through inflation of the general price level. Of course, given the great importance of oil in economic life, a change in its relative price as large and abrupt as in fact took place would have placed severe strains even on a system where relative prices were highly flexible, in spite of the fact that the required income adjustment was not very great over all.

But prices in the great industrial countries are not highly flexible, especially money wages and salaries, and it is largely because the governments of the major industrialized countries pursued perverse economic policies when faced with the rise in the price of oil that the increase in price did aggravate significantly world recession and inflation.

If current expectations are correct; if existing prices are not leading to conservation in consumption; if they are not producing sufficiently rapid substitution on the supply side either because they are not high enough to encourage it; or because business is not permitted to make the profits it requires to invest(in part perhaps because horizons are short due to uncertainty which recession and inflation do little to reduce) or becuase ofpublic resistance to certain forms of substitution (e.g. nuclear energy); then why should not prices be further raised by the oil exporting countries?

EXPORTING COUNTRIES:ABSORPTIVE CAPACITY AND DEPLETION

Let us first examine this question from the point of view of the long-term interest of OPEC countries in the sale of oil. In this respect, the broad problem for the producers is simply to estimate the price which would lead to a rate of substitution in importing countries of other things for oil (whether these be other sources of energy, new sources of oil in consuming countries, insulation materials, including warmer clothing, or whatever)consistent with the desired flow of revenues over time which their reserves can sustain after allowing for their own consumption requirements. Oil revenues can only be used to import foreign goods and services or to acquire foreign assets, and it is not true that in all circumstances present revenues are to be preferred to future revenues, especially if the expected rate of increase in oil prices exceeds the expected rate of interest. Thus oil in the ground may be preferable to the foreign assets which have to be held if the rate of receipt of oil revenues exceeds the desired rate of consumption of imports plus the rate at which the economy can transform imported resources into productive investments. Moreover, the increased investment abroad gives rise to a return flow of income which further reduces the need for oil revenues.*

This is, of course, the notorious 'absorptive capacity' problem; by now many of the oil exporters themselves, and especially those with the largest reserves and output and therefore those most important to the consuming countries, are becoming concerned about the rate at which they have been attempting to spend their revenues. Even straightforward consumption creates a problem because of import bottlenecks and pressure on non-importables. Less speed could bring faster progress.

Thus, the fear-indeed the knowledge-that much is now not only wasted but that the rate of expenditure is positively inimicable to development, has focussed attention even more strongly on the rate of depletion; existing policies seem to involve the oil exporting countries in unnecessary depletion of their exhaustible resources, especially since the inelasticity of demand implies that prices, and thus revenues, could be increased with little effect on the rate of output in the short to medium term. On the other hand, if the governments of the oil exporting countries want to give more aid to help the less developed countries meet their oil bills, they could raise the money from the rich oil importing countries at little cost of themselves. Greatly increased help to the former would undoubtedly bring political gains, for an increase in the price of oil would certainly create much resentment among the poorer countries. Aid in the form of financial assistance in the construction of plants to provide new sources of energy, such as hydroelectric, nuclear or even solar facilities, depending on the circumstances of each of the different countries, might be especially welcome.

*In 1976 Saudi Arabian foreign assets as reported by the IMF, had already reached nearly $ 50,000 million, yielding nearly $4,000 million in income.

It is not clear that increased prices would significantly increase the rate of substitution, as we have noted. Indeed, so far as there is any increase in total consumption because of lower prices, be it through the direct effects of price elasticity or the indirect effects of income elasticity, the resulting increased dependence of the major importing industrial countries on oil imports from the Middle East and Africa might push their governments to even greater efforts to bring about faster substitution. For a commodity as important as oil, the political force arising from a fear of heavy dependence on foreigners seems to be more powerful than is the economic force of higher prices, particularly in the United States. Hence, for the exporting countries a lower price might bring a more rapid rate of depletion and an earlier increase in the rate of substitution than would have occured at higher prices. The question is at least arguable, but the possibility reinforces the demand of those exporting countries with relatively limited reserves, such as Algeria, that prices should be increased.

In addition to a natural antipathy to selling exhaustible resources at falling real prices, the exporting countries are under pressure from their own peoples whose expectation of rapidly increasing incomes are aroused by the knowledge of increasing oil revenues. Thus, even if the [illegible] rate of /existing government expenditure is excessively high, any significant decceleration in the existing momentum might give rise to other problems for the governments, as all countries attempting to stem a high rate of inflation have discovered; this also increases pressure to maintain revenues-at least in real terms in relation to import costs. Since it is probable that crude oil prices can be raised still further in real terms, yielding increased venenues to the exporting countries and perhaps some reduction in the rate of depletion, while not producing an unacceptable rate of substitution for even the countries with the largest reserves, it would seem that the producing countries should raise them.* They should proceed cautiously, however, for no one knows how far prices can be raised without precipitating further international economic disorder.

EXPORTING COUNTRIES:PRICES

The arguments against an increase in prices by the exporting countries are of four general kinds;

1.The government of the major importing countries could retaliate politically, and in particular they might use force to ensure their supplies at the prices they prefer.

*It is also likely that increased prices would actually reduce the temptation to cut prices on the part of those countries whose need for greater revenues is most strongly felt.

2. If an increase in prices serves to worsen the economic difficulties of the industrialized capitalist world, aggravating recession and inflation, the producing countries would gain little since they have to hold their surplus revenues in the assets of these countries on the one hand, and on the other, they have to rely on imports from these countries for their own investment progrems and for consumption. Further inflation in the price of supplies, therefore would aggravate their own difficulties.

3. Increased economic instability in the capitalist world might intensify world political instability and lead to political changes undesired by the major oil exporters.

4. The poor importing countries of the world would be placed in an even more serious economic position that they are now; not only would their further economic development be slowed down or halted but shortages of food and other necessities of life might be aggravated.

Except for the possibility that attempts to subvert particular governments might be made by some powerful foreign groups, the first of these propositions need not, I think, be taken very seriously. The second is probably a valid consideration for the oil exporting countries, but for reasons somewhat different from those usually advanced. It is undoubtedly already one of the factors inducing caution. Moreover, if an increase in the price of oil should bring economic disorder it would also bring the danger of political instability to the industrial world if governments remained unable to take appropriate action. Finally, there is no doubt that poor countries have suffered, are suffering, and would suffer much more if the price of oil were raised.

We have already noted that the increased price of oil would not have had a particularly disastrous effect in the past on the industrialized world had it not been for the perverse economic policies adopted by governments; we saw that this perversity continues in that the sensible response to prevailing expectations of impending scarcity, such as a marked acceleration of conservation and search for alternatives, does not seem to be occurring.* There is no reason to doubt the sincerity of Shaikh Yamani's frequently reiterated plea to the consuming countries to take such measures in order to relieve the 'burden' on the oil exporters. In appealing to the exporting countries to hold their prices, the governments of the importing countries are, in effect, appealing for an understanding of their own <u>political</u> difficulties in persuading their people, the richest in the world, to accept the inconveniences. What then is the answer to the exporters' question: "Why should we deplete our resources and give up income to help your political problems?" The answer, clearly, is: "If you do not, you too will suffer from continued and deepen-ing

international economic disorder." But since the evidence so far is that appropriate short-term adjustments in financial flows can be made more easily than is often assumed, this argument merely counsels moderation. It does not support the proposition that the real price of oil should not be raised to some extent. It does seem to me that the -moderation of the oil exporting countries, and in particular Saudi Arabia, is more convincingly explained with reference to an understanding of the political difficulties of the United States and other importing countries which might force them to pursue policies in response to increased prices that would lead the world into even deeper trouble, than it is by any conspiracy theories or assumed 'special relationship' of the Saudis with the United States at the expense of their OPEC colleagues. Such understanding is reasonable within limits but it can only carry a certain amount of strain.

The Shah, and also Shaikh Yamani, have suggested, however, that the question whether or not OPEC should raise prices is a passing one because increasing demand will soon press even more strongly against dwindling supplies giving rise to market pressures for higher prices: the OPEC countries will soon be relieved of any necessary to act. If this occurs it is likely to be reinforced by the oil exporting countries themselves as they adopt conservation policies which place limits on the rate of production. Just as the United States Government for years argued that its pro-rationing policy, which restricted domestic supply, had nothing to do with maintaining prices, so the oil exporting countries today are likely to argue that their reasonable measures to make oil last longer are not price-raising devices. On the contrary, it will be asserted that demand and 'the market' force prices up. The market price can be held up as the 'right' price, the fair' price, simply because it is the market price. This, of course, will be economic nonsense if there are deliberate controls on supply, but it will make much political sense. Political critisism of 'conservation' policies is more easily answered than are attacks on 'cartels and price fixing', and the general public, at least in North America, is easily conned by arguments appealing to 'free enterprise' and 'free markets'. Furthermore, with no visible cartel agreement, the expectation that 'scarcity rules' will soon be accepted as confirmed.

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*High standards of living in the industrialized countries seem to be very closely associated with waste in the physical though not necessarily in the economic, sense. 'Convenience' or effort-saving devices are part of the definition of 'welfare' as interpreted by peoples as they get richer. These often involve substitution of physical resources, including exhaustible resources, for even the slightest exertion of human effort in consumption as well as production.

As to the Third World, an increase in prices will increase the funds that can be used for aid. Hopes that oil funds could be used to help some of the poor countries to establish effective price-raising arrangements for their own exports are no longer widespread. There is no question that the poor countries will suffer when the price of oil goes up again and the moral case for further aid from the oil exporting countries grows stronger every time the price of oil increases, but moral cases are notoriously ineffective as means of inducing governments to do the right thing unless they are supported by self-interest. The poor countries of the world have been, and continue to be, a kind of international political constituency for the OPEC countries; generous financial support for them may be a necessary condition of their continued political support. By and large the countries of the Third World have tended to identify themselves with the OPEC countries because both groups of countries are engaged on the same task: industrialization, diversification and general development of their economies in the hopes of reaching the levels of the rich countries. It would be wise of the OPEC countries to encourage this type of identification.

CONCLUSION

My argument can be briefly summarized: the oil exporting countries should not be condemned for acting in their own interest. It would be in their interest to increasethe real price of oil. The rate of substitution would probably not accelerate greatly in response to moderate increases since it is more influenced by political than by economic factors, at least in the medium term, and a moderate decline in the rate of depletion may be desirable. Any price increase, however, may be best brought about by controls on the rate of supply imposed by the largest exporters rather than by explicit increases in real prices by OPEC, for the latter action can too easily be represented as unreasonable monopolistic behavior without justification. Since the demand for oil seems to be highly inelastic even at current prices and very likely at somewhat higher prices, revenues would increase disproportionately to any fall in consumption and a goodly proportion of the increment in vrevenues should be used to ease the burden of the increased prices on the poor countries of the world, partly for humanitarian reasons and partly to prevent a rising tide of criticism from them which would have international political repercussions.

The increase in prices should be less than consensus estimates of what the market would bear becuase it seems politically impossible for the governments of some of the large industrialized importing countries to induce their peoples to accept rapidly enough appropriate economic adjustments in consumption and in the development of other sources of energy. Instead, such governments have been forced, and probably will continue to be forced for some time to come, to adopt domestic economic measures in response to an increase in the price of oil which, instead of assisting their economies to adjust, merely aggravate their economic disorders. More time is needed, and perhaps a higher price of oil, before the major consuming countries are likely to take appropriate and sufficiently effective action. It would be in the interest of the oil exporting countries

to recognize these difficulties and to avoid any severe shock to the present precarious economic state of the world economy.

The political implications are also clear: the Arab oil exporting countries have their own political objectives with respect to the conflict with Israel. If the countries of the industrialized world, and specifically the United States, expect the Arabs to take account of their economic and political difficulties, they will have to go further than they have so far done to meet the Arab insistence on a Middle East settlement that takes account of the needs of the Palestinian people for their own 'national home'.

Finally, I must repeat: this analysis assumes the validity of the expectation that oil supplies will become scarcer in relation to demand by the turn of the century and that new discoveries and newly created reserves will not return the world to continuing long-term surpluses of crude oil. The expectation may be unfounded. If it is, and I am right about the political nature of the incentives encouraging conservation, the case for increasing oil prices now is even stronger from the point of view of the oil exporting countries.

Source:-Middle East Economic Survey, January 16, 1978.

5.5 OPEC-REVENUES AND BALANCES

BY E Stanley Tucker

The oil revenues of the 13 OPEC governments rose last year by one-tenth to a combined total of over $128 billion (thousand million). Since their exports of crude oil and products were only fractionally higher than in 1976, the principal reason for the rise in their incomes was the higher level of prices.

By comparison with 1976, when the gain in revenues was 22½ per cent, last year's increase of 10½ per cent looks comparatively modest. But that means a gain of no less than $12 billion, and it is significant that oil revenues have now reached a level almost nine times that of 1972, the last complete year before the dictated price increase of 1973-74.

The latest revenue estimates have been compiled by Shell International from the best available information. Revenues include royalties and income tax obligations in respect of equity crude, the proceeds of buy-back sales under participation agreements, and third-party sales by state oil companies. In general they represent the sums due to governments for the year in question rather than the cash actually received. (There is a time-lag here because the companies are normally granted a few months credit). But because of discrepancies in published data, complications due to back-payments, and differing credit periods, the estimates must be regarded as approximations only; they are therefore given in rounded form.

DEMAND AND PRICES

OPEC oil incomes clearly depend in the main on the size of their exports and the level of prices. It is common knowledge that world consumption of oil has been far from buoyant in recent years, largely because of the disappointing rate of economic growth in the principal industrialised countries. Last year's consumption increase was less than 4 per cent, or about half what it was a few years ago. And the

OPEC: OIL PRODUCTION, EXPORTS AND REVENUES

	Production (Million barrels/day)				Exports a) Million Barrels/day			
	1974	1975	1976	1977	1974	1975	1976	1977
Saudi Arabia b)	8.5	7.1	8.6	9.2	8.5	7.1	8.3	8.8
Iran	6.0	5.4	5.9	5.7	5.7	5.0	5.4	5.2
Iraq	2.0	2.3	2.3	2.3	1.8	2.1	2.1	2.1
Kuwait b)	2.5	2.1	2.1	2.0	2.4	2.0	2.1	1.9
U.A.E.c)	1.7	1.7	1.9	2.0	1.7	1.4	1.8	1.9
Qatar	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4
Libya	1.5	1.5	1.9	2.1	1.5	1.4	1.8	2.0
Nigeria	2.3	1.8	2.1	2.1	2.2	1.7	2.0	2.0

Algeria	1.0	1.0	1.1	1.1	0.9	0.9	1.0	1.1
Venezuela	3.0	2.3	2.3	2.2	2.8	2.1	2.2	2.0
Indonesia	1.4	1.3	1.5	1.7	1.2	1.1	1.2	1.4
Gabon	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Ecuador	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.1
Total OPEC	30.7	27.2	30.6	31.2	29.6	25.5	28.8	29.1

	Revenues Million dollars				% increase	
	1972	1975	1976	1977	1976-77	1972-77
Saudi Arabia b)	3107	25700	33500	37800	12.8	1220
Iran	2380	18500	22000	23000	4.5	870
Iraq	575	7500	8500	9600	12.9	1570
Kuwait b)	1657	7500	8500	8500	-	410
U.A.E. c)	551	6000	7000	8300	18.6	1410
Qatar	255	1700	2000	1900	-5.0	645
Libya	1598	5100	7500	9400	25.3	490
Nigeria	1174	6600	8500	9400	10.6	700
Algeria	700	3400	4500	5600	24.4	700
Venezuela	1948	7500	8000	8000	-	310
Indonesia	429	3850	4500	5600	24.4	1205
Gabon	-	800	800	800	-	-
Ecuador	-	550	800	500	-37.5	-
Total OPEC	14374	94700	116100	128400	10.6	790

a) Including products where applicable.
b) Including half of the Neutral Zone.
c) Abu Dhabi, Dubai and Sharjah.

effect of this laggard growth of OPEC oil exports has been exacerbated by the development of new sources of crude - mainly in the North Sea, Alaska and Mexico. So OPEC exports of crude and products rose only 1 per cent, to 29.1 million barrels/day in 1977, as compared with a jump of 13 per cent in the preceding year. They failed in fact to regain the peak rate of 29.6 million b/d attained in 1974.

Over these last three years Venezuelan exports have shown a decline of 800 000 b/d below the 1974 rate, while those of Iran and Kuwait have each lost about 500 000 b/d. Nigerian sales are also slightly down on balance. Libya, Saudi Arabia, Iraq, the United Arab Emirates (UAE), Algeria and Indonesia all registered a modest net gain over this period.

So far as crude oil prices are concerned, the majority of the exporting countries raised their official selling prices by 10 per cent at the beginning of 1977, while Saudi Arabia and the UAE advanced theirs by only 5 per cent. In mid-year the minority came into line with the majority; thus the increased cost of crude oil in general over the whole year was under 10 per cent. But the price disparities of the first six months caused a shift in demand towards the cheaper crudes and led to a good deal of price discounting for the dearer crudes on the spot markets.

Thus, although OPEC revenues rose last year by an average of 10½ per cent, there were wide variations in the performance of the different countries. Loss of export business reduced Qatar's earning by 5 per cent and Ecuador's by an estimated 37 per cent. Venezuela and Kuwait, both with slightly reduced exports, showed no significant change in revenues. For Saudi Arabia and the UAE, on the other hand, the effect of relatively lower prices in the first half of the year was offset by better sales, to yield revenue increases of 13 per cent and 18½ per cent respectively. Demand (especially from the USA) for light, sweet crudes remained active for most of the year, so that both Libya and Algeria were able to record revenue increases of the order of 25 per cent; Indonesia was in the same category. Iraq managed to achieve a 13 per cent increase in income with production and exports virtually unchanged.

FIVE-YEAR COMPARISON

The revenues section of our table gives the relevant figures for 1972, to enable a five-year comparison to be made. It shows that total government oil receipts have over this period registered an almost nine-fold expansion (more precisely, a rise of 790 per cent) from just over $14 billion to $128 billion. And since total OPEC oil exports have grown in this period by only about 14 per cent, from 25.5 to 29.1 million b/d, the huge increase in cash flow is almost entirely due to higher revenues per barrel. Back in 1972-it seems hard to believe now- the governments' per-barrel receipts averaged less than $1.50 in the Middle East and Libya; the figure was just over $1.70 in Venezuela and Nearly $1.90 in Algeria and Nigeria. Today, for reasons that are well known, it averages almost $12.10 a barrel for OPEC as a whole.

Further analysis reveals a wide range of individual experience in this eventful period. Leaving aside Iraq, which had exceptionally low revenues in 1972 because of the dispute with IPC, the biggest increase in oil income-by factors of 13 to 15 - is recorded by Saudi Arabia and the UAE with their expanding export trade, and by Indonesia with its new production-sharing arrangements. Roughly average increases, of eight to ten times, were made by Iran, Nigeria and Algeria, while relatively low growth rates are shown by Kuwait and Libya-countries where the need for revenue is less pressing. Lowest growth of all-a roughly four-fold expansion of revenues- is registered /Venezuela, where /by crude oil reserves are limited and production is in gradual decline.

The general upsurge of oil revenues has, of course enabled the OPEC countries to import rapidly growing quantities of goods and services to nourish the economic development of their countries. Naturally, the industrialised countries have been the main beneficiaries of this appetite for imports- which has, indeed, made it

possible for the latter countries to pay for their needed oil imports. Figures redently issued by the US Treasury Department show that, of the 16 nations mainly responsible for supplying OPEC's manufactured imports, the USA had a share of 22 per cent last year, compared with 24.8 per cent in 1970-72. Over this*/West Germany's from 13.1 to 16.7 per cent. Conversely, Britain's share declined from 12.3 to 10.2 per cent and France's from 12.4 to 9.7 per cent. For Italy, the proportion rose from 7.9 to 9.1 per cent, while the remaining 10 countries supplied 15 per cent of the total in 1970-72 and 14.2 per cent last year.

However, in their national finances, as in other respects, the members of the OPEC group show wide diversity. A few- Saudi Arabia, Kuwait and the UAE - are still unable to spend all they earn whereas others supplement their rising incomes by borrowing on the international capital markets. According to the Bank for International Settlements the OPEC countries as a whole borrowed $ 11.3 billion from international banks during 1977 and deposited $ 13.4 billion. The position, however, seems to have been in transition last year, since the figures for the last quarter suggest that aggregate borrowing by the OPEC group exceeded the total of their deposits with the banking system.

The unspent balances of OPEC revenues, which have constituted a widely advertised threat to the world's financial stability, have been declining as the growth of imports has outpaced the increasing flow of petrodollars. There is some disagreement about the precise magnitude of these surpluses. The Bank of England estimates that the total fell from about $56.4 billion in 1974 to $35.8 billion in 1976 and further to $33.0 billion last year. The Morgan Guaranty Trust, while agreeing about the downtrend, puts the 1976 and 1977 totals rather higher, at $38 and $35 billion respectively. In view of the present prospect of oil price stability and continued slow economic growth, together with a continued rise in the cost of OPEC imports, Morgan estimates that the aggregate surplus will be down to about $25 billion this year.

As regard the development of these financial surpluses, the Bank of England calculates that about $8.9 billion was invested in the USA last year--considerably less than the 1976 figure of $12 billion-and about $4.1 billion in the UK. Investments in other countries amounted to $19.7 billion, against $17.3 billion in the previous year, while $0.3 billiln was placed with international organisations, compared with $2.0 billion in 1976.

Source:-Petroleum Economist July 1978.

*/period, Japan's share rose from 14.5 to 18.1 per cent and

5.6 INTERDEPENDENCE BETWEEN EUROPE AND OPEC COUNTRIES THE NEED FOR A NEW RELATIONSHIP

By
Ali M. Jaidah
Secretary General of the
Organisation of the Petroleum Exporting Countries(OPEC)

(The following is the text of a lecture delivered by Mr Ali Jaidah, the Secretary General of OPEC, to the Friedrich-Ebert-Stiftung at Bad Godesberg, West Germany, on 22nd September 1977.)

In all of the present discussions on "interdependence" between the Member Countries of OPEC and the industrialized nations of Western Europe, one might be forgiven for thinking that this must be something new. In fact, however, the ties which bind our two groups of countries are very old, going back far beyond the relatively recent growth of trade, including oil.

The impact of this relationship is evident in many aspects of life in our countries. Even the past colonial relationship could now be turned to some positive aspects. Old ties mean a better knowledge and understanding. In this sense, we expect European countries to be in a better position to understand the needs and aspirations of our countries.

Since the Second World War, the painful process of /the Third World, including our OPEC Member Countries, /decoloni has been practically completed. We are now entering zation o an era which needs, not so much struggle and strife, but cooperation and interdependence. It is my sincere hope that we will all accept change as a desirable process; otherwise, change will come abruptly on us with shattering consequences to all mankind. Europe cannot wish away the existence of its poorer neighbours. Nor can it wish away change. A new relationship is evolving and we can help it evolve smoothly, because that is the only way to avoid disaster for all of us.

Perhaps the best opportunity to build a new relationship is arising now between Europe and OPEC countries.

OPEC Member Countries are part of the developing world. They have all the problems and aspirations of all developing countries; and like all developing countries they look to the industrialized and developed nations, of which Western Europe is a foremost and very

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important part, for many of the ingredients of their future development and progress. Indeed, by virtue of the historical connections mentioned earlier, it is to Western Europe, more than elsewhere, that we look for economic cooperation, educational training, manpower development, technological transfers and social improvement.

What I am trying to say is that it would be wrong to think of our relationship only in terms of oil and energy supplies. However, important as they are, oil and energy are only one of the items of trade between our two groups of countries (see Table). OPEC Member Countries import substantial quantities of manufactured goods, machinery and equipment from Western Europe and these are rising steadily: during the six years from 1969 to 1975, for example, OPEC imports from Europe went up more than seven-fold; whilst, on the basis of estimates of OPEC imports fromEurope for 1976, the increase since the end of the sixties is almost nine-fold.

OPEC Countries imported goods worth less than US$ 4 billion from Europe in 1969. Now, their import bill is approaching US$ 40 billion. If we add other expenditures related to various services, consultancy work, tourism, etc., the figure might be even more striking in magnitude. In 1975, imports of OPEC Countries from Europe were more than half of total OPEC imports. Germany is taking the leading place among the countries of Europe in selling to OPEC Countries. It is surpassed only by the USA (22%) and Japan (16%)*.

Oil accounts for nearly all the value of OPEC exports to Europe, reaching 99.9% of total exports in some cases. Traditionally, the value of those exports is much higher than expenditure on imports from Europe. In 1969, OPEC exports to Europe were about US$ 7.6 billion, while imports from Europe were nearly half as much. The percentage of revenue from oil sales spent on imports from Europe deteriorated during the early seventies. But during 1975, when Europe's oil bill to OPEC was about US $ 43.8 billion, OPEC Countries spent about 65% of that revenue on commodities bought in Europe. If services and travel are taken into the balance, a smaller deficit in the trade between Europe and OPEC would remain. This trend is expected to continue with the increasing needs of OPEC Countries, especially in development projects. Europe's increasing involvement in our

*According to figures relased by the West German Economics Institute during July 1977.

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development efforts could well result in wiping out all the deficit in a very short time. German official sources indicate that 1977 might be in balance in the light of substantial increases in exports to OPEC.

Some OPEC Member Countries produce other raw materials, e.g. vegetable oils, minerals and agricultural commodities, for which Western Europe has always been an important market.

But it is to oil that we naturally look for the means with which our Member Countries can diversify their economies. This means that we seek to establish industries, both to provide employment and opportunity for our peoples and to ensure economic stability in the long run. We are only too well aware of the finite nature of our oil resources - and of the inevitable fate which awaits an economy based, more or less, on a single, fast-depleting commodity. Unfortunately, we are continuing the high rate of depletion of our resources without a commensurate influx of technology. This question of speedy development is becoming even more vital to us than prices, since prices are only a means of acquiring purchasing power.

OPEC is engaged in a race with time which it must win. In this context, the 1975 Solemn Declaration states:

> "With regard to the depletable natural resources, as OPEC's petroleum resources are, it is essential that the transfer of technology must be commensurate, in speed and volume, with the rate of their depletion, which is being accelerated for the benefit and growth of the economies of the developed countries."

Now the countries of Western Europe have shown no reluctance in selling technology to us, but the type of technology and terms of transfer require review. Even taking account of inflation, the costs of technology transfer are so high that it is almost beyond the reach of some of our Member Countries. The technology itself seems to be one tailor-made for results that will ensure no competition with the developed countries. Markets for such goods as can be produced are restricted by tariff walls and barriers. This is an area where genuine cooperation between our countries and yours can produce fruitful results. The alternative is resentment and suspicion, and probably hostility - all of which do as much harm to our interests as to yours.

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The first and most natural step in our efforts towards industrialization is to integrate the oil sectors with the rest of our economies and use this sector as an engine of structural change. This means that we have to bring domestic inputs into the efforts of exploration and development, on the one hand, and advance downstream into refining and petrochemicals, on the other. There is little cooperation from developed countries on exploration and production, but there is an alarming unwillingness to cooperate in refining and petrochemicals for export purposes, on a fair and equitable basis. Total OPEC Member Countries' share in world refining capacity is only 6% - i.e. OPEC: 4.60 million b/d of the world's 75 million b/d. We are told that there is already a surplus in refining and petrochemicals plants, but we see that several countries in Europe and elsewhere are building new plants.

There is also unwillingness on the part of developed countries to improve the access of our petroleum and petrochemical products into their markets. The EEC levies tariffs of 5-7% on the main petroleum products. Several countries have quota restrictions as well as tariffs. These restrictions which look small are enough to wipe out any profit our export refineries might hope for. Both in the Paris Conference and in the Arab-European Dialogue, which OPEC Countries naturally consider as stepping stones to greater cooperation, there has been little progress on these issues.

In the field of petrochemicals, as well as in many other industrial processes, the optimal size of a plant is fairly large, capital-intensive and based on advanced technology. We are finding that the capital cost charged by those who monopolize patents is so high that products of such a plant are not competitive. If developed countries do not facilitate access to their markets for products of such costly plants, then losses will be compounded due to under-utilization.

We are also finding that those expensive high-technology packages are bogged down by restrictions on patents. Such patents and related restrictions give rise to technology monopolies which are difficult to penetrate, even at the high price OPEC Countries are paying. When such turn-key packages are bought, they are usually run, directly or indirectly, by the firms who provided the technology. Operational skills, maintenance, spare parts, follow-up and research and development are totally or partially controlled by the

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supplier, thus making the apparent transfer of technology of minimal effect on our general economic progress.

We believe that Europe, having largely overcome the debilitating effects of the recent recession, should now feel itself in the position to make good the promise to carry out meaningful and effective transfer of appropriate technology in a fairer international division of labour.

Our present status as raw material exporters and markets for manufactured goods of OECD countries has to be transformed fast enough to make it worthwhile for us to run down our hydrocarbon resources at current rates. The fear of unemployment, which might be created by real transfer of certain technologies to developing countries, has to be faced squarely by both sides. In the short term, there are problems in which we have proved our readiness to cooperate, such as recycling of liquid assets, balance of payments assistance, price stability, etc. Structural changes involved in this new partnership do create birth pains. But in the long run, we all stand to gain from the increased prosperity which will be generated by increased wealth and exchange, as the example of industrialization in Japan has shown.

Here, it is important to signal a sign of alarm, which I feel must be voiced louidly and clearly. It is a salient part of human history that nations are always on the move; and, as such, there is no room for the status quo, which is, after all, not desired by the developing countries. We should all work for the needed structural changes rather than resist them. Here an effort is needed by both developed and developing countries alike; otherwise, events will catch us unawares.

On our side, we have to reflect upon our strategies regarding supply and prices of oil. In March 1975, the Sovereigns and Heads of State of OPEC Member Countries "reaffirmed their countries' readiness to ensure supplies that will meet the essential requirements of the consuming countries". But this guarantee of security of supply seems to be taken for granted by consuming countries without any real collateral. Perhaps the consuming countries feel that their obligations are terminated by payment of the monetary price of OPEC oil and gas. In this connection, it is my feeling that we should be thinking less in terms of the dollar value of our oil, and more and more in terms of the material commitment by the consumers to our transformation effort. If all we

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get for our oil, when it is exhausted, are bank accounts and a few losing projects, that would be tragic indeed - whether oil prices are "high" or "low". The price of oil ought to be measured by the degree of development and diversification in our economies and the acceptance by the consumers of non-oil exports from our countries. The disappointments we have faced so far with higher monetary prices of oil make us think of non-monetary yardsticks to measure the selling price of oil.

On the part of the consumers, too, and especially those in Europe, we expect some real efforts for change. Security of oil supply can only be real and enduring if consumers succeed in making our economies dependent on them as suppliers for development goods and eventually as markets for our non-oil exports. Interdependence is the only guarantee of real security of supply in both directions. This might need a great effort in a period of high unemployment. But unless we reach a fairer international division of labour, frictions will arise.

In the field of energy cooperation between OPEC and Europe, there are several issues to be resolved. The point to be taken into-account here is the fact that this must be a case of two-way traffic.

Firstly: there is the question of OPEC Countries' domestic requirements, Naturally, our countries are basing some of their development on energy-intensive industries and on industries which use liquid and gaseous hydrocarbons as feedstock. This fact means that we expect high rates for domestic consumption of petroleum products. In the medium term, this means that expectations of net exports from OPEC have to take this into consideration. In the long term, some OPEC Countries have to slow down depletion of their hydrocarbon resources to keep their domestic economies going. For a few countries, with large populations and limited reserves, the long term means importing energy.

It is vital for our present-day consumers to realize that the terms of our energy supplies to them today ought to be matched with reciprocal terms for their supplies to technological energy alternatives in the future, be it nuclear technology or other novel technologies.

Secondly: Planning for future energy needs can only be meaningful if the OPEC area, as the main exporter of petroleum to Europe, USA and Japan, is accepted as a positive partner and not regarded as a

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hostile group which ought to be dismantled. OPEC has survived difficult times in the past. Those who think that the availability of North Sea and Alaskan oil is an opportunity for another go at OPEC are doing themselves, the OECD countries and the whole world a great disservice. The next two or three years will not witness a decline in demand for OPEC oil. The most likely eventuality is that a global shortage will be slightly delayed and some OPEC Countries will be relieved from the pressure to produce at levels higher than their needs warrant. But it would be unfortunate if, during this breathing space, opportunities for better coordination of production and future planning were to be neglected.

Thirdly: In looking at long-term pricing policies, we hope that the main oil importing countries of Europe; as well as the USA and Japan, will rise above the short-sighted desire for cheap oil and accept a more realistic view of energy pricing and allocation. The OPEC oil price adjustments of 1973/74 did not overstate the price of oil. Those adjustments might have been too sudden, but, if anything, they were overdue. What is needed now is a view of prices which is rational and designed to achieve optimal allocation of exhaustible energy resources. To achieve conservation of oil and gas through non-price mechanisms, such as taxes, legal imperatives, quotas, rebates and penalties, does not lead us very far, and it creates distortion in the system. If the reason for all these measures is to keep crude oil prices artificially separated from the real demand level, then the whole system is both unfair and inefficient. The consuming countries should try to put an end to this policy of beating down crude oil prices and beating down demand by non-price mechanisms. In our view, the best mechanism for the rational allocation of oil and gas resources is the price of crude oil.

Fourthly: The main consuming countries of the OECD should accept a degree of responsibility for surplus assets accruing to some OPEC Member Countries as a result of production levels required by the consuming countries themselves. Surplus assets of this kind must at least be made as secure as oil reserves held for posterity. This is the only fair collateral for inducing the countries concerned to sustain production levels needed by the consumers. They should not be penalized for not making supplies conditional on guarantees for surplus assets.

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On the side of the consumers, we recognize the need for stable supplies within a commercial context. There is no problem in meeting these supplies for the next four or five years from existing reserves and already operational or planned capacity. But beyond that period there should be closer cooperation to meet world energy requirements; some careful forward planning is called for. OPEC should not be expected to fill an ever-increasing gap in world energy demand from its presently known reserves. Our own estimates show that existing reserves, plus likely additional reserves, might enable us to reach production levels which are not very much in excess of 40 million b/d. Increasing portions of that production are expected to be consumed internally by OPEC Countries. Even if we maintained such production till the end of the century, exports would be eroded by our internal consumption. Worse still, a decline would set in thereafter, threatening all exports as well as our own needs. An intensive cooperation in the field of exploration for petroleum which still is untapped in our Member Countries, as well as utilizing the existing and potential natural gas will give us a longer breathing space and is definitely more economical than contemplated alternative sources of energy.

Ultimately, and gradually, some of our Member Countries will turn to Europe and elsewhere for energy supplies. Already some OPEC Countries are involved in importing nuclear technology from Europe. Another area of energy cooperation is in the exploitation of solar energy potential of OPEC Countries which happen to have a good supply of sun. European cooperation in providing finance, research and technology could prove to be most rewarding to both sides in view of Europe's proximity to some OPEC Countries with maximum supplies of solar energy.

This two-way traffic needs to be carefully nutured and expanded in an atmosphere of mutual respect and trust. That is the only workable formula for prosperity - if not, indeed, for mankind's very survival.

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Source: Middle East Economic Survey, Vol. XX, No.49, 26 September 1977.

Table

OPEC IMPORTS

(In Billion of US Dollars)

	1969	1970	1971	1972	1973	1974	1975	1976**
EEC	3.7	4.1	4.1	5.9	8.1	13.3	22.5	27.8
Other Europe*	0.2	0.2	0.3	0.5	0.7	1.2	6.0	5.9
Total Europe	3.9	4.3	4.4	6.4	8.8	14.5	28.5	33.7
Total World	8.7	10.0	11.7	14.4	20.4	34.7	55.8	-

OPEC EXPORTS

(In Billion of US Dollars)

	1969	1970	1971	1972	1973	1974	1975	1976
EEC	7.1	8.1	10.4	11.7	17.3	44.4	37.6	42.1
Other Europe	0.5	0.8	1.0	1.2	2.1	5.7	6.2	9.6
Total Europe	7.6	8.9	11.4	12.9	19.4	50.1	43.8	51.7
Total World	15.7	17.7	22.3	26.3	40.9	112.4	106.0	-

* According to IMF definition.

** Estimate.

5.7 AN ANALYSIS OF INDIA'S TRADE WITH OPEC COUNTRIES

(Contributed by E & S Division)

India's trade with some of the major OPEC countries has assumed important economic significance since the beginning of the current decade as a result of successive rise in crude oil prices. In 1970-71, India's trade with OPEC countries was of the order of Rs.225 crores, consisting of Rs.99 crores of exports and Rs.126 crores of imports which gave a trade deficit of Rs.27 crores for India vis-a-vis the OPEC group as a whole. The imports largely consisted of crude oil/POL and to some extent dried fruits & nuts, while the exports included large variety of consumer items like textiles, tea, coffee, tobacco, sugar, engineering goods and metal manufacturers and to some extent iron & steel, transport equipment and such capital intermediates. The proportion of trade with OPEC group constituted only 7.1 % of India's total foreign trade and that too was confined to 5/6 important countries like Iran, Iraq, Indonesia, Kuwait, Saudi Arabia, etc. Since 1970-71, there has been a progressive increase in both value and volume of India's trade with these countries, particularly due to successive hikes in crude oil prices so much so that in 1976-77 India's trade with OPEC group reached a height of Rs.1993 crores including Rs.694 crores of exports and Rs.1299 crores of imports. This constituted around 20% of India's foreign trade and this position more or less remains unchanged even today, despite a three-fold increase in India's foreign trade.

2. One of the main contributory factor to this rise in India's trade with OPEC group has been the quadruppling of prices of crude oil which inflated substantially the value of our imports from these countries overnight and necessitated extra efforts towards pushing up our exports for bridging the rising gap. Consequently, India's trade deficit with OPEC countries has tended to widen and currently stands at an average of about Rs.600 crores per annum. Although there has been a progressive rise in India's export trade with these countries, this has not been commensurate with the rise in value of imports from these countries on account of large crude price hikes. An idea about India's trade balance with OPEC countries vis-a-vis India's overall foreign trade since 1970-71 is provided in statement as Attachment-I. The following table summaries this trend :

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Table 1

(Rs./crores)

Year	India's trade with OPEC			India's overall trade			% of India's trade with OP	
	Exports	Imports	B/T	Exports	Imports	B/T	Exports	Impor
1970-71	99	126	-27	1535	1634	- 99	6.4%	7.7%
1971-72	76	182	-106	1608	1825	-217	4.7%	10.0%
1972-73	94	200	-106	1971	1867	+104	4.8%	10.7%
1973-74	187	532	-345	2523	2955	-432	7.4%	18.0%
1974-75	507	1100	-593	3329	4519	-1190	15.2%	24.3%
1975-76	629	1165	-536	4043	5265	-1222	15.6%	21.1%
1976-77	694	1299	-605	5146	5074	- 72	14.1%	25.6%
1977-78 (April-Dec.)	503	953	-450	3935	4448	- 513	13.4%	21.4%

B/T = Balance of Trade.

3. At the outset it may be stated that most of India's requirements of crude oil (which constitute about 85% of total POL imports) originates from 4 or 5 OPEC countries and that of petroleum products comes from USSR and other rupee payment area; and all available indications suggest that this position is not likely to change in the foreseeable future. The proportion of crude oil and product imports to India's total exports which reflects individual commodity's foreign exchange burden to the national economy, has also been showing a persistently rising trend consequent upon successive hikes in crude oil/product prices. It may be of interest to depict the behaviour of the share of India's crude oil and product imports as a proportion of its total exports and the rising unit values of crude oil imports from OPEC countries during the period 1970-71 to 1977-78 in the following table :

Table 2: Showing imports of POL as proportion of India's total exports and unit values of crude imports.

(Rs./crores)

Year	Value of POL imports	Value of exports	% of POL imports to total exports	Unit values (CIF) of crude oil imports (Rs/MT)
1970-71	137	1535	8.9%	91
1972-73	207	1971	10.5%	121
1973-74	541	2523	21.4%	300
1974-75	1110	3329	33.3%	654
1975-76(P)	1249	4043	30.9%	755
1976-77(P)	1447	5146	28.1%	832
1977-78(P)	1556	5253	29.6%	855

(P) = Provisional.

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Major OPEC Countries trade with India

4. While India has trade relations, in varying degrees, with almost all the OPEC countries, not all the OPEC countries are economically important from the point of view of their trade links with India. This differential in trade status is brought out in the statement at Attachment-II which shows India's balance of trade with individual OPEC countries. It will be seen that there are only 5/6 OPEC countries which are of important economic significance to India's trade and these countries are : Iran, Iraq, Saudi Arabia, Kuwait, UAE and Indonesia. These countries together account for almost the entire India's import with OPEC and about 85% of India's exports trade with OPEC. With the exception of Indonesia, India is having trade deficit with all the remaining five countries because India since mid 1960s has ceased to be an importer of crude oil from Indonesia. India's trade deficit with these countries as a group is currently of the order of over Rs.680 crores per annum. With expectations of further rise in crude prices, this deficit is likely to be still larger. A composite picture showing year-wise growth of India's trade with major OPEC countries and with OPEC group as a whole from 1973-74 to 1977-78 (April-December 1977) is given in the following table :

Table 3: Showing India's exports/imports with major OPEC Countries.

(Rs./crores)

A. Exports to Major OPEC Countries

Country	1973-74	1974-75	1975-76	1976-77	1977(April-Dec.)
1.Saudi Arabia	26	35	60	74	95
2.Iran	43	215	271	145	84
3.Iraq	20	73	65	46	44
4.U.A.E.	26	45	65	161	110
5.Kuwait	21	39	45	113	89
6.Indonesia	27	51	52	61	24
Total:	163(87%)	458(90%)	558(89%)	600(86%)	446(89%)
Other OPEC	24(13%)	49(10%)	71(11%)	94(14%)	59(11%)
(A)GRAND TOTAL	187	507	629	694	503

B. Imports from OPEC

1.Saudi Arabia	131	298	290	332	186
2.Iran	268	473	459	508	434
3.Iraq	61	251	248	280	217
4.U.A.E.	neg.	neg.	82	85	67
5.Kuwait	71	64	63	77	28
6.Indonesia	neg.	3	3	3	15
Total:	532	1089 (99%)	1145 (98%)	1285 (99%)	947 (99%)
Other OPEC	neg.	11(1%)	20(2%)	15(1%)	6(1%)
(B) GRAND TOTAL	532	1100	1165	1300	953
Balance of Trade (A-B)	-345	-593	-536	-606	-450

(Figures in brackets indicate percentage to total OPEC's trade with India).

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5. It will be seen from the above table that bulk of our trade with OPEC is confined to six countries and there is a tendency for our trade deficit to widen with successive increase in the prices of crude oil announced by OPEC. This deficit would widen further consequent upon anticipated rise in the prices of imported crude oil as well as in the volume of crude oil imports from OPEC countries. In order to reduce the widening trade deficit with these countries, there is an underlying need to develop and diversify our exports to these countries. It may, therefore, be of interest to analyse commodity composition of India's trade with these countries, the dimensional magnitude of current account trade imbalance that we are likely to develop with these countries and the economic imperatives needed to reduce the ever rising burden on India's foreign exchange resources.

Commodity composition of India's trade with major OPEC Countries

6. An analysis of commodity-wise composition of India's trade with OPEC over years would be helpful in identifying areas where trade could be further developed with these countries. A detailed statement showing commodity-wise composition of India's trade with major OPEC countries (which account for about 85% of India's trade with OPEC) during the last 4/5 years is provided in Attachment-III.

7. It will be noted from Attachment-III that major items of exports from India to these countries, apart from host of consumer items like tea, tobacco, jute manufacturers, dye-stuffs, pharmaceuticals, sugar, meat & fish, consist of engineering goods and intermediates capital goods like iron & steel, machine & metal manufacturers and transport equipment. Sugar is not a major/regular item of exports to these countries. Large exports of sugar during 1974-75 and 1975-76 to Iran and Indonesia took place mainly due to boom condition in international sugar market and trade reciprocity extended to Iran in exchange of easy credit terms on import of crude oil provided to India. U.N.publications classifies 1 OPEC countries as oil exporting countries. These countries are at different stages of economic development and have different resource and population base. Accordingly their requirements for consumer consumer and capital goods are different. Iran, Iraq, Indonesia, Nigeria and Algeria are more populous of OPEC countries and have larger absorption capacity both in terms of consumer and capital goods than low population countries such as Kuwait, Saudi Arabia, Libya and U.A.E. Although these countries are highly rich today measured in terms of their per capita income derived from oil revenues, but with few exceptions, their economies lack diversity and resourcefulness of supplies of both consumer and capital goods. In order to diversify their economic structure on the basis of their huge oil revenues, most of these countries have already embarked upon a programme of industrialisation

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of their economic over-heads facilities, apart from raising their consumption standards. But their absorption capacities of both consumer and capital goods, because of their different economic and population base are different and availability of surplus oil revenues b-y itself would not provide sufficient inducement to undertake investment unless complimentary resources are available at local l-evels.

8. Th-ere are limits to which the oil producing countries can expand their imports of consumer and capital goods. An asses-smenttof OPEC countries' absorption capacity during the years 1973-77 is provided in Attachment-IV. It will be seen that while all the oil exporting countries have increased their spending on imports very rapidly, relative to increase in total oil revenues as reflected in export earnings, there have been clear diff-erences in their import spending. While large populous countries like Algeria, Iran, Iraq, Indonesia, Nigeria, etc. have spent a large proportion of their increasing earnings on additio-nal imports, the low population countries such as Kuwait, Saudi Arabia, U.A.E. , Libya, etc. have spent much smaller proportion of their oil revenues on imports. In the years to come, the latter countries and particularly Saudi-Arabia will continue to account for bulk of total OPEC surplus. The more populous of these countries having trade links with India such as Iran, Iraq and Indonesia account for major imports of consumer items and other intermediate capital goods including trans-port equipments. Si-nce India is comparatively at a higher stage of development and has resourcefulness of supplies of various consumer items, engineering and intermediate capital goods, transport equipment, etc. to cater to the requirement of th-ese countries and also has advantage of geographical contiguity and histor-ical trade continuity with some of these countries, there is good scop for further expansion of trade by India for various consu-mer items and intermediate capital goods on the basis of comp-limentarity and particularly with the more popul-ous of these countries like Iran, Iraq, Indonesia, Nigeria, Algeria, etc. having comparatively larger absorption capacity of their surplus oil revenues.

Prospects of India's trade balance with major OPEC countries in perspective of 1987 - 88.

9. As indicated above, India's trade with major oil producing countries has expanded manifold during the last 5-6 years mainly on account of successive hikes in imported crude oil prices, which necessitated larger exports of various types of consumer and intermediates capital goods to these countries. Despite seven-fold increase in exports to these countries during 1970-71 to 1976-77, India still has a current account trade deficit with these countries of the order of Rs.600 crores per annum; and this gap is likely to grow further on account of estimated increase in value and volume of crude imports from these countries. This aspect requires little more elaboration.

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10 India's current demand for petroleum products is reckoned at about 27 million tonnes and this is likely to reach a level of about 32.5 MMT by 1980-81 36.3 MMT by 1982/83, 42.1 MMT by 1985/86 and 47.5 MMT by 1987-88 based on the Draft Sixth Plan estimates made by the Planning Commission. Against this demand, the domestic availability of crude oil (both onshore & offshore) is likely to reach a level of 18MMT by 1982-83 and remain at that level for some years. On current reckoning of proven and probable reserves of crude oil (both offshore & onshore) in the country and with successive tapering of crude oil production from existing oil wells/fields after middle of 1980s and the need for conserving fast depleting oil reserves, it may not be optimal to stretch our crude production beyond 20-25 MMT per annum by 1987-88 unless some large scale discoveries of crude oil are made. With domestic demand for petroleum products projected to reach a level of 47.5 MMT by 1987-88, our dependence on imports of crude oil/petroleum products by then would be to the tune of 25 MMT per annum. What this would mean to Indian economy in terms of foreign exchange outgo can be judged against the background of international oil situation. The world outlook for oil in perspective of 1985-90 studied by OECD, EXXON, CIA and Petroleum Economics Ltd., London some time back indicates likely world shortage of oil after 1985 even when prices of crude oil are pushed up substantially higher (to say $ 18/bbl-$20/bbl) and that USSR might also turn into a net importer of crude oil. In this context and assuming that there are no major larger scale discoveries of oil, India will have to place increasing reliance on imports of crude oil and petroleum products from OPEC's countries and more particularly traditional sources like Iran, Iraq, Saudi Arabia, UAE, Kuwait, etc. A broad assessment of supply/demand balance for POL in respect of Indian economy made by E&S Division on the basis of figures indicated in the Draft Sixth Plan document together with the estimated outgo of foreign exchange on the assumption of 5% crude price hike from 1978-79 onwards is given in the following table :

Year.	Estimated demand (MMT)	Estimated crude prodn. (MMT)	Balancing imports (MMT) Crude	Balancing imports (MMT) Product	Refining crude throughput. (MMT)	Imported crude prices FOB $/bbl	Estd. foreign exchange outgo based on FOB values @ Rs/crores.
1978-79	28.0	13.0	14.5	2.5	27.5	13.35	1422
1980-81	32.5	17.0	14.5	3.0	31.5	14.72	1614
1981-82	34.3	18.0	15.5	3.0	33.5	15.45	1791
1982-83	36.3	18.0	16.5	4.0	34.5	16.22	2083
1985-86	42.1	20.0	19.0	5.0	39.0	18.77	2822
1987-88	47.5	22.5(E)	22.5	5.0	45.0	20.70	3560

Note: After excluding refinery fuel & loss, the resultant output from refinery plus product imports would balance with demand.

@ Based on $/Rupee conversion rate of Rs.8.50 = 1 $

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11. It will be seen from above table that India's import of crude oil/petroleum products would go up from a level of 17/MMT in 1978-79 to about 24 MMT by 1985-86 and further to 27 MMT by 1987-88 on the assumption of a 5% per annum cumulative rise in imported crude oil prices from 1978/79, which is very much in the realm of possibility, the FOB value of our POL imports would go up from about Rs.1420 crores in 1978/79 to about Rs.2820 crores by 1985-86 and further to about Rs.3560 crores by 1987-88. In this process crude oil prices would go up from $ 13.35/bbl in 1978-79 to $ 18.77/bbl in 1985/86 and to over $ 20/bbl by 1987-88. Assuming that about 80% of our imported crude/POL requirements would be met from traditional OPEC sources and balance 20% from non-OPEC sources like USSR, Egypt, Rumania, etc. (although world agencies have forecast that USSR would turn from net exporter to net importer of crude oil by mid 1980s), our imports from OPEC would still have to go up from current level of around Rs.1200 crores per annum to about Rs.2300 crores per annum by 1985-86 and Rs.2800 crores by 1987-88. This means that unless simultaneous efforts are made to diversify and expand our exports to the OPEC countries, there would be a growing tendency for India's trade deficit with this group of countries to widen thereby creating the need to bridge this gap from foreign exchange earned through multilateral transactions with other countries.

12. How are we to meet the vast anticipated trade deficit with these countries? What are the constraints to meet such deficit? Whether our traditional OPEC sources have the necessary capacity to absorb increasing merchandise, intermediate capital goods and other metal manufacturers imports from India, what has been the behaviour of OPEC countries imports from other world countries vis-a-vis imports from India? To what extent the current account trade deficit with OPEC countries could be bridged by extension of long term soft credit or through project aid on mutually advantageous terms, such as Iran's aid for financing our Kudremukh Iron ore project for supply of iron ore concentrates to Iran or Kuwait 's financial assistance for implementing Kalinadi Hydro-electric project in Karnataka, etc.? The identification of areas where we could develop bilateral trade links and technical co-operation with OPEC countries on mutually advantageous terms.

13. It has been indicated in para 11 above that India 's imports of crude oil from OPEC countries is likely to go up from the current level of about Rs.1400 crores to over Rs.2800 crores by 1985-86 and Rs.3500 crores by 1987-88. As against this our exports to these countries, which is currently reckoned at around Rs.700 crores is not likely to show similar trends. Considering the rate of growth of imports of oil producing countries, the share of India 's exports to their total imports, their diminishing absorption capacity of surplus oil revenues (as reflected in widening gap between value of imports and imports (see Attachment IV) to catch up with estimated imports of crude oil from OPEC countries would require vast magnitude of efforts both in terms of augmentation and diversification of our exports to these countries as also in establishment of bilateral trade links.

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14. The behaviour of India's exports to major OPEC countries as a whole shows that after an initial accelerated rise in exports during 1974/75, there has been a slowing down in the tempo of growth of exports in 1976-77 and 1977-78 (April-December). While there had been over 150% increase in our exports to major OPEC countries in 1974/75 over the preceding year, the rate of increases in exports during 1975-76 and 1976-77 had been of the order of 37% and 8% respectively. During April- December 1977, the growth in India's export trade to major OPEC countries had been 16% over the corresponding period last year. A bulk of the increase in exports during 1974-75 and 1975-76 had been on account of sugar exports to Iran under a special bilateral credit agreement. As against this, the world's exports to OPEC during 1975, 1976 and 1977 grew by 61%, 31% and 35% respectively in the three years 1975 to 1977 (see Attachment V). This shows that during the last three years, India's exports to OPEC has lagged far behind the world exports to OPEC. But for spurt in India's sugar exports to Iran during 1974/75 and 1975/76, the growth in India's exports would have been still smaller. This means that India would have to make all out efforts not only to keep pace with growth in world exports to OPEC but also to catch up with past lags so that we are able to reduce the vast trade deficit that is expected to occur with OPEC countries.

15. The following broad conclusions emerge from our analysis of foreign trade with OPEC countries :

(i) The overall India's trade with OPEC countries has shown large increase during the last 5/6 years (1970-71 to 1977-78). While India's exports to OPEC rose by 7 times, imports from OPEC, which consists primarily of crude oil, rose by over 10 times. This has created a wide gulf in our current account trade with OPEC which presently is of the order of Rs.600 crores. A major chunk of this rise in imports could be attributed to successive hikes in crude oil prices. The unit values of crude imports has shown significant increase of about nine times during the period 1970-71 to 1977-78.

(ii) While India has trade links with almost all OPEC countries, there are only 5/6 major OPEC countries which are economically significant from the point of view of their trade with India. These countries in order of economic importance are: Iran, Iraq, Saudi Arabia, UAE, Kuwait and Indonesia. These countries account for about 90% of India's export trade with OPEC and almost the entire value of imports trade from OPEC. It is to these countries and special efforts would need to be directed for expansion and diversification of our exports trade.

(iii) All the major OPEC countries with whom India has trade links are developing countries. They are at different stages of economic development and because of differences in their 'resource' and 'population' bases their requirement for consumer and intermediate

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goods and capital goods are also different. On the one hand, we have the high populous countries like Algeria, Nigeria, Iran, Iraq, Indonesia with comparatively higher absorption capacities of their surplus oil revenues on the other hand, we have the low populated countries like Saudi Arabia, Kuwait, Libya, Qatar, etc. having comparatively large surplus of oil revenues and lower absorption capacities. India is comparatively at a higher stage of economic development than most of these countries. These countries have embarked upon a programme of industrialisation of their economies and on laying down of infra-structure facilities and economic & social over-heads out of their surplus oil revenues, apart from raising their own consumption standards. India could diversify and augment its exports to these countries on a complimentary basis by supplying them vast variety of consumer goods, intermediate capital & capital goods, minerals and raw materials in exchange for import of crude oil.

(iv) The behaviour of India's exports to OPEC group as a whole shows that after an initial period of accelerated rise in exports during 1974/75 there had been a slowing down of the tempo of growth of exports during 1975-76, 1976-77 and 1977-78(April-December), compared to world's exports to OPEC countries in the same period. But for spurt in India 's sugar exports to Iran during 1974-75 and 1975-76, the growth in India's exports would have been still smaller. The overall marginal propensity of imports of OPEC countries has shown a tendency to decline and major brunt of this decline has been felt in India, although India enjoys advantages of geographical contiguity and historical trade continuity with major OPEC countries. India would have to make all out efforts not only to keep pace with growth in world exports to OPEC but also to catch up with past lags so that it is able to reduce the vast anticipated trade deficit with OPEC countries.

(v) Although India is having current account trade deficit with all its major OPEC partners from where it imports crude oil, there are number of other OPEC countries with whom India enjoys current account trade surplus like Indonesia, Nigeria, Libya, Qatar and of late even Kuwait etc. India could further develop trade with these countries on the basis of trade reciprocity.

(vi) In view of our future rising need for import of crude oil/POL, all out efforts would need to be directed to diversify and augment exports to all OPEC countries, including those countries with whom we are presently having small trade. If possible, we could develop bilateral trade relations with as many countries as possible based on mutual help and economic cooperation.

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Attachment I

Trend in India's overall trade balance and trade balance with OPEC Countries

Year	India's overall trade (Rs.crores) Exports	Imports	B/T	% variation over preceding year Exports	Imports	India's trade with OPEC Countries Exports (Rs./crores)	Imports	B/T	% variation over preceding year Exports (Percentage)	Imports (Percentage)	% of India's trade with OPEC to India's total trade Exports (Percentage)	Imports (Percentage)
1970-71	1535	1634	- 99	8.6	3.3	99	126	- 27	-	-	6.4	7.7
1971-72	1608	1825	-217	4.8	11.7	76	182	-106	-23.2	44.4	4.7	10.0
1972-73	1971	1867	+104	22.6	2.3	94	200	-106	23.7	9.9	4.8	10.7
1973-74	2523	2955	-432	28.0	58.3	187	532	-345	98.9	166.0	7.4	18.0
1974-75	3329	4519	-1190	31.9	52.9	507	1100	-593	171.1	106.8	15.2	24.3
1975-76	4043	5265	-1222	21.4	16.5	629	1165	-536	24.1	5.9	15.6	22.1
1976-77	5146	5074	+ 72	27.3	-3.6	694	1299	-605	10.3	11.5	13.5	25.6
1977-78 (April-Dec.)	3935	4448	- 513	10.9*	23.8*	503@	953	-450	21.2*	6.6*	12.8	21.4
% increase (1975-76/1970-71)	163%	222%				518%	813%					

* % variation over the corresponding period in the preceding year.

@ Excluding Oman.

Attachment II

India's Trade with OPEC and other oil supplying nations

(Rs./crores)

Country	1973-74 Exports	1973-74 Imports	1973-74 B/T	1974-75 Exports	1974-75 Imports	1974-75 B/T	1975-76 Exports	1975-76 Imports	1975-76 B/T	1976-77 Exports	1976-77 Imports	1976-77 B/T	1977-78(April-Dec.) Exports	1977-78(April-Dec.) Imports	1977-78(April-Dec.) B/T
Saudi Arabia	25.71	131.35 (129.49)	-105.64	35.54	297.65 (296.64)	-262.11	59.79	290.11 (285.07)	-230.32	74.37	331.98	-257.61	94.87	185.67	-90.8
Iran	42.78	267.58 (256.39)	-224.80	214.83	472.66 (451.88)	-257.83	270.82	459.29 (447.80)	-188.46	144.58	507.87	-363.29	83.87	434.40	-350.5
Iraq	20.25	61.24 (56.76)	- 40.99	72.85	251.46 (238.85)	-178.61	64.60	247.61 (231.62)	-183.01	46.51	280.17	-233.66	44.14	217.09	-172.9
Kuwait	21.23	71.13 (61.15)	-49.90	38.98	63.70 (37.22)	-24.72	45.59	62.63 (31.86)	-17.04	112.76	77.29	+ 35.47	89.03	28.42	+ 60.6
Venezuela	neg.	0.22	- 0.22	0.22	0.31	- 0.09	1.10	0.09	1.01	4.03	0.20	+ 3.83	1.49	0.45	+ 1.0
Nigeria	11.48	0.03	11.45	21.87	0.01	21.86	37.13	1.85	35.28	24.97	0.05	+24.92	18.89	1.04	+17.8
Libya	5.06	nēg.	5.06	8.61	neg.	8.61	3.90	nēg.	3.90	13.11	-	+13.11	17.62	-	+17.6
U.A.E.	25.88	0.14	25.74	44.85	0.40	40.45	64.87	81.59 (81.48)	-16.72	160.60	84.53	+76.07	110.20	66.74	+43.9
Indonesia	26.78	0.41	26.37	50.94	2.64	48.30	52.02	3.44	48.58	60.55	2.88	+57.67	23.67	14.71	+ 8.9
Qatar	6.93	0.01	6.92	8.64	neg.	8.64	10.28	3.70	6.58	19.30	13.74	+ 5.56	14.02	3.89	-10.1
Gabon	-	neg.	-			0.01			0.01	0.15	neg.	+ 0.15	0.08	neg.	0.08
Ecuador	0.04	-	0.04	9.50	12.00	0.29	18.86	15.00	0.31	0.16	-	+ 0.16	0.12	-	0.12
Algeria	0.19	0.14	0.05			0.20			1.54	2.43	0.10	+ 2.33	4.21	0.27	3.94
TOTAL:	186.33	532.25	-345.92	506.83	1100.47	-593.64	628.96	1165.31	-536.35	693.53	1299.24	-605.71	502.21	952.68	-450.47

B/T = Balance of Trade.

(Figures in brackets includes crude/POL products, etc.).

Attachment III

Trend in commodity-wise composition of India's trade with important OPEC Countries (1973/74 - 1977/78)

(Rs. / crores)

Commodity	Iran					Iraq					Saudi Arabia				
	1973-74	1974-75	1975-76	1976-77	1977-78 (Apl-Dec)	73-74	74-75	75-76	76-77	1977 (Apl-Dec)	73-74	74-75	75-76	76-77	1977 (Apl-Dec)
Exports (A)															
Ores & mineral scrap	0.3	0.6	2.1	0.2	0.3	0.3	0.3	0.8	0.2	0.9	4.6	6.1	n.a.	-	-
Fruits & vegetables	0.1	0.8	5.5	2.3	0.4	neg.	neg.	0.3	1.1	1.1	-	-	-	0.9	2.6
Meat & fish	-	-	-	0.1	-	-	-	-	-	-	-	-	-	0.1	0.8
Rice	-	-	-	-	-	-	-	3.6	-	1.2	-	4.2	5.0	3.1	0.7
Sugar	4.1	141.8	192.3	8.4	-	-	-	2.6	neg.	-	-	-	-	-	-
Tea	4.6	13.8	9.6	13.3	12.9	5.3	4.7	6.7	6.7	8.0	0.3	0.3	0.9	1.4	1.6
Jute & manufactures & jute	5.1	12.5	5.4	2.0	1.9	1.7	1.9	0.7	-	0.9	0.6	1.2	0.7	0.4	2.4
Spices	0.6	1.0	0.9	0.8	1.7	0.3	0.4	0.1	1.0	0.7	5.7	5.8	9.0	4.2	11.9
Textile & garments	3.4	11.5	4.7	17.4	17.7	1.4	6.7	14.3	1.5	0.5	3.6	4.5	10.2	14.3	9.3
Tobacco	-	-	-	-	-	-	2.1	1.9	2.3	2.3	1.0	1.1	1.8	0.5	0.6
Transport & equipment	-	-	-	6.71	7.0	1.1	1.0	1.4	0.9	1.7	-	0.5	0.5	0.6	0.8
Iron & steel	1.6	7.9	18.2	51.2	13.0	1.7	24.9	5.0	2.8	0.8	0.1	2.9	7.8	14.1	27.9
Machinery & metal manufacturers	6.3	7.5	11.2	12.8	11.8	4.6	10.7	14.5	15.3	10.4	3.2	4.4	6.6	12.9	12.2
Dyes, chemicals & pharmaceuticals	0.6	2.3	4.2	1.9	0.9	-	-	-	0.8	0.4	2.1	2.2	1.8	1.5	1.3
Cement	-	6.3	6.9	12.1	3.6	-	-	-	-	-	-	-	-	0.6	0.1
Others	16.1	8.8	6.8	15.4	12.7	3.8	20.1	12.7	13.9	15.2	4.5	8.3	15.5	18.8	22.7
Total(A)	42.8	214.8	270.8	144.6	83.9	20.2	72.8	64.6	46.5	44.1	25.57	35.5	59.8	74.4	94.9
(B)Imports incl. POL	267.4	472.7	458.9	507.7	434.4	61.2	251.5	247.6	280.2	217.1	131.4	297.6	290.1	332.0	185.7
Balance of Trade	-224.8	-257.9	-188.5	-363.1	-350.5	-41.0	-178.7	-183.0	-233.7	-173.0	-105.7	-262.1	-230.3	-257.6	-90.8

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Attachment-III

Trend in commodity-wise compsosition of India's trade with important OPEC Countries (1973/74 - 1977/78)

(Rs. / crores)

Commodity	Kuwait					U.A.E.					Indonesia				
	73-74	74-75	75-76	76-77	1977 (Apl-Dec)	73-74	74-75	75-76	76-77	1977 (Apl-Dec)	73-74	74-75	75-76	76-77	1977 (Apl-Dec)
(A) Exports															
Ores & mineral scrap	-	-	-	neg.	-	-	-	-	-	-	-	-	-	0.2	-
Fruits & vegetables	0.7	1.1	1.8	5.6	3.3	-	1.2	3.4	7.2	5.5	-	-	-	-	-
Meat & fish	1.0	1.9	1.7	7.0	6.2	-	1.0	2.3	4.7	6.6	-	-	-	-	-
Rice	-	5.9	0.6	0.3	-	1.7	5.2	-	1.5	-	-	-	-	-	-
Sugar	1.6	-	neg.	neg.	-	neg.	neg.	neg.	-	-	16.8	34.6	31.8	34.7	-
Tea	0.5	1.1	0.8	2.7	1.8	2.1	3.9	6.7	7.4	9.8	-	-	-	-	-
Jute manufacturers	0.4	2.2	0.6	1.8	1.2	0.1	0.2	0.4	0.2	0.7	-	-	-	-	-
Coffee	0.4	0.7	0.4	1.9	-	-	0.7	1.0	0.9	3.6	-	-	-	-	-
Spices	4.6	3.8	7.9	6.6	17.1	0.8	0.7	1.1	-	-	-	-	-	-	-
Textiles	1.5	2.9	4.1	5.5	4.0	2.4	4.2	11.4	12.6	12.3	-	-	-	0.9	0.3
Tobacco	-	0.8	1.2	0.1	neg.	-	0.4	0.1	0.2	0.1	0.2	1.4	0.1	n.a.	-
Iron & steel	-	-	-	32.3	16.6	0.5	4.8	10.4	52.4	12.7	0.1	0.2	2.9	9.9	6.4
Transport equipment	0.3	0.7	2.8	6.2	3.4	0.1	0.8	1.3	2.1	1.4	0.3	2.2	4.7	4.3	8.3
Machinery & metal	2.7	7.3	4.0	18.7	13.4	3.0	6.6	11.7	25.1	12.2	1.0	7.0	6.9	7.4	5.3
Dyes & chemicals	-	0.9	0.8	1.0	0.8	1.1	2.4	2.4	1.8	1.8	1.0	1.7	1.7	0.9	1.0
Cement	-	-	-	1.1	0.2	0.2	0.8	1.3	4.7	1.2	-	-	-	0.2	-
Others	7.5	9.7	18.7	22.1	21.0	13.9	11.9	11.3	39.8	32.3	7.4	3.8	3.9	2.1	2.4
Total(A)	21.2	39.0	45.4	112.8	89.0	25.9	44.8	64.8	160.6	110.2	26.8	50.9	52.0	60.6	23.7
(B) Imports															
Chemicals & ferts.	-	-	-	11.7	9.8	-	-	-	-	-	-	-	-	-	-
Vegetable oils	6.5	26.4	29.7	-	18.6	-	-	-	-	-	-	-	-	0.3	7.0
P.O.L.,etc.	61.1	37.2	31.8	65.6	-	-	-	-	84.5	66.7	-	-	-	2.1	6.8
Others	3.5	0.1	1.1	-	-	-	-	-	-	-	0.4	0.2	0.3	0.5	0.9
Total(B)	71.1	63.7	62.6	77.3	28.4	0.1	0.5	81.5	84.5	66.7	0.4	2.6	3.4	2.9	14.7
(C) Balance of Trade (a-b)	-49.9	-25.4	-17.2	-55.5	-60.6	-25.8	-44.3	-16.7	+76.1	43.5	-26.4	+48.3	+48.6	57.9	9.0

Attachment IV

Surplus export earnings on current account in respect of major OPEC Countries.

(Million $)

Country		1973	1974	1975	1976	1977
Algeria	Exports	1897	4599	4430	5163	5233
	Imports	2242	4058	5855	5311	6952
	B/T	-345	541	-1425	-148	-1719
Iran	Exports	6263	21575	20211	23502	24246
	Imports	3393	5433	10343	12894	13750
	B/T	2870	16142	9868	10608	10496
Iraq	Exports	2193	6600	8297	9272	9664
	Imports	2906	2371	4215	3470	4052
	B/T	1287	4229	4082	5802	5612
Indonesia	Exports	3061	7426	7103	8547	10853
	Imports	2720	3842	4770	5673	6230
	B/T	341	3584	2333	2874	4623
Nigeria	Exports	3466	9218	7990	10566	11796
	Imports	1865	2776	6041	8200	10050
	B/T	1601	6442	1949	2366	1746
Saudi Arabia	Exports	7707	30991	27737	36124	40932
	Imports	1949	2859	4214	8694	17196
	B/T	5763	28132	23523	23430	23736
Kuwait	Exports	3447	9854	8644	9844	9839
	Imports	1052	1552	2390	3324	4796
	B/T	2395	8302	6254	6520	5063
U.A.E.	Exports	1936	6392	6879	8542	9490
	Imports	821	1705	2669	3327	4583
	B/T	115	4687	4210	5215	4907
Total Oil Producing Countries	Exports	39300	117771	109443	133085	144795
	Imports	19900	32212	51196	62683	84205
	B/T	19400	85559	58247	70403	60590

B/T = Balance of Trade.

Source: IMF's International Financial Statistics, July 1978.

Attachment V

Overall growth of import of OPEC Countries and that from India

(Million $)

Country	OPEC Countries overall imports						OPEC's imports from India					
	1973	1974	1975	1976	1977	% growth 1977/1973	1973/74	1974/75	1975/76	1976/77	1977 (E)	% growth 1977/1973
Iran	3393	5433	10343	12898	13750	305%	43	215	271	145	120	180%
Iraq	906	2371	4215	3470	4052	347%	20	73	65	46	55	175%
Saudi Arabia	1944	2859	4214	8694	17196	785%	26	35	60	74	114	338%
Kuwait	1052	1552	2390	3324	4796	356%	21	39	45	113	117	457%
U.A.E.	821	1705	2669	3327	4583	458%	26	45	65	161	150	477%
Indonesia	2720	3842	4770	5673	6230	129%	27	51	52	61	39	44%
Total overall	10836	17762	28601	37388	50607	367%	163	408	558	600	595(E)	265%

	Percentage growth in imports over preceding year (Overall)					Percentage growth in imports from India over preceding year				
	1974/73	1975/74	1976/75	1977/76	1977/1973	1974-75 / 1973-74	1975-76 / 1974-75	1976-77 / 1975-76	1977(Apl-Dec) / 1976(Apl-Dec)	1977 / 1973
Iran	60%	90%	25%	7%		400%	26%	-47%	2%	
Iraq	162%	78%	18%	17%		265%	11%	-28%	48%	
Saudi Arabia	47%	47%	106%	98%		38%	67%	24%	71%	
Kuwait	48%	54%	39%	44%		86%	18%	147%	7%	
U.A.E.	108%	57%	25%	38%		73%	44%	148%	4%	
Indonesia	40%	24%	6%	10%		89%	2%	16%	-21%	
Overall Trade OPEC	64%	61%	31%	35%	367%	150%	37%	8%	16%	265%

5.8 INTERNATIONAL COMPARISON OF PRICES OF SELECTED PETROLEUM PRODUCTS, THEIR BEHAVIOUR AND TAX DUTIES INCIDENCE

(Contributed by E & S Division)

The object of this note is to attempt an international comparison of retail prices of selected petroleum products prevailing immediately before the onset of oil crisis in 1973 and those prevailing in 1977, how the individual countries have reacted to the successive increases in prices of international crude/petroleum products announced by OPEC countries by way of adjustments in their retail prices or excise duty/tax variations.

2. Technically speaking, it is strictly not possible to make international comparison of product prices because (i) in a regime of floating exchange rate, the monetary unit in which the prices are expressed, viz. U.S.dollar itself undergoes variations; and (ii) there are difference in cross rates of exchange as between currencies of individual countries and their movement over time is not in alignment with each other. However, over short periods when variations in value of U.S.dollars are marginal and the cross rates of exchange remain more or less stable and where dollar remains the basic unit of account/expression of international currency vis-a-vis SDRs, the international comparison of retail prices of petroleum products expressed in terms of U.S.dollars does provide a fairly good and approximate idea of the behaviour of petroleum product prices in different countries. Furthermore, in our analysis that follow since taxes and duties have been expressed both in relative terms,i.e. as percentage ratio of retail prices, the international comparison of those ratios would not get affected by any variations in exchange rates or cross rates of exchange.

3. For convenience of analysis on international comparison of petroleum product prices as between selected countries, the world has been broadly grouped into 6 or 7 regions with important countries representing each region. The Statement-I gives the comparative retail prices of motor gasoline, kerosene oil, motor lubricating oil, bunker fuel and distillate fuel oil in 26 important countries of the world (excluding oil exporting nations and Sino-Soviet block) as they stood on 31st July, 1977. It would be seen from the Statement-I, that retail prices of motor gasoline varied

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between ¢ 10.8/litre in Burma to ¢ 54.4/litre in Italy, the price in India standing at ¢ 37.6/litre. The retail price of motor gasoline in Italy is the highest in the world followed by Israel, France, Norway, Belgium, Netherlands, Japan, Srilanka, West Germany and India. The price of motor gasoline in most of the European countries are higher than in India. In Asia, on the other hand, a Japanese pays the highest price for motor gasoline followed by Srilanka and India. In case of kerosene, barring West Germany where its prices is exceptionally high, the retail prices of kerosene varied between ¢ 7.7/litre in Burma to ¢ 31/litre in South Africa, the price of kerosene in India standing at ¢ 14.4/litre. This means that the prices of kerosene on account of its larger socio-economic content and its usage by the mass of population, has been pegged down at a lower level by deliberate Government policies in India and many developing countries of the world. In case of other petroleum products namely motor lubricating oil, distillate fuel oil and bunker fuel, the prices in India have not only been much lower than the upper-range of international prices but they have been lower than the average prices of 26 nations under considerations. The following table gives the range of price variations of the aforesaid five petroleum products vis-a-vis retail prices prevailing in India and the world's (26 countries under reference) simple average of these prices :

Table 1: Showing range of prices of petroleum products as on 31.7.1977.

(U.S.¢/litre)

	Motor gasoline	Household kerosene	Motor lubricating oil	Distillate fuel oil	Bunker fuel
Lowest price	10.8Burma	7.7Burma	54.7Keneya	7.7Burma	5.3Burma
Highest price	54.4Italy	31.0S.Africa	339.9W.Germany	32.2S.Africa	16.7S.Africa
India's price	37.6	14.4	99.3	14.9	8.1
Average price	32.7	16.4	159.4	18.8	10.0

4. It will be seen from Attachment-I that average prices of motor gasoline, household kerosene and distillate fuel oil are generally higher in Europe than any other region of the world including Asia. For motor gasoline, the average price in Europe is ¢ 42/litre as against ¢ 28.6/litre in Asia and world's average of ¢ 32.7/litre. For kerosene the average price in Europe (excluding West Germany) is about ¢ 18/litre as against ¢ 15/litre in Asia and world's average of ¢ 16.4/litre. Similarly in case of distillate fuel oil(diesel oil)

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the average price in Europe is about ¢ 24/litre as against about ¢ 15/litre in Asia and world's average of about ¢ 19/litre. Further, while the average price of kerosene and distillate fuel oil(diesel oil) varies within narrow limits of ¢ 16.4 and ¢ 18.8 per litre, the existence of large price differential between the two in countries like W.Germany, Netherlands, Yugoslavia & Kenya without danger of adulteration is because of greater business ethics and integrity and phenomenon of adulteration is quite unknown to the people there. In countries like Srilanka, Pakistan, high price differential co-exist with possibilities of adulternation.

Incidence of taxation on petroleum products

5. A comparative picture of retail prices of petroleum products under reference in various countries/regions of the world and percentage incidence of taxes is provided in Attachment-II. The following table gives the comparative picture of average price of petroleum products in 26 representative countries of the world and the average incidence of taxation vis-a-vis India as on 31.7.1977 :

Table 2: Showing average incidence of tax on various petroleum products in 26 representative countries of the world vis-a-vis India.

Product	World (26 countries)		India	
	Average price ¢/litre	Average incidence of taxation(%)	Price ¢/litre	% incidence of taxation
Motor gasoline	32.7	49.3%	37.6	70%
Household kerosene	16.4	19.7%	14.4	36%
Lubricating oil	159.4	22.8%	99.3	23%
Distillate fuel oil	18.8	28.8%	14.9	38%
Bunker fuel	10.0	30.1%	8.1	5%

It will be observed from above table that incidence of taxation as percentage of retail price in respect of motor gasoline, kerosene, lubricating oil and distillate fuel oil is generally higher in India than the average incidence of taxation of the combined 26 countries. On the other hand, the retail price of kerosene, lubricating oil and distillate fuel oil in India are lower than the combined average price of 26 countries. This shows that because of joint nature of petroleum products each country has its own way of valuing and taxing different petroleum products, and higher incidence of taxation has no relation to the higher retail prices of products.

6. Summary and Conclusions: The comparative product-wise position of prices and tax incidence on petroleum products in the world vis-a-vis India is summarised below :

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(i) Motor Gasoline: The retail prices of motor gasoline are higher in Italy, Israel, France, Germany, Belgium, Netherlands, Norway and Japan than in India. Most of these countries are also comparatively on higher stages of development than India. India stands 9th among the higher priced paying nations of the world. However, an average Indian still pays somewhat higher price for motor gasoline than the average of the 26 nations under reference ;

(ii) Kerosene: The retail price of household kerosene in India has been pegged down quite low, because of its socio economic content compared to prices in most of the countries of the world under reference. India stands 18th in the descending order of price among 26 nations under reference. However, in South East Asia, with the exception of Japan and Philipines, an average Indian pays higher price for kerosene than an average citizen of Pakistan, Singapore, Thailand, Burma and Srilanka. Further, with the exception of Pakistan, the incidence of taxation on kerosene is also lower in these countries than in India ;

(iii) Motor lubricating oil: The price of motor lubricating oil in India at ₵ 99.3/litre is lower than the world average retail price of ₵ 159.4/litre. The price of lubricating oil in all European and Latin American countries, in Austrlia, Japan, Singapore and even in Pakistan are higher than in India. However, the relative tax incidence on lubricating oil in India is comparatively higher than most other countries and is lower only to Argentina, Yugoslovia, Israel, Chile and Australia.

(iv) Distillate fuel oil(diesel oil): The price of distillate fuel oil at ₵ 14.9/litre in India is lower than most of the European countries, Japan, USA and even African countries under consideration, but it is higher than some of the neighbouring countries of Asia. It is lower than the world's average price of ₵ 18.8/litre. The incidence of taxation on distillate fuel oil at around 38% in India though fairly comparable with most European nations and Japan, is higher than most of the Asian nations and world's average of about 29% ; and

(v) Bunker fuel oil: The bunker fuel oil price is generally lower in India than other countries of the world and it is lower than the world's (26 countries) average price of ₵ 10/litre. The tax incidence of bunker fuel oil in India at 5% is similarly lower than most other countries and world's average incidence of about 30%.

(vi) While the average price of kerosene and distillate fuel oil(diesel oil) varies within narrow limits of ₵ 16.4 and ₵ 18.8 per litre, the existence of large price differential between the two in countries like West Germany, Netherlands, Yugoslavia and Kenya without danger of adulteration is because of greater business ethics and integrity and phenomenon of adulteration is quite unknown to the people there. In countries like Srilanka, Pakistan, high price differential co-exist with possibilities of adulteration.

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Attachment I

International comparison of retail prices of major petroleum products at current dollar before and after the oil crisis of 1973/74.

U.S.cents/litre

	Motor gasoline		Superior kerosene		Lubricating oil		Bunker fuel		Distillate fuel oil
	31.7.73	31.7.77	31.7.73	31.7.77	31.7.73	31.7.77	31.7.73	31.7.77	31.7.77
North America									
U.S.A.	10.5	17.1	7.4	15.8	80.8	95.1	1.6	8.20	16.5
Canada	15.0	18.3	11.0	12.8	110.0	131.7	2.7	7.9	17.3
Middle East									
Israel	16.3	48.6	7.4	24.3	43.1	73.3	1.9	9.9	n.a.
Latin America									
Argentina	16.0	18.7	9.0	13.1	85.0	153.9	2.5	12.7	10.3
Brazil	7.7	39.9	7.2	22.0	49.9	202.7	1.5	8.5	22.0
Chile	15.0	24.0	10.0	14.0	124.2	239.7	15.8	16.0	19.8
Europe									
Belgium	30.0	43.9	9.2	15.0	125.8	130.8	3.5	9.2	27.0
France	28.1	44.8	23.4	25.4	182.9	276.2	2.6	9.0	29.3
Germany	31.2	38.1	5.8	140.3	389.7	339.9	3.7	9.2	35.1
Italy	26.1	54.4	8.6	13.9	224.1	n.a.	1.6	10.4	25.1
Luxumberg	23.2	34.1	10.3	17.5	122.0	152.4	5.0	9.8	17.7
Netherlands	30.2	43.1	9.8	19.7	163.8	n.a.	3.3	8.9	23.5
U.K.	20.6	31.3	7.9	15.0	87.7	131.0	3.0	10.0	15.0
Yuglosovia	19.0	37.2	9.5	15.6	93.0	151.4	1.6	7.6	23.2
Norway	22.2	44.1	7.1	18.9	131.9	285.3	3.3	11.2	17.2
South East Asia									
Pakistan	13.4	28.5	4.4	8.2	36.8	295.6	2.7	5.5	14.3
Philippines	4.8	22.4	4.2	15.1	37.0	74.0	2.6	10.7	16.3
Singapore	23.2	28.3	24.1	13.8	77.1	125.8	3.7	9.5	11.0
Thailand	10.3	19.4	9.5	13.2	84.3	93.6	3.2	7.9	13.0
India	18.8	37.6	8.1	14.4	72.9	99.3	2.6	8.1	14.9
Japan	22.0	42.9	8.0	16.0	225.7	300.0	3.0	11.0	24.0
Burma	11.4	10.8	5.5	7.7	33.0	54.8	2.5	5.3	7.7
Srilanka	18.9	38.8	4.6	10.6	78.2	93.1	-	13.3	15.9
Africa									
Kenaya	15.6	33.0	8.8	18.2	65.5	54.7	5.1	n.a.	22.2
South Africa	15.3	32.2	18.2	31.0	84.8	137.8	9.4	16.7	32.2
Australia	14.1	18.7	10.8	14.8	95.5	133.8	4.2	12.7	16.8

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Attachment II

International comparison of retail prices of major petroleum products at current dollar and percentage incidence of excise duties and other levies.

U.S.cents / litre

	Motor Gasoline		Superior kerosene		Lubricating oil		Bunker fuel		Distillate F.O.	
	31.7.77	% of excise duty & tax	31.7.77	% of excise duty & tax	31.7.77	% of excise duty & tax	31.7.77	% of excise duty & tax	31.7.77	% of excise duty & tax
North America										
U.S.A.	17.1	20%	15.8	Neg.	95.1	2%	8.20	19%	16.5	-
Canada	18.3	39%	12.8	-	131.7	-	7.9	-	17.3	35%
Middle East										
Israel	46.6	66%	24.3	35%	73.3	37%	9.9	7%	n.a.	n.a.
Latin America										
Argentina	18.7	85%	13.1	47%	153.9	39%	12.7	28%	10.3	46%
Brazil	39.9	25%	22.0	9%	202.7	12%	8.5	-	22.0	14%
Chile	24.0	42%	14.0	10%	239.7	31%	16.0	19%	19.8	30%
Europe										
Belgium	43.9	64%	15.0	13%	130.8	16%	9.2	9%	27.0	41%
France	44.8	61%	25.4	15%	276.2	15%	9.0	15%	29.3	50%
Germany	38.1	58%	140.3	20%	339.9	12%	9.2	11%	36.1	50%
Italy	54.4	72%	13.9	27%	n.a.	-	10.4	16%	25.1	28%
Luxumberg	34.1	50%	17.5	9%	152.4	9%	9.8	7%	17.7	12%
Netherlands	43.1	62%	19.7	11%	n.a.	-	8.9	11%	23.5	36%
U.K.	31.3	54%	15.0	3%	131.0	9%	10.0	10%	15.0	7%
Yuglosovia	37.2	65%	15.6	37%	151.4	27%	7.6	56%	23.2	42%
Norway	44.1	69%	18.9	22%	285.3	9%	11.2	23%	17.2	20%
South East Asia										
Pakistan	28.5	56%	8.2	74%	295.6	n.a.	5.5	57%	14.3	72%
Philippines	22.4	30%	15.1	6%	74.0	12%	10.7	57%	16.3	15%
Singapore	28.3	53%	13.8	4%	125.8	7%	9.5	6%	11.0	-
Thailand	19.4	37%	13.2	12%	93.6	14%	7.9	neg.	13.0	13%
India	37.6	70%	14.4	36%	99.3	23%	8.1	5%	14.9	38%
Japan	42.9	39%	16.0	2%	300.0	6%	11.0	3%	24.0	32%
Burma	10.8	6%	7.7	6%	54.8	23%	5.3	8.%	7.7	6%
Srilanka	38.8	20%	10.6	9%	93.1	16%	13.3	9%	15.9	9%
Africa										
Kenya	33.0	44%	18.2	9%	54.7	13%	n.a.	-	22.2	26%
South Africa	32.2	36%	31.0	37%	137.8	neg.	16.7	70%	32.2	36%
Australia	18.7	58%	17.8	nil	133.8	74%	12.7	-	16.8	58%

6. PETROCHEMICALS

6.1 MARKETS FOR MIDDLE EAST PRODUCERS

by Martin Quinland

The plans of some OPEC members for downstream development in petrochemicals have in the past generated more surprise than concern from established manufacturers. But with the total of first-generation (and mainly small) plants completed and of those under construction in the Middle East and North Africa rising stradily, capacity predictions are being taken more scriously. Although many tentative projects have now been cancelled or postponed following more realistic assessments of what can usefully be achieved in the oil producing countries, plant construction companies are hopeful of rapidly growing business in the area. Investment in oil refineries, petrochemicals and fertiliser plants and gas facilities in the five years to 1980 has recently been estimated at $ 67327 million.

But despite the optimism of construction companies, the difficulties of building chemical plant in the oil producing regions are leading to extended construction times and limiting the complexity of plant being considered. Problems such as the lack of skilled labour, the absence of local engineering facilities, and inadequate transport and communications infrastructure mean that projects attempted at present are smaller and less sophisticated than their counterparts in West Europe or the USA. These considerations support the industry view that the quantities of chemicals reaching Europe from Middle East manufacturing centres by 1985 will be only slight, and even by 1990 will be well below 10 per cent of the market.

However, if the impact of new centres of petrochemicals production on world markets in the short and medium term is to be less than previously predicted, this will be due entirely to the practical limitations mentioned and not to a lack of ambition. It seems certain that if it were not for these difficulties there would, within a few years, be massive overcapacity in some sectors. Although the Arab states have agreed to coordinate their petrochemicals ventures to avoid some duplication, it is doubtful if there is sufficient unity of purpose for worthwhile capacity reduction to be achieved by this means alone.

The problem is that is most cases planners are not being guided by normal commercial considerations. Motives behind such downstream ventures include the desire to utilise, on conservation geounds, resources such as flared associated gas which are at present wasted; the need for industrial development in preparation for reduced oil income as reserves become diminished; the provision of employment; and the wish for prestige projects into which existing oil revenues

may be channelled. Profit is rarely mentioned. The producing countries' ambition of upgrading their raw material so that refined products and petrochemicals can be exported in addition to crude oil is perfectly legitimate, butit may not be compatible with the present world overcapacity in refining.

Although in some oil producing countries there are potential domestic markets for petrochemicals, existing manufacturers are in no doubt that most Middle East and North African capacity will be competing directly for a share of the three main world markets-West Europe, the USA and Japan. Developing countries with large populations(such as India), to which oil producers have looked as possible future markets, are too far behind the developed world to become sizeable outlets for sophisticated petrochemicals products, it is argued. With high oil prices tending to widen the "prosperity gap" between the developed and developing world, new markets in this direction can only be a long term possibility.

COMPETING FOR EXISTING MARKETS

The OPEC countries with large oil reserves and large populations (such as Nigeria, Algeria, Iraq and Iran) can doubtless be considered potential markets on a shorter time-scale, but forecasts of consumption are unreliable. Certainly, their present consumption of polymeric materials such as plastics, synthetic fibres and synthetic rubbers which account for a high proportion of organic base chemicals production is very low.

It therefore seems inevitable that Middle East and North African petrochemicals production will be directed at the nearest industrialised market - West Europe. Mr M C Hyde of Chemical Insight has predicted that up to 70 per cent of the output will be so directed, after local demand has been met by the first few plants. He estimates that in 10 to 15 years some 6 million tonnes/year of ethylene and 2 million tonnes/year of propylene could be available from Arab countries, if 50 per cent of their assoicated gas potential were realised. This output would*demand by 1985-90, but he says that "effective Middle East ethylene capacity is unlikely to top 3 million tonnes/ year by 1990, and may well be nearer to 2 million tonnes". In his view Arab states are overestimating demand, with the Arab League predicting a 12 per cent annual growth rate for European petrochemicals until 1990 compared with industry expectation of 6 to 8 per cent (and even these may prove optimistic).

These over-expectations are evidenced in US and Middle East estimates for total new ethylene capacity required in West Europe, the USA and Japan from 1980-90. While US estimates indicate a need for about 18 million tonnes/year of additional capacity, equivalent predictions by the Industrial Development Centre for arab States call for some 37 million tonnes/year of new plant in the.

*represent some 20 per cent of estimated world

same period. Clearly, Arab planners are assuming that the industry will continue to expand at the rates achieved several years ago- a view which could prove quite unrealistic.

However, an alternative view of the impact of Arab petrochemicals capacity was presented recently by Mr P B Godfrey of Chem Systems International who expressed the announced 1990 Arab capacity for major intermediates and products as a proportion of forecast 1990 demand in world markets. He showed (see table) that Arab producers could meet only a relatively small share of estimated demand in West Europe and USA, although their output amounts to a greater proportion of the (smaller)Japanese market. It has been argued that these figures(which are based on projects announed up to 1975) assume growth-rates which cannot be sustained- however, by no means all of the projects considered will be built.

The figures therefore represent theoretical maxima. As the table shows, it would appear that output of the product likely to make greatest impact on world markets- low density polyethylene-would amount to only about one-quarter of US demand, assuming that all plans go ahead, that all plants work at full capacity, and that all product is exported to the USA. The indication is that existing producers need not fear a glut of cut-price petrochemicals from the Middle East, especially if exports could be distributed evenly amongst the three major markets.

But regardless of capacity predictions, Middle East and North African petrochemicals will have to make their entry into existing markets on the basis of selling price. OPEC countries could insist that buyers take some downstream products as a condition for crude oil deliveries, but practial considerations(such as the

ARAB CAPACITY AS PROPORTION OF 1990 DEMAND

per cent

	Western Europe	United States	Japan
Ethylene	16.6	18	52
Propylene	4	5	11.5
Butadiene	10	7.5	21.5
Benzene	9	6.5	16.5
Ortho-xylene	10	15	44
Para-xylene	19	8	19
Vinyl chloride	12.5	21.5	31.5
Styrene	12.5	16.5	31.5
Low-density polyethylene	21.5	27.8	89
High-density polyethylene	17.5	14	58
Polypropylene	7.5	8	19

wide variations in buyers' specific plant and quality requirements) argue against this. Transport cost and tariffs (possibly including selective tariffs to safeguard domestic industry) are fixed by external circumstances, so if the landed price of exports is to be competitive with domestic production then manufacturing costs attributable to feedstock, process energy and return on investment must be lower.

Although state-owned companies may be satisfied with an investment return lower than that sought by commercial ventures, previous assumptions that feedstock and process energy will be available at minimal cost are now being questioned. Large quantities of associated gas are at present flared, but once gathered and treated the gas acquires an alternate value-as an export in its own right, for example, or as fuel for other industries. Similarly, although the proportion of crude oil putput which will need to be diverted to petrochemicals manufacture will not be great, it does not follow that governments will be prepared to supply it "at cost" and forfeit the return they would have made if it had been exported as such.

In view of the pricing difficulties it would appar that refining, rather than petrochemicals manufacture, offers oil producers a more practical means of increasing the value of their exports. The present over-capacity, particularly in West Europe, means that opportunities will be limited for some years, but as demand increases and old plant is phased out there will be real opportunities for oil producers to meet directly a proportion of the consuming countries' refined products needs. With increasing capital costs, environmental restrains and (in Europe) the problem of finding suitable locations for new refineries, a moderate shift of capacity in this direction could be useful to producers and consumers alike.

On the basis of projects announced, such a transfer of refining capacity has already been noted. In the Petroleum Economist 1976 world refinery/construction survey, it was found that the Middle East, with 4.7 per cent of 1975 capacity, was attracting 17.4 per cent of project capacity for the period 1976-81. New capacity slated for the Middle East and Africa totalled 351 million.t/y.

However, a recent survey concludes that investment in basic petrochemicals (olefins, aromatics and their main derivatives) will be concentrated in industrialised countries for the next few years. Only in the mid-1980s, according to Chemical Age, are petrochemicals complexes in the developing OPEC countries likely to materialise, although the large number of studies for new plants-particularly olefins complexes-is noted. Almost 20 million tonnes/year of new ethylene capacity will be commissioned in the period 1976-80, it is predicted. This will be distributed mainly between West Europe (6.4 million tonnes/year) and the USA (6.1 million), but East Europe and the Far East will receive 2.4 and 2.3 million tonnes/year respectively. The balance will go to Latin America (1.0), the Near/Middle East(0.8)and Africa (0.6 million t/y).

6.2 EFFECTS OF HIGH OIL PRICES ON PETROCHEMICALS

The escalating price of crude oil, and therefore of feedstocks and process energy for the petro-chemicals industry, in the winter of 1973-74 resulted in a sharp decline in production growth rates for the industry worldwide in following years. Product price rises averaging 30-40 per cent led to increases in turnover of up to one-quarter for European countries and the US in 1974, but output slumped seriously in first half 1975 in Europe and Japan. In accordance with the industry's usual policy of investing throughput periods of depression, capital spending in 1974 showed a marked increase over previous years with a rise of 15 per cent over the 1973 level in Europe and larger increases elsewhere. However, the rise was in part accounted for by higher plant costs.

According to the recently-published OECD analysis of the industry's performance in 1974 and early-1975*, member countries' chemicals production showed an increase of only 2.7 per cent in 1974 compared with the previous year- the lowest growth rate recorded in the 1970s- while industrial output overall remained static. Annual growth in the chemicals sector over the 1970-74 period averaged 6.8 per cent, compared with 4.2 per cent average for all industry, so the differential between the two was maintained despite the slump. As shown in Table I remarkably high growth was achieved by Spain, with Sweden and Finland also giving good results. However, data available for about half the member countries for first-half 1975 show a serious decline in performance, with a sharp 14 per cent drop in European output compared with an 8 per cent fall in industrial production overall. The situation was similar (but on a greater scale)in Japan, where chemicals output fell 21 per cent and the average of all industrial output 16 per cent.

Higher operating costs (attributable mainly to crude oil and phosphate rock raw materials, process energy and labour costs)in 1974 were reflected in a 39 per cent increases over the previous year in product selling prices in Japan, a 34 per cent increase in the USA and a 30 per cent increase in Europe. These rises (analysed in Table II)were in excess of those for industry as a whole, but according to the report were necessary as cost increase in previous years had been absorbed. Turnover in 1974 increased accordingly, by 23 per cent to $114500 million for European member countries and by 25 per cent to $81 375 million for the USA (Japanese figures are not quoted). Value added is estimated at some $52 000 million for European countries - about 45 per cent of turnover.

Although chemicals consumption in West Europe and the USA increased in 1974 compared with the previous year (at constant exchange rates by less than 20 per cent from $81 000 million to $105 000 million for West Europe, and by 24 per cent from $61 000 million to $75 000 million

for the USA), price increases of about one-third mean that actual domestic consumption declined. The highest per capita consumption within the OECD group was recorded by Belgium at $427, followed by Finland at $398(partly due to large-price increases in two successive years) and West Germany at $392. It is interesting to note that the average per capita consumption in OECD European countries has increased in recent years and, at $325 in 1974,was not far behind that in at the USA($356).

TABLE I

CHEMICALS INDUSTRY GROWTH COMPARED WITH INDUSTRIAL AVERAGE

	Change in Production 1973-74		Average annual increase 1970-74	
	Chemicals	Industrial	Chemicals	Industrial
Germany	+2.8	-0.9	6.8	2.9
Austria	+7.6	+5.0	6.4	5.9
Belgium*	+3.2	+5.2	9.2	4.9
Spain	+36.9	+9.5	25.5	10.7
Finland	+4.0	+1.7	12.4	5.3
France	+4.6	+2.5	6.3	5.3
Italy	+4.6	+5.2	7.0	4.7
Norway	+1.7	+3.5	4.3	4.4
United Kingdom*	+4.9	-2.7	6.2	1.9
Sweden	+8.1	+6.3	12.5	4.2
Switzerland*	+6.6	+0.9	7.2	2.6
Canada	+5.2	+2.5	8.5	5.9
United States	+2.7	-0.8	6.4	4.0
Japan	-5.2	-2.3	4.9	5.9

*Chemicals industry production index excludes synthetic fibres (included for other countries). [illegible].

TABLE II

PRICE INCREASES FOR CHEMICALS COMPARED WITH MANUFACTURED GOODS

	Chemicals Products		Manufactured goods	
	1972-73	1973-74	1972-73	1973-74
Germany	+2.9	+25.5	+7.6	+23.5
Austria	-2.8	+7.6	+7.5	+9.5
Belgium	+3.9	+14.2	+3.3	+17.3
Spain	+5.5	n.d.	+11.4	+15.7
Finland	+23.7	+32.7	+13.8	+27.3
France	+8.7	+31.7	+11.0	+27.7
Greece	+5.9	n.d.	+16.8	+47.4
Italy	+11.5	+59.4	+13.9	+31.0
Norway	+4.9	+26.1	+8.4	+24.2
Netherlands	+3.7	+23.0	+8.0	+9.6
United Kingdom	+4.6	+28.5	+8.0	+24.7
Sweden	+7.4	+41.4	+12.1	+23.3
Switzerland	+5.6	+31.1	+8.7	+9.8
Canada	n.d.	+29.6	+11.2	+20.0
United States	+5.6	+33.5	+6.8	+22.1
Japan	+14.7	+38.6	+15.0	+26.6

A degree of optimism was indicated by the chemicals sector's investments in 1974, which for the nine European reporting countries increased (at constant exchange rates) by 15 per cent from the 1973 total to $5900 million. Non-European member countries' investments rose even more-in the USA by 27 per cent to $5 690 million, in Canada by 104 per cent to $693 million and in Japan by 72 per cent to $ 2919 million. However, it is difficult to quantify how much net additional capacity this spending will bring; according to the OECD, construction costs in 1974 increased by some 6-28 per cent and the costs of investment goods by 9-40 per cent depending on the country, so in Europe at least it is likely that investment was limited to essential replacement and modernisation projects.

A potentially worrying sign for the organic chemicals sector is the report's finding that in 1974-for the first time-plastics output in West Europe did not increase. After an average annual increase in plastics production of 16 per cent over the past ten years, output of condensation and ploy-condensation products fell 5 per cent in 1974 and that of polymerisation products and cellulose derivatives rose slightly, leaving total production at the same level as that in 1973.

Statistics available for nine member countries confirm the view that the full effect of the economic slump was experienced by the chemicals industry in 1975. Except in Canada and Spain (both implementing ambitious petrochemicals development projects) the fall in chemicals output was worse than the industrial average, with the organics and plastics materials sectors most seriously affected. A 29 per cent decline in organic chemicals production was recorded for first-half 1975 in Germany(compared with the same 1974 period) while the UK index fell 21 per cent. For plastics materials over the same period, Norway recorded a drop in production of 34 per cent, the UK 20 per cent and Spain 12 per cent. But investment (in financial terms, although not necessarily in terms of plant constructed)continued to increase.

Source:- Petroleum Economist April 1977.

STATISTICS

7. INTERNATIONAL PETROLEUM STATISTICS

7.1 ESTIMATED WORLD CRUDE OIL AND GAS RESERVES
(as on 1.1.78)

COUNTRY.	OIL		NATURAL GAS	
	Billion Tonnes	% of Total.	Trillion Cubic Feet.	%Total
1. Total Western Hemisphere Which.	10.4	11.8	376.6	14.9
1.1 U.S.A.	4.0	4.5	210.0	8.3
1.2 Venezuela	2.5	2.8	41.0	1.6
1.3 Canada.	0.8	0.9	58.0	2.3
1.4 Ecuador.	0.2	0.2	5.0	0.2
1.5 Mexico.	1.9	2.1	30.0	1.2
1.6 Argentina.	0.3	0.3	8.1	0.3
2. Total Africa of which	8.1	9.2	207.5	8.2
2.1 Libya	3.4	3.8	25.7	1.0
2.2 Algeria.	0.9	1.0	125.0	5.0
2.3 Nigeria,	2.6	2.9	43.0	1.7
2.4 Egypt.	0.3	0.3	3.2	0.1
2.5 Gabon.	0.3	0.3	2.5	0.1
Total Middle East.	50.0	56.7	719.7	28.0
3.1 Saudi Arabia.	20.5	23.2	85.0	3.4
3.2 Kuwait.	9.2	10.4	31.5	1.3
3.3 Iran.	9.5	9.6	500.0	19.8
3.4 Iraq.	4.7	5.3	28.0	1.1
3.5 Neutral Zone.	0.8	0.9	5.0	0.2
3.6 Abu Dhabi.	4.2	4.7	20.0	0.8
4. Total Eurpoe of which.	3.7	4.2	138.2	5.5
4.1 West Germany.	0.04	0.1	7.3	0.3
4.2 U.K.	2.60	2.9	29.0	1.2
4.3 Netherlands.	0.01	neg.	60.0	2.4
4.4 Italy & Sicily.	0.08	0.1	8.8	0.3
4.5 Norway	0.82	0.9	20.0	0.8
4.6 Yugoslavia.	0.04	0.1	1.4	0.1
5. Total Asia & Pacific of which.	2.7	3.0	122.7	4.9
5.1 Indonesia.	1.4	1.6	24.0	1.0
5.2 Australia.	0.3	0.3	32.0	1.3
5.3 India.	0.4	0.5	3.5	0.1
5.4 Pakistan.	0.04	0.1	15.5	0.6
5.5 Brunei.	0.2	0.2	8.3	0.3
5.6 Malaysia.	0.3	0.3	15.5	0.6
6. Total free World.	75.1	84.9	1564.7	62.1
7. Total Communist World.	13.4	15.1	955.0	37.9
7.1 Russia.	10.3	11.6	920.0	36.5
7.2 Red China	2.7	3.1	25.0	1.0
7.3 Hungry(Ot-hers) Cuba.	0.4	0.4	10.0	0.4
Total World	88.5	100	2519.7	100

Source:- Oil & Gas Journal, Dec. 26, 1977. 1 Tonne = 7.3 per barrel.

7.2 World oil Production, relative share of each Country/Region and their percentages variations.

(Mn.Tonnes)

Country/Region	1977% share of total	1977	1976	1975	1973	Percentage Change 1977-76	Percentage Change 1977-73
North America	17.8	541.2	538.6	557.4	621.3	+0.5	-12.9
U.S.A.	15.3	465.5	461.4	473.9	519.0	+0.9	-10.3
Canada	2.5	75.7	77.2	83.5	102.3	-1.9	-26.0
Latin America	7.8	238.9	233.0	228.1	272.1	+2.4	-12.2
Argentina	0.7	22.5	20.4	20.3	22.0	+9.9	+0.3
Mexico	1.8	53.7	46.0	39.8	26.9	+16.8	+99.6
Venezuela*	3.9	119.5	122.9	125.3	179.0	-2.8	-33.2
Ecuador*	0.3	9.4	9.1	7.9	10.2	+3.3	- 7.8
Others	1.1	33.8	34.6	34.8	34.0	-2.3	- 0.6
West Europe	2.2	70.1	45.0	30.6	22.6	+55.8	+210.2
France	-	1.0	1.1	1.0	1.3	-2.0	-23.1
Itly	-	1.1	1.1	1.0	1.0	+0.7	+10.0
Norway	0.4	13.5	13.8	9.3	1.8	-2.5	+650.0
U.K.	1.2	37.9	11.5	1.2	0.1	+229.1	+279.0
West Germany	0.2	5.4	5.5	5.7	6.6	-2.2	-18.2
Others	0.4	11.2	12.0	12.4	11.8	-6.7	- 5.1
Middle East	36.2	1104.4	1100.1	972.7	1047.1	+0.4	+ 5.5
Abu Dhabi*	2.6	80.0	76.8	67.3	62.6	+4.2	+27.8
Dubai*	0.5	15.8	15.6	12.6	10.8	+1.3	+46.3
Iran*	9.3	283.5	295.0	267.7	293.2	-3.9	- 3.3
Iraq*	3.6	110.4	112.2	110.9	99.0	-1.6	+11.5
Kuwait*	2.9	89.6	98.4	92.4	138.4	-8.9	-35.3
Oman	0.6	17.1	18.4	17.1	14.7	-7.3	+16.3
Qator*	0.7	21.1	23.4	21.0	27.3	-9.8	-22.7
Saudi Arabia*	15.0	455.0	421.6	343.9	364.7	+7.9	+24.8
Others	1.0	31.9	38.7	39.8	36.4	-17.6	-12.4
Africa	10.2	306.0	285.4	245.9	290.6	+7.2	+ 5.3
Algeria*	1.8	53.5	50.1	45.8	51.2	+6.7	+ 4.5
Egypt	0.7	21.0	16.4	14.8	13.0	+27.8	+61.5
Libya*	3.3	100.0	93.3	71.3	104.9	+7.2	- 4.7
Nigeria*	3.4	104.1	102.9	88.8	100.1	+1.2	+ 4.0
Gabon*	0.4	11.3	10.8	10.3	8.1	+4.3	+39.5
Others	0.6	16.1	11.9	14.9	13.0	+35.3	+23.9
South East Asia	3.9	118.0	102.5	88.5	91.0	+11.5	+29.7
India	0.3	10.2	8.7	8.3	7.2	+17.2	+41.7
Brunei	0.4	10.9	10.2	9.4	11.6	+ 7.0	- 6.0
Indonesia*	2.7	83.5	74.6	65.0	66.0	+11.9	+26.5
Others	-	12.6	9.0	5.8	6.2	+40.0	+103.2
Japan	-	0.6	0.6	0.6	0.7	+2.3	-14.3
Australasia	0.7	21.4	20.5	19.9	18.5	+4.1	+15.7
USSR	17.8	540.0	515.0	485.0	421.0	+4.9	+28.3
Eastern Europe	0.7	20.0	20.0	20.0	19.2	-	+10.4
China	2.7	81.0	75.0	65.0	40.0	+8.0	+102.5
*OPEC-Countries	51.2	1556.6	1508.5	1332.1	1515.5	+1.5	+2.7
Total World	100.0	3041.6	2935.7	2713.7	2844.1	+3.6	-6.5

7.3 WORLD OIL REFINING CAPACITIES AS ON 1.1.78 AND 1.1.77

Million Tonnes per Annum

COUNTRY/AREA	1977	1976	1977% share of Total.	1977% over 1976	% Change Annual Average 1972-77
U.S.A.	849	817	22.2	+4.0	+4.6
Canada.	114	109	3.0	+4.3	+5.5
Total North America.	963	926	25.2	+4.0	+4.7
Latin America	408	390	10.7	+4.3	+4.8
Argentina.	33	35	0.9	-6.6	+0.9
Brazil.	59	51	1.5	+15.2	+8.2
Mexico.	49	45	1.3	+8.2	+10.6
N.W.I.	42	40	1.1	+4.0	+1.0
Trinidad.	23	23	0.6	-	+0.9
Venezuela.	72	72	1.9	-	-0.4
Other Latin America.	130	124	3.4	+4.8	+8.4
Total Western Hemisphere.	1371	1316	35.9	+4.1	+4.7
Western Europe	1033	1046	27.1	-1.2	+3.7
Belgium.	53	54	1.4	-2.1	+4.3
France.	172	174	4.5	-0.9	+3.6
Itly.	225	216	5.9	+3.9	+4.5
Netherlands.	91	97	2.4	-5.9	+0.3
Spain.	60	64	1.6	-5.2	+6.6
U.K.	132	143	3.5	-7.6	+1.3
West Germany.	153	155	4.0	-1.4	+2.8
Other Western Europe.	147	143	3.8	+2.5	+7.8
Middle East.	161	146	4.1	+10.2	+6.1
Bahrain.	12	12	0.3	-	-
Iran.	48	36	1.3	+35.0	+9.8
Iraq.	9	9	0.2	-	+10.1
Kuwait.	29	29	0.7	-	+2.0
Neutral Zone.	4	4	0.1	-	+0.8
Saudi Arabia.	31	31	0.8	-	+8.1
Other Middle East	21	18	0.5	+16.6	+10.1
Africa.	73	69	1.9	+5.0	+8.7
South Asia.	39	37	1.0	+7.2	+4.5
South East Asia	145	142	3.8	+2.0	+6.4
Indonesia.	26	26	0.7	-	+4.8
Singapore.	52	52	1.4	-	+13.6
Other South East Asia.	67	64	1.7	+4.4	+2.8
Japan.	266	266	7.0	-	+3.9
Australasia.	38	38	1.0	-	+1.5
USSR, E.Europe & China.	693	647	18.2	+7.1	+7.9
Total Eastern Hemisphere.	2448	2391	64.1	+2.4	+5.3
Total World.	3819	3707	100	+3.0	+5.1

World oil consumption, relative share of each Country/Region and their percentage growth.

(Million Tonnes)

Country /Region	1977 % share of total.	1977	1976	1975	1973	Percentage Change 1977-76	Percentage Change 1977-73
U.S.A.	29.2	867.3	822.4	765.9	818.0	+5.5	+6.0
Canada	2.9	85.4	85.9	83.1	83.7	-0.6	+2.0
Total North America	32.1	952.7	908.3	849.0	901.7	+4.9	+5.7
Latin America	6.5	192.1	186.5	174.0	163.7	+3.0	*17.3
Total Western Hemisphere	38.6	1144.8	1094.8	1023.0	1065.4	+4.6	+7.5
France	3.9	114.6	119.5	110.4	127.3	-4.1	-10.0
Italy.	3.2	95.9	98.8	94.5	103.6	-2.9	-7.4
Netherlands	1.3	37.6	39.2	34.8	41.3	-4.0	-9.0
Spain	1.5	44.9	48.3	42.7	39.1	-7.2	+14.8
U.K.	3.1	92.3	91.5	92.1	113.4	+0.9	-18.6
West Germany	4.6	137.1	138.9	128.9	149.7	-1.3	-8.4
Other W.E.Countries	5.9	174.2	173.7	161.0	174.6	+0.3	-0.2
Total West Europe	23.4	696.6	709.9	664.4	749.0	-1.9	-7.0
Middle East	2.7	79.2	74.7	66.8	64.6	+6.0	+22.6
Africa	1.9	57.0	55.2	51.3	47.5	+3.2	+20.0
South East Asia. (excluding India)	3.2	94.3	88.7	81.2	77.6	+6.3	+21.5
India	0.9	26.5	24.9	23.5	23.7	+6.5	+11.8
Japan.	8.8	260.1	253.5	244.0	269.1	+2.6	-3.3
Australasia	1.3	37.9	36.6	35.3	34.8	+3.4	+8.9
USSR	13.0	395.0	380.0	362.0	317.7	+3.9	+24.3
Eastern Europe.	3.4	100.0	90.0	86.0	76.7	+11.1	+30.4
China*	2.5	73.0	66.0	55.6	37.6	+10.6	+94.1
Total Eastern Hemisphere (excluding Western. Europe.).	61.4	1827.6	1787.2	1677.6	1707.8	+2.3	+7.0
Total World:-	100.0	2972.4	2882.0	2700.6	2773.2	+3.1	+7.2

7.5 World oil production, consumption and relative deficits/surplus in each region/country during 1977 and 1973.

(Million Tonnes)

Country/Region	1977				1973			
	Production.	Consumption.	Deficit-Surplus+	%extent of dependence.	Production.	Consumption.	Deficit-Surplus+	%extent of dependence
1	2	3	4	5	6	7	8	9
North America	541.2	952.7	-411.5	43.2	621.3	901.7	-280.4	31.1
Latin America	238.9	192.1	+ 46.8	24.4	272.1	163.7	+108.4	66.2
West Europe.	70.1	696.6	-626.5	89.9	22.6	749.0	-726.4	97.0
Middle East	1104.4	79.2	+1025.2	-1294.4	1047.1	64.6	+982.5	-1520.1
Africa	306.0	57.0	+249.0	-436.8	290.6	47.5	+243.1	-511.8
South East Asia (excluding India)	103.8	94.3	+ 9.5	10.1	82.0	77.6	+ 4.4	5.7
India	10.2	26.1	- 15.9	60.9	7.4	23.7	- 16.3	68.8
Japan	0.6	260.1	-259.5	99.8	0.7	269.1	-268.4	99.7
Australasia	21.4	37.9	-16.5	43.5	18.5	34.8	-16.3	46.8
USSR	540.0	395.0	+145.0	36.7	421.0	317.7	+103.3	32.5
Eastern Europe	20.0	100.0	- 80.0	+80.0	19.2	76.7	- 57.5	75.0
China	81.0	73.0	+ 12.0	16.4	40.0	37.6	+ 2.4	6.4
Total :-	3041.6	2972.4	+ 69.2		2844.1	2773.2	+ 70.9	

8.1 Key Crude Oil Price Postings around the World

These are not sales prices (except in the U.S. and Indonesia), but prices posted by Governments for computing oil company taxes.
In $ per barrel. Postings in effect on dates shown or thereabouts)

		1973			1974		1975	1977			1978
		Jan.1	Oct.1	Oct.16	Jan.1	Nov.1	Oct.1	Jan.1	July	Sep.8	Sept.
1		2	3	4	5	6	7	8	9	10	11
PERSIAN/ARABIAN GULF CRUDES											
Crude & Gravity											
Arab Light	34	2.591	3.011	5.119	11.651	11.251	12.376	13.000	13.660		NO
Arab Barri	39	2.666	3.086	5.682	12.351	11.951	12.768	13.420	14.220		CHANGE
Arab Medium	31	2.482	2.884	4.903	11.561	11.161	12.227	12.570	13.250		UPTO
Arab Heavy	27	2.345	2.725	4.633	11.441	11.041	12.086	12.230	12.920		29th
Iran Light	34	2.579	2.995	5.341	11.875	11.475	12.495	13.774	13.774		Sept.
Iran Heavy	31	2.527	2.936	4.991	11.635	11.235	12.360	13.430	13.430		1978.
Kuwait	31	2.482	2.884	4.903	11.545	11.145	12.260	-	-		
Abu Dhabi											
Umm Shaif	37	2.642	3.070	5.537	12.086	11.686	12.575	13.200	14.020		
Murban	39	2.654	3.084	6.045	12.636	12.236	12.815	13.440	14.260		
Zakum	40	2.687	3.115	5.964	12.566	12.166	12.715	13.340	14.160		
Iraq Basrah	35	2.562	2.977	5.061	11.672	11.272	12.400	-	13.624	13.55/13.60	
Qatar Marine	36	2.614	3.037	5.503	12.013	11.613	12.540	-	13.979		
Qatar Dukhan	40	2.705	3.143	5.834	12.414	12.014	12.740	-	14.183		
Oman	34	2.634	3.058	5.738	12.298	12.298	NA£	@13.677			
MEDITETTAREAN & AFRICAN CRUDES											
Arab Light	34	3.451	4.205	7.149	13.647	13.247	NA£	NA£			
Iraq Kirkuk	36	3.484	4.243	7.213	NA£	N.£	NA£	-			
Libyan	40	3.777	4.604	8.925	15.768	15.768	16.060	18.250			
Nigorian	34	3.561	4.287	8.310	14.691	14.691	13.071	-			
"	37	-	-	-	-	-	-	15.291	15.291		
INDONESIAN CRUDE (OFFICIAL SELLING PRICE)											
Sumatra Light	34	2.960	4.750	4.750	10.800	12.600	NA£	-			
VENEZUELAN CRUDES (REFERENCE PRICES)											
Tia Juana	26	3.094	4.925	4.925	13.836	14.312	14.643				
Tia Juana	31	3.249	5.203	5.203	14.356	14.906	15.579				
Oficina	35	3.396	5.447	5.447	14.876	15.436	16.169				
UNITED STATES (REPRESENTATIVE POSTING)											
East Taxas.	Flat	3.600	4.200	4.200	*10.000	*10.600	NA£				

*Posted prices for crude not subject to Government price controls; controlled crudes (about 60% of output) are posted at $ 5.200 per barrel. NA£ Posting not available. Source: Oil Grams April 26, 1977
@Effective Feb.1.1977
PIW 18th August, 1975.
MEES 11th July, 1977.

8.2 Retail price and incidence of taxes and duties-an Internationa Comparison as on 31.7.1977

U.S. cents per litre.

Countries	Motor Gasoline			Kerosene			Lubricating oil			Distellate Fuel Oil		
	Price	Duty	Taxes	Price	Duty	Taxes	Price	Duty	Taxes	Price	Duty	Taxes
1	2	3	4	5	6	7	8	9	10	11	12	13
North America												
USA(New York)	17.5	0.3	3.4	16.2	0.1	-	95.0	0.5	1.6	17.0	NA	3.4
Canada	18.3	-	7.2	12.8	-	-	131.6	-	-	17.3	-	6.1
Middle East												
Israel	48.6	10.7	21.2	24.3	3.3	5.1	73.3	18.2	10.9	NA	NA	NA
Latin America												
Argentina	21.8	60%	13.6	12.1	45%	4.6	153.8	15%	43.3	10.3	15%	3.8
Brazil	39.9	-	10.0	22.0	-	2.0	202.5	-	23.9	22.0	-	3.0
Chile	24.0	-	10.0	14.0	-	1.4	239.5	-	74.8	20.0	-	6.0
Europe												
Belgium	43.9	22.0	6.0	15.0	1.0	1.0	130.7	1.0	19.9	27.0	8.0	3.0
France	44.8	-	27.1	25.4	-	3.8	276.0	-	40.9	29.3	-	14.6
Germany(west)	58.1	6%	19.3+11%	140.3	6%	19.3+11%	339.6	6%	19.3+11%	25.2	6%	9.3+11%
Italy	54.4	NA	39.1	13.9	NA	3.8	NA	NA	NA	17.5	NA	5.0
Luxamburg	34.1	15.3	1.6	17.5	1.3	0.8	152.5	0.3	13.9	17.7	2.2	0.8
U.K.	31.3	-	17.0	15.0	-	0.4	130.7	-	1.2	15.0	-	1.0
Netherlands	43.4	20.0	6.9	19.7	1.4	0.8	NA	NA	NA	23.5	7.6	0.9
Yugoslavia	37.0	-	24.0	15.6	-	5.8	152.6	-	40.7	23.2	-	9.8
South East Asia												
Pakistan	28.5	8.2	7.9	8.2	-	6.1	295.4	NA	NA	14.3	2.1	8.2
Phillipines	22.4	NA	6.7	15.1	NA	1.0	74.2	NA	8.8	16.3	NA	2.4
Singapore	28.3	14.9	14.9	13.8	0.5	0.5	125.7	9.1	9.1	11.0	-	-
Srilanka	38.8	-	20%	10.6	-	9%	93.1	6.4	9%	15.9	-	9%
Thailand	19.4	6.3	0.8	13.2	1.1	0.6	93.5	7.6	5.8	13.0	1.1	0.6
India	37.6	23.8	7%	14.4	4.8	3%	99.2	NA	7%	14.9	4.6	7%
Japan	42.9	0.8	16.0	16.0	0.4	-	300.3	6%	-	24.0	0.7	7.0
Burma	10.8	-	0.7	7.7	-	0.4	54.8	10.3	2.4	7.7	-	0.4
Africa												
Kenya	33.0	7.1	7.4	18.2	1.6	NA	54.6	22.6	4.2	23.5	4.8	1.3
SouthAfrica	32.1	11.7	-	31.0	11.5	-	137.7	neg	-	32.2	11.6	-
Australia	18.7	5.4	5.4	17.8	-	-	133.7	98.8	-	18.8	5.4	5.4

8.3 Impact of OPEC's price hike decision on lowest posted prices of petroleum products(ex-Bander Mahshahr) and relativity of indices when kerosene prices is taken as unity. (Volumetric basis).

US.Ø/US Gallon

	Prs Oct'75		Post Oct.'75		Prs.Jan'77		Post Jan'77		11thJuly'77		25th Aug.78	
	Price	Index	Price	Index	Price	Index	Price	Index	Price	Index	Price	Index
Avgas 115/145	50.6	1.51	53.0	1.46	56.0	1.53	58.0	1.51	58.3	1.51	63.5	1.51
" 100/130	48.8	1.46	51.0	1.40	54.0	1.48	56.0	1.46	56.5	1.46	60.5	1.44
" 73	47.5	1.42	51.0	1.40	51.0	1.40	53.0	1.38	53.5	1.38	-	-
MS 93 Octane	35.9	1.08	38.3	1.05	39.6	1.08	41.2	1.08	41.2	1.06	44.0	1.05
" 83 "	34.0	1.02	36.7	1.00	36.7	1.01	39.0	1.02	39.0	1.01	40.5	0.96
ATF	34.1	1.02	36.7	1.01	37.0	1.01	38.8	1.01	39.3	1.01	43.0	1.02
Kerosene	33.4	1.00	36.4	1.00	36.5	1.00	38.3	1.00	38.8	1.00	42.0	1.00
HSDO(Diesel index)	30.8	0.92	33.6	0.92	33.7	0.92	36.2	0.95	36.3	0.93	39.5	0.94
LDO(industrial Diesel).	28.8	0.86	30.6	0.84	33.3	0.91	33.5	0.88	33.5	0.86	-	-
FO(Light Fuel oil)	23.9	0.72	25.7	0.71	25.7	0.71	27.7	0.72	28.2	0.73	27.0	0.64

Note :-Prices are expressed in terms of US Ø / US gallon.
Relative indices computed on the basis of kerosene price being taken as one.

Source :-Platt's Oil Gram.

8.3(b) Impact of OPEC's price hike decision on lowest posted prices of Petroleum Products (ex-Bandar Mah Shahr) and relativity of indices (gravimetric basis) when kerosine price is taken as unity.

Product	Pre October'75		Post October'75		Pre January'77		Post Jan.'77		11th July '77		25th Aug' 77	
	$/MT	Index	$/MT	Index	$/MT	Index	$/MT	Index	$/MT	Index	$/MT	Index
Avgas 115/145	193.69	1.71	202.88	1.64	214.36	1.73	222.02	1.71	223.93	1.70	243.07	1.70
Avgas 100/130	183.19	1.61	191.45	1.55	202.71	1.64	210.22	1.62	212.10	1.61	227.11	1.59
Avgas 73	179.69	1.58	192.93	1.56	192.93	1.56	200.50	1.54	202.39	1.54	-	-
MS 930ctane	131.44	1.16	140.23	1.13	144.99	1.17	150.85	1.16	150.85	1.14	161.10	1.13
" 83 "	126.73	1.12	135.68	1.10	136.80	1.10	145.37	1.12	145.37	1.10	150.16	1.06
ATF	116.03	1.02	124.87	1.01	125.89	1.02	132.02	1.02	133.72	1.01	146.31	1.03
Kerosene	113.38	1.00	123.56	1.00	123.90	1.00	130.01	1.00	131.71	1.00	142.57	1.00
HSDO(Diesel Index).	78.45	0.82	107.40	0.87	107.72	0.87	115.71	0.89	116.03	0.88	126.26	0.89
LDO(Indl. diesl).	89.17	0.79	94.74	0.77	103.10	0.83	103.72	0.80	103.72	0.79	-	-
F.O.(Light fuel oil).	67.62	0.60	72.71	0.59	72.71	0.59	78.37	0.60	79.79	0.61	76.39	0.54

Source:-PLATT's OIL GRAMS.

8.4 POSTED AIRFIELD PRICES OF JET A-1 FUEL AT MAJOR INTERNATIONAL AIRPORTS AS ON 1.4.1977 & 1.1.1978 & 1.6.78.

Country/Airfield	JET A-I Price		
	USC/USG 1.4.77	USC/USG 1.1.78	USC/USG 1.6.78
Australia			
Perty	41.35	49.93	50.29
Sydney	41.35	49.93	50.29
Bahrain	59.01	60.01	60.01
Belgium			
Brussels.	65.95	66.15	66.75
Egypt			
Cairo.	64.00	64.00	66.00
Ethiopia			
Addisabba	76.31*	76.31*	76.31*
France			
Paris(Orly)	56.32	58.07	60.46
Germany			
Frankfurt	70.15	70.15	79.08
Holland			
Amsterdam (Schiphol)	63.90	66.99	71.30
Italy			
Rome(Fimicino)	63.00	63.80	66.03
Kenya			
Nairobi	67.40*	67.40*	67.40*
Lebanon			
Beirut	70.00	70.00	70.00
Malaysia			
Kuala Lumpur	57.64	57.64	57.64
Mauritius			
Plaisance	63.20	63.20	65.20
Singapore			
Paya Lebor	54.83	54.83	54.83
Switzerland			
Geneva	70.41	74.86	82.33
United Arab Emirate			
Abu Dhabi	60.01	60.01	60.01
Sharajah	60.01	60.01	60.01
United Kingdom			
London(Heathrow)	58.73	63.38	63.38

*Less Rebate 2.00 USC/USG

Colombo	55.07	55.07	55.07
Karachi	73.88	73.88	73.88
Kuwait (35.80 fils/lts)	47.12	48.91(Note1)	48.91
New York	36.46	38.46(Note2)	39.94
Teheran(8.50 rials/lts)	46.38	45.78(Note1)	45.78
Tokyo	42.25	43.07(Note3)	48.95(Narita)

Note:1-Monopoly price.
Note:2-(Lawful Price-Domestic Fuel)
Note:3-Air India Contract Price.PAP not available

COUNTRY WISE PROFILES OF OPEC

1. Algeria

Area ('000 Sq.Km.) 2382
Population (1977 mid.) 17910
Density/Sq.Km. 8

	Unit	1972	1973	1974	1975	1976	1977
1. International reserves	Million $	493	1143	1689	1353	1987	1917
2. Exports	Million Dinars	5854	7479	19241	17535	21499	21701
3. Petroleum exports	-do-	4614	6214	17538	16026	19814	19909
4. Imports c.i.f.	-do-	6694	8876	16922	23148	22723	-
5. Exchange rate**	Algerian Dinar per US$	4.556	4.185	3.997	4.125	4.359	4.035
6. GNP at current price	Million US $	6026	7431	-	-	-	-
7. Population (mid year)	Million	15.27	15.77	16.28	16.78	17.30	17.91

8. Govt. revenue/ expenditure*		1972/73	1973/74	1974/75	1975/76
Revenue	Million Dinars	8702	10310	14180	21995
Expenditure	Million Dinars	8935	10620	14173	21854

9. Trade with India		1971-73	1973-74	1974-75	1975-76	1976-77	1977 (April-Dec.)
Imports from India	Rs./@ crores	0.16	0.19	0.20	1.54	2.43	4.21
Exports to India	Rs./@ crores	0.21	0.14	-	-	0.10	0.27
Balance of Trade with India		0.05	(-)0.05	(-)0.20	(-)1.54	(-)2.33	(-)3.94

* Refers to Algerian Financial year.

@ Refers to Indian Financial year.

** Exchange rate = Market rate/par rate.

2. Indonesia

Area ('000 Sq.Km.)	1904
Population('000)(1977 mid)	139620
Density per Sq.Km.	73

	Unit	1972	1973	1974	1975	1976	1977
1. International Reserve	Million $	574	807	1492	586	1499	2516
2. Reserve position in IMF	-do-	-	-	35	-	-	83
3. Exports	Million US $	1534	3061	7449	7103	8547	10853
4. Petroleum exports	-do-	913	1609	5211	5282	6004	7492 E
5. Imports c.i.f.	-do-	1562	2729	3842	4770	5673	6230
6.(i) Exports price index(1970=100)		136	197	429	454	477(E)	-
(ii) Export Price Index(1975 = 100)	"	30	43	95	100	105	-
7. Market ex-rate at the end of period (Rupiah/US $)	"	415	415	415	415	415	415
8. GNP at current price	Billion Rupiah	4405	6508	10201	12087	15035	n.a.
9. Population (mid year)	Million	122.61	125.84	129.15	132.55	136.04	139.62

9. Govt. revenue/expenditure*		1972/73	1973/74	1974/75	1975/76
Revenue	Billion Rupiah	748	1172	1577	2735
Expenditure	Billion Rupiah	736	1164	1577	2735

10. Trade with India@	1972-73	1973-74	1974-75	1975-76	1976-77	1977(April-December)
Imports from India Rs./	5.30	26.78	50.94	52.02	60.55	23.67
Exports to India crores	0.27	0.41	2.64	3.44	2.88	14.71
11. Balance of trade with India	(-)5.03	(-)26.37	(-)48.30	(-)48.58	(-)57.67	(-)8.96

(E) = Estimated.
* Refers to Indonesian financial year.
@ Refers to Indian financial year.

3. Iran

Area ('000 Sq.Km.) 1648
Population('000)(1976 mid) 33900
Density per sq.km. 21

	Unit	1972	1973	1974	1975	1976	1977
1. International reserves	Million US $	960	1236	8383	8897	8833	12266
2. Reserve position in IMF	-do-	21	58	517	1122	1160	1197
3. Oil facility lending	-do-	-	-	458	1066	1081	1116
4. Exports	Billion Rials	306	426	1459	1367	1651	1712
5. Petroleum exports	-do-	276	387	1414	1328	1609	1666
6. Imports c.i.f.	-do-	183	233	367	700	905	994
7. Exports price index	1970 = 100	140	170	565	602	664	-
	1975 = 100	19.0	25.4	93.2	100.0	106.4	117.1
8. Exchange rate**	Rials/US $	76.38	67.625	67.625	69.275	70.625	70.475
9. GNP at current prices	Billion Rials	1235	1826	3150	3574	4684	-
10. Population(mid year)	Million	30.55	31.30	32.14	33.02	39.90	-

11. Govt. revenue/expenditure*		1972/73	1973/74	1974/75	1975/76	1976/77
Revenue	Billion Rials	323	449	1427	1627	1802
Expenditure	-do-	380	504	1287	1614	1850

12. Trade with India @		1972-73	1973-74	1974-75	1975-76	1976-77	1977(April-December)
Imports from India	Rs./	24.77	42.78	214.83	270.82	144.58	83.87
Exports to India	crores	121.46	267.58 (256.39)	472.66 (451.88)	459.29 (285.01)	507.87	434.40
13. Balance of Trade with India		+121.46	+224.80	+257.83	+188.46	+363,29	+350.53

(Figures in brackets include POL/crude oil).

*Refers to Iranian financial year.

@Refers to Indian financial year.

**Exchange rate = Market rate/Par rate.

4. Iraq

Area ('000 Sq.Km.)	438
Population('000)(1977 mid)	11910
Density per Sq.Km.	27

	Unit	1972	1973	1974	1975	1976	1977
1.International reserves	Million US $	782	1553	3273	2727	4601	6996
2.Reserves in IMF	-do-	19	33	33	32	32	33
3.(i)Exports(all)	Million Dinars	369	588	1949	2450	2738	2854
(ii)Exports POL	-do-	340	555	1921	2415	2691	2807
4.Imports c.i.f.	-do-	235	270	700	1245	1025	-
5.Exports prices index	1970=100	131	155	524	560	599	-
	1975=100	19	26	94	100	107	117
6.Exchange rate at the end of year **	U.S. $/ Dinar	2.98	3.386	3.386	3.386	3.386	3.386
7.GNP at current price	Million Dinars	1338.5	1451.0	3032.8	3802.4	-	-
8.Population	Million	10.07	10.41	10.77	11.12	11.51	11.91

9.Govt.revenue/expenditure*		1972/73	1973/74	1974/75	1975/76
Revenue	Million dinars	574	675	3028	3203
Expenditure	-do-	589	675	3649	3641

10.Trade with India@		1972-73	1973-74	1974-75	1975-76	1976-77	1977 (Apl-Dec.)
Imports from India	Rs./ crores	10.98	20.25	72.85	64.60	46.51	44.14
Exports to India		6.60	61.24 (56.76)	251.46 (238.85)	247.61 (183.01)	280.17	217.09
11.Balance of trade with India		-4.38	+40.99	+178.61	+183.01	+233.66	+172.95

(Figures in brackets includes crude/POL, etc.)

* Refers to Iraqi financial year.

@ Refers to Indian financial year.

** Exchange rate = Market rate/Par rate.

5. Kuwait

Area ('000 Sq.Km.) 16
Population('000)(1977 mid) 1090
Density per sq.km. 68

	Unit	1972	1973	1974	1975	1976	1977
1. International reserve	Million US $	363	501	1399	1655	1929	2990
2. Oil facility landing	-do-	-	-	276	613	796	821
3. Exports	Million Dinars	841	981	2090	2507	2873	2816
4. Petroleum Exports	-do-	780	895	2724	2287	2617	2544
5. Imports c.i.f.	-do-	262	311	455	693	970	-
6. Ex.rate at the end of year**							
a) SDR/Dinar		2.810	2.794	2.820	2.904	2.995	2.939
b) US $/Dinar		3.051	3.371	3.453	3.400	3.485	3.570
7. GNP	Million Dinars	1200	1769	3169	3503	-	-
8. Population	Million	0.850	0.890	0.940	1.000	1.030	1.090

9. Govt. revenue/expenditure*		1972/73	1973/74	1974/75	1975/76
Revenue	Million Dinars	629	715	2750	2580
Expenditure	-do-	399	477	917	869

10. Trade with India ○		1972-73	1973-74	1974-75	1975-76	1976-77	1977 (Apl-Dec.)
Imports from India	Rs.crores	14.95	21.23	38.98	45.59	112.76	89.03
Exports to India	-do-	25.51	71.13	63.70	62.63	77.29	28.42
11. Balance of trade with India.		+10.56	+49.90	+24.72	+17.04	-35.47	-60.61

* Refers to Kuwait financial year, beginning on 1st April.

○ Refers to Indian financial year.

** Exchange rate = Market rate/Par rate.

6. Libya

Area ('000 Sq.Km.) 1760
Population('000)(1975 mid) 2440
Density per sq. km. 1

	Unit	1972	1973	1974	1975	1976	1977
1. International reserve	Million U.S.$	2925	2127	3616	2195	3206	4891
2. Exports	Libyan million dinar	798	1032	2111	1805	2499	2994
3. Exports of crude oil	-do-	796	1032	2110	1804	2497	2991
4. Imports of c.i.f.	-do-	343	540	818	1062	948	-
5. Export price index	1975=100	26	37	111	100	106	120
6. Exchange rate **							
a) SDR/Dinar		2.80	2.80	2.76	2.89	2.91	2.78
b) US $/Dinar		3.04	3.350	3.378	3.378	3.378	3.378
7. GNP at current prices	Million Libyan Dinar	1523	1928	3534	3497	-	-
8. Population	Million	2.16	2.25	2.35	2.44	-	-

9. Govt. revenue/expenditure*		1972/73	1973/74	1975/75	1975/76
Revenue	Million Libyan Dinar	599	736	1050	1550
Expenditure	-do-	599	736	1050	1550

10. Trade with India @		1972-73	1973-74	1974-75	1975-76	1976-77	1977 (Apl-Dec)
Imports from India	Rs/crores	3.55	5.06	8.61	3.90	13.11	17.62
Exports to India	-do-	neg.	neg.	neg.	neg.	neg.	neg.
11. Balance of trade with India		-3.55	-5.06	-8.61	-3.90	-13.11	-17.62

* Refers to Libyan financial year.

@ Refers to Indian financial year.

** Exchange rate = Market rate/Par rate. neg. = Negligible.

7. Nigeria

Area ('000 Sq.Km.) 924
Population('000)(1976 mid) 64750
Density per sq. km. 70

	Unit	1972	1973	1974	1975	1976	1977
1. International reserve	Million $	376	583	5626	5609	5203	4262
2.i) Reserve in IMF	-do-	14	40	41	248	388	413
ii) Of which oil faciling lending	-do-	-	-	-	207	349	360
3. Exports	Million Naire	1412	2277	5795	4988	6358	-
4. Imports c.i.f.	-do-	990	1225	1737	3722	5140	-
5. Exports price index	1970=100	117	172	432	444	-	-
	1975=100	23	39	102	100	112	-
6. Exchange rate **	US $/Naire	1.52	1.52	1.623	1.596	1.585	1.535
	SDR/Naire	1.40	1.26	1.325	1.363	1.365	1.264
7. GDP	Million Naire	7703	9001	14424	15449	-	-

8. Govt. revenue/expenditure*		1972/73	1973/74	1975/75	1975/76	76/77
Revenue	Million Naire	1023	1769	4190	4712	5523
Expenditure	-do-	898	1207	2646	n.a.	6964

9. Trade with India@		1972-73	1973-74	1974-75	1975-76	1976-77	1977 (Apl-Dec)
Imports from India	Rs./	9.65	11.48	21.87	37.13	24.97	18.89
Exports to India	crores	neg.	0.03	0.01	1.85	neg.	1.04
10. Balance of Trade with India		-9.65	-11.45	-21.86	-35.28	-24.97	-17.85

* Refers to Nigerian financial year, beginning with 1st April.

@ Refers to Indian financial year.

** Exchange rate = Market rate/Par rate.

neg. = Negative.

8. Saudi Arabia

Area ('000 sq.km.) 2240
Population('000)(1976 mid) 9240
Density per sq.km. 4

	Unit	1972	1973	1974	1975	1976	1977
1. International reserves	Million $	2500	3877	14285	23319	27025	30034
2.i) Reserve position in IMF	-do-	36	40	729	1838	2563	2693
ii) Oil facility lending	-do-	-	-	688	1774	2498	2581
3. Exports	Billion Riyals	19	28	110	98	128	144
4. Crude Petroleum exports	-do-	19	28	110	97	127	144
5. Imports c.i.f.	-do-	4.71	7.31	10.15	14.82	30.69	-
6. Export price index	1975=100	19.1	26.1	93.0	100.0	107.0	114.6
7. Exchange rate at the end of period :**							
a) Riyals/SDR		4.5051	4.2825	4.3464	4.1324	4.1013	4.2576
b) Riyals/US $		4.150	3.550	3.530	3.530	3.530	3.505
8. GNP at current prices	Million Riyals	22577	30094	82349	130487	145431	-
9. Population (mid year)	Million	8.20	8.45	8.71	8.97	9.24	-

10. Govt. revenue/expenditure *		1972/73	1973/74	1974/75	1975/76
Revenue	Billion Riyals	13.2	22.81	98.25	110.94
Expenditure	-do-	13.2	22.81	98.25	95.85

11. Trade with India ○		1972-73	1973-74	1974-75	1975-76	1976-77	1977 (Apl-Dec)
Imports from India	Rs./crores	12.14	25.71	35.54	59.79	74.37	94.87
Exports to India	-do-	44.83 (n.a.)	131.35 (129.49)	297.65 (296.64)	290.11 (285.07)	331.98	185.67
12. Balance of trade with India.		32.69	105.64	262.11	230.32	257.61	90.80

* Refers to Saudi Arabian financial year ending 30th June.
○ Refers to Indian financial year.
** Exchange rate = Market rate/Par rate.
(Figures in brackets includes crude oil/POL products etc.).

9. Venezuela

Area ('000 sq.km.) 912
Population('000)(1977 mid) 12740
Density per sq. km. 14

	Unit	1972	1973	1974	1975	1976	1977
1.International reserve	Million US $	1732	2412	6513	8861	8578	8214
2. Reserve position in IMF	-do-	121	134	491	942	1075	1011
3.Oil facility lending	-do-	-	-	308	704	709	679
4. Exports	Million Bolivares	13754	21020	46418	37706	39894	40724
5.Petroleum exports	-do-	12571	18632	44185	35668	37593	38593
6.Imports c.i.f.	-do-	10608	12094	17955	25840	-	-
7.Export prices index	1970=100	134	197	556	559	662	-
	1975=100	22	33	94	100	104	114
8.Exchange rate at the end of period **							
i)Bolivares/SDR		4.723	5.169	5.246	5.016	4.987	
ii) Bolivares/US $		4.350	4.285	4.285	4.285	4.293	
9.Population (mid year)	Million	10.94	11.28	11.63	11.99	12.36	12.74

10.Govt.revenue/expenditure*		1972/73	1973/74	1974/75	1975/76
Revenue	Million Bolivares	12192	16054	42558	40899
Expenditure	-do-	12543	14817	39041	n.a.

11. Trade with India ○		1972-73	1973-74	1974-75	1975-76	1976-77	1977 (Apl-Dec)
Imports from India	Rs/crores	0.18	neg.	0.22	1.10	4.03	1.49
Exports to India	-do-	-	0.22	0.31	0.09	0.20	0.45
12.Balance of trade with India		-0.18	0.22	0.09	-1.01	-3.83	-1.04

* Refers to Venezulian financial year.

○ Refers to Indian financial year.

** Exchange rate = Market rate/Par rate.

10. Qatar

Area ('000 sq.km.) 22
Population ('000) (1976 mid) 98
Density per sq. km. 5

	Unit	1972	1973	1974	1975	1976	1977
1. International reserves	Million $	28.7	75.5	71.7	104.4	137.1	162.2
2. Reserves position in IMF	-do-	5.4	6.0	6.1	15.3	18.8	17.6
3. Exports	Million Qatar Rials	1740	2467	7956	7107	8754	8107
4. Petroleum crude exports	-do-	1674	2399	7814	6906	8467	8037
5. Imports c.i.f.	-do-	606	778	1070	1622	3290	-
6. Crude oil production index	1970=100	131	152	141	121	135	-
	1975=100	110	130	118	100	114	102
7. Petroleum prices index	1970=100	115	156	564	595	625	-
	1975=100	19.4	26.3	94.8	100.0	105.2	117.1
8. Volume of crude petroleum exports index	1970=100	136	161	144	121	137	122
9. Population	Million	0.084	0.085	0.087	.090	.098	-
10. Exchange rate market rate/par rate :							
SDR per Rial		0.210	0.2100	0.2069	0.2142	0.2175	0.2079
US $/per Rial		0.228	0.2533	0.2533	0.2508	0.2526	0.2525

11. Govt. revenue/expenditure*		1972-73	1973/74	1974/75	1975/76
Revenue	Million Qatar	700	1735	7319	-
Expenditure	-do-	700	1354	2964	-

12. Trade with India ◊		1972-73	1973-74	1974-75	1975-76	1976-77	1977 (Apl-Dec)
Imports from India	Rs/crores	3.27	6.93	8.64	10.28	19.30	14.02
Exports to India	-do-	0.03	0.01	neg.	3.70	13.74	3.89
13. Balance of trade with India		-3.24	-6.92	-8.64	-6.58	-5.56	-10.13

* Refers to Qatar financial year.

◊ Refers to Indian financial year.

11. U.A.E.

	Unit	1972	1973	1974	1975	1976	1977
1. International reserves	Million US $	-	91.7	452.9	988.6	1928.6	824.4
2. i) Reserve position in IMF	-do-	4.1	4.5	85.2	134.4	132.6	117.2
ii) Oil facility lending	-do-	-	-	78.1	117.1	116.2	102.0
3. Exchange rate :							
i) Dirham per SDR		4.762	4.835	4.874	4.676	4.621	4.735
ii) Dirham per US $		4.386	4.008	3.981	3.994	3.977	3.898
4. Exports	Million Dirham	4745	7198	25305	27250	33770	37038
5. Crude petroleum exports	-do-	4541	6953	24966	26647	32566	35657
6. Export prices	1975=100	19.8	27.6	98.2	100.0	107.1	115.8
7. Population (mid year)	Million	.198	1.320	0.450	0.656	-	-

8. Trade with India	1973-74	1974-75	1975-76	1976-77	1977-78 (Apr-Dec.)
Imports from India	Rs/crores 25.88	44.85	64.87	160.60	110.20
Exports to India	-do- 0.14	0.40	81.59	84.53	66.74
9. Balance of trade with India	25.74	44.45	16.72	76.07	43.46

12. Gabon

Area ('000 sq.km.) 268
Population('000) 534
(1976 mid)
Density per sq.km. 2

	Unit	1972	1973	1974	1975	1976	1977
1. International reserves	Million $	23.25	47.88	103.32	146.10	116.17	-
2. Reserve position in IMF	-do-	2.66	2.99	3.07	2.99	2.96	3.10
3. Exports	Billion CFA France	58.90	84.73	184.34	201.92	271.45	247.26
4. Petroleum exports	-do-	23.99	27.51	161.07	171.68	194.76	209.03
5. Imports c.i.f.	-do-	34.11	35.54	79.89	95.38	120.02	-
6. Volume of exports index	1970=100	119	145	206	209	-	-
7. Population	Million	.516	.520	.522	.528	.534	-
8. GNP	Billion CFA Franc	98.9	146.6	344.5	-	-	-
9. Market rate/par rate of exchange :							
CFA Franc per SDR		278.21	283.97	272.08	262.54	288.70	285.76
CFA France per US $		256.25	235.40	222.22	224.27	248.49	235.25

10. Trade with India	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78 (Apl-Dec)
Imports from India Rs/crores	0.06	-	0.01	0.01	0.15	0.08
Exports to India -do-	neg.	neg.	-	-	neg.	neg.
11. Balance of trade with India	-0.06	-	-0.01	-0.01	-0.15	-0.08

13. Oman

	Unit	1972	1973	1974	1975	1976	1977
1. International reserves	Million US $	161.8	107.1	193.7	239.0	308.9	400.8
2. i) Reserve position in IMF at the end of period	-do-	1.9	2.1	18.8	28.6	29.1	23.6
ii) Oil facility lending	-do-	-	-	14.2	23.0	23.4	20.0
3. Exports total	Million Oman Riyals	89	115	393	499	544	544
4. Exports of crude petroleum	-do-	88	114	392	498	543	542
5. Imports c.i.f.	-do-	19	41	136	254	251	302
6. Export prices index	1975=100	19.8	27.1	95.0	100.0	103.9	114.4
7. Exchange rate :							
i) Oman Rials per SDR		0.4167	.4167	.4229	.4043	.4013	.4196
ii) Oman Rials per US $		.3838	.3454	.3454	.3454	.3454	.3454
8. GDP	Million Omani Rials	141	169	569	739	839	873
9. Population (mid year)	Million	.70	.72	.74	.77	.79	-

10. Trade with India		1975/76	1976/77	1977 (April-Dec.)
Imports from India	Rs. crores	19.46	30.01	22.43
Exports to India	-do-	4.91	0.43	0.54
11. Balance of Trade with India.		(-)14.55	(-)29.58	21.89

10 TRADE

10.1 Overall Balance of International Payments, 1976 & 1977.*

(million SDRs)

	1976	1977
Industrial countries	4045	3274
Austria	47	325
Belgium Luxembourg	523	223
Canada	476	1158
Denmark	50	698
France	2361	297
Germany Fed Rep.	2916	3907
Italy	253	4676
Japan	3290	5529
Netherlands	278	284
Norway	24	104
Sweden	468	922
Switzerland	2578	521
United Kingdom	793	11674
United States	9064	29972
Oil Exporting countries	7623	8404
Algeria	551	73
Indonesia	792	851
Iran	31	2893
Iraq	1631	2031
Kuwait	239	863
Libya	876	1431
Nigeria	339	833
Saudi Arabia	3220	2475
Venezuela	221	375
Other	905	859
Other primary producing countries	6989	9553
More developed countries	1289	713
Australia	314	719
Finland	91	54
Greece	83	121
Iceland	3	17
Ireland	263	448
Malta	107	93
New Zealand	5	46
Portugal	367	53
South Africa	636	124
Spain	962	1081
Turkey	73	308
Yugoslavia	859	149
Less developed countries	8278	8840
Other Western Hemisphere	3605	3224
Other Middle East & Africa	142	1552
Other Asia	4531	4064
Total	10567	14683

*Overall balances are measured here by changes in official gold holdings, in SDRs, in reserve position in the Fund, in foreign exchange reserves, in other officially held foreign assets, in use of IMF credit, and, where data are available, in liabilities to foreign monetary authorities.

**Comprisis of Oman, Qatar, and the United Arab Emyrates.

10.2 Growth of World Trade in pre and post oil crisis period

(Billion U.S. $)

	Exports					Imports				
	1973	1974	1975	1976	1977	1973	1974	1975	1976	1977
1. Industrial countries	376.4	504.2	537.7	597.5	677.1	386.2	545.0	545.9	632.9	719.1
2. Other Europe	22.8	30.3	32.0	36.5	40.1	34.4	53.0	56.0	59.5	65.1
3. Australia, Newzeland and South Africa	18.3	22.2	23.0	23.9	26.5	15.0	23.9	22.6	23.0	23.3
4. Oil exporting countries	39.3	117.8	109.4	133.1	144.8	19.9	32.2	51.2	62.7	84.2
5. Other less developed areas	67.4	97.7	93.9	115.4	135.2	78.4	131.4	137.8	144.3	161.7
6. India	2.9	3.9	4.3	5.0 (4.982)	5.7	3.2	5.0	6.1	5.0 (4.958)	5.8
WORLD TOTAL:	524.2	772.2	796.1	906.3	1023.8	534.9	785.5	813.5	922.3	1053.4

(Figures in brackets actuals. These have been rounded).

Source: IMF's International Financial Statistics, July 1978.

Note: Excluding Eastern Touching area.

10.3 Industrial Countries: Changes in Output and Prices

(per cent)

	Annual average 1963-73	Change from preceding year 1974	1975	1976	1977	1978
Real Gross National Product						
Canada	5.7	3.7	1.1	4.9	2.6	4.5
United States	4.0	- 1.4	-1.3	6.0	4.9	4.5
Japan	10.3	-1.3	2.5	6.0	5.1	5.7
France	5.9	2.3	0.1	5.2	2.7	3.1
Germany, Fed.Rep.	4.8	0.4	-2.5	5.7	2.5	3.1
Italy	4.8	3.9	-3.5	5.6	1.7	2.6
United Kingdom 3	2.6	-0.8	-1.4	2.3	0.8	2.9
Other countries 4	4.6	3.5	-1.9	3.5	1.9	2.2
All industrial countries	4.8	0.1	-0.9	5.4	3.7	4.0
Seven larger countries[5]	4.8	-0.3	-0.8	5.6	3.9	4.2
European countries	4.5	1.7	-1.8	4.5	2.1	2.8
GNP Deflator						
Canada	4.3	14.9	11.2	9.6	6.5	6.0
United States	3.9	9.6	9.6	5.4	5.5	6.2
Japan	5.6	20.7	7.4	6.4	6.3	3.9
France	4.6	11.6	12.9	9.7	9.3	8.1
Germany, Fed.Rep.	4.3	6.9	7.1	3.3	3.6	3.5
Italy	5.3	17.7	17.3	17.8	18.3	12.5
United Kingdom[3]	6.2	14.5	28.0	15.1	15.4	9.5
Other countries[4]	5.5	9.7	11.1	7.7	7.2	6.3
All industrialised countries	4.6	11.9	10.9	7.3	7.0	6.2
Seven larger countries[3]	4.5	12.1	10.9	7.2	7.0	6.1
European countries	5.1	10.9	13.5	9.2	9.0	7.0

Note: Both in this table and in the companion tables, the projections are based upon several broad assumptions or working hypotheses: (1) that average exchange rates for February 1978 will prevail in subsequent months through the first half of 1979; (2) that 'present policies' of national authorities will be maintained through the first half of 1979; and (3) that the U.S.dollar price of oil will remain unchanged.
1 Compound annual rates of change. 2 Seasonally adjusted changes, at annual rate. 3 Gross domestic product. 4 Includes Austria, Belgium-Luxembourg, Denmark, the Netherlands, Norway, Sweden and Switzerland. 5 As listed separately, above.

Source: I.M.F.Survey, May 8, 1978.

10.4 Exports & Imports of Oil Producing Countries in relation to World Exports & Imports and India's trade.

(Million U.S. $)

Country		1973	1974	1975	1976	1977
1. Algeria	Exports	1897	4599	4430	5163	5233
	Imports	2242	4058	5855	5311	6952
2. Indonesia	Exports	3061	7426	7103	8547	10853
	Imports	2720	3842	4770	5673	6230
3. Iran	Exports	6263	21575	20211	23502	24246
	Imports	3393	5433	10343	12894	13750
4. Iraq	Exports	2193	6600	8297	9272	9664
	Imports	906	2371	4215	3470	4052
5. Kuwait	Exports	3447	9854	8644	9844	9839
	Imports	1052	1552	2390	3324	4796
6. Libya	Exports	3454	7129	6098	8442	9666
	Imports	1737	2762	3586	3211	5148
7. Nigeria	Exports	3466	9218	7990	10566	11796
	Imports	1865	2776	6041	8200	10050
8. Oman	Exports	330	1135	1445	1567	-
	Imports	169	711	668	-	-
9. Qatar	Exports	619	2015	1791	2129	-
	Imports	195	271	413	817	-
10. Saudi Arabia	Exports	7707	30991	27737	36124	40932
	Imports	1944	2859	4214	8694	17196
11. U.A.E.	Exports	1936	6392	6879	8542	9490
	Imports	821	1705	2669	3327	4583
12. Venezuela	Exports	4892	10834	8800	9299	9487
	Imports	2825	4191	6031	7058	9269
13. Total oil producing countries	Exports	39300	117771	109443	133085	144795
	Imports	19900	32212	51196	62683	84205
14. Total World	Exports	524400	772200	796100	906300	1023800
	Imports	535300	785500	813500	922300	1053400
15. % of 13 to 14	Exports	7.5%	15.3%	13.8%	14.4%	14.1%
	Imports	3.7%	4.3%	6.6%	7.3%	8.0%
16. India's Trade	Exports	2917	3926	4299	5013	5655
	Imports	3210	5046	6135	5094	5843

Note: Minor variations in world exports/imports are due to rounding of.

Source: International Financial Statistics, 1978 issues.

10.5 Export unit value indices of oil exporting countries, India and the industrialised countries.

Indices of unit values(prices) in terms of U.S. $
(1975 = 100)

	1974	1975	1976	1977
I. Oil exporting countries				
Indonesia	95	100	105	-
Iran	98	100	106	117
Iraq	94	100	107	117
Kuwait	94	100	106	117
Libya	111	100	106	120
Nigeria	100	100	110	-
Saudi Arabia	93	100	107	115
U.A.E.	98	100	107	116
Venezuela	93	100	104	114
Total oil expoorting countries	95	100	107	117
II. India, China & other Asian countries				
India	93	100	99	-
China	106	100	102	109
Total Asian countries	108	100	104	-
III. All Industrialised countries (USA, Canada, Japan, France, UK, Germany, Netherlands, Italy, etc.)	89	100	100	109
IV. WORLD	92	100	102	-

Source:-International Financial Statistics.

10.6 India's P.C.L. imports as proportion of its total exports, unit values of crudes imports and impact on its overall terms of trade.

(Rs./crores)

Year	Value of POL imports	Value of exports	% of POL imports to toal exports	Unit values(CIF) of crude oil imports(Rs/MT)	Unit value index Exports	Unit value index Imports	Net terms of trade
1.	2.	3.	4.	5.	6.	7.	8.
1972-73	207	1971	10.5%	121	120	97	124
1973-74	541	2523	21.4%	300	146	138	106
1974-75	1110	3329	33.3%	654	183	239	77
1975-76	1249(P)	4043	30.9%	755	197	280	70
1976-77	1447(P)	5146	28.1%	832	210	278	76
1977-78	1556(P)	5253	29.6	855	n.a.	n.a.	n.a.

Note:- The net terms of trade is the ratio of overall export unit value indices to similar import indices.

(P) = Provisional. n.a. = Not available.

10.7 Oil Revenue of Main CPEC Countries.*

($ Million)

Country	1972	1973	1974	1975	1976	1977	% change 1977/1976
Venezuela	1948	2670	8700	7525	8500	8000	- 5.9
Algeria	700	900	3700	3375	4500	5600	+24.4
Libya	1598	2300	6000	5100	7500	9400	+25.3
Nigeria	1174	2200	8900	6570	8500	9400	+10.6
Iran	2380	4100	17500	18500	22000	23000	+ 4.5
Iraq	575	1843	5700	7500	8500	9600	+12.9
Kuwait	1657	1900	7000	7500	8500	8500	-
Qatar	255	409	1600	1700	2000	1900	- 5.0
Saudi Arabia	3107	4340	22574	25676	33500	37800	+12.8
U.A.E.	551	900	5536	6000	7000	8300	+18.6
Indonesia	429	950	3300	3850	4500	5600	+24.4
Total:	14374	22512	90510	93296	115000	127100	+10.5

* Excludes Gabon and Ecuador.

10.8 Revenues per barrel of Exports

$ / bbl

Country	1972	1973	1974	1975	1976	1977	% change 1977/1976
Venezuela	1.72	2.33	8.71	9.61	11.64	10.96	- 5.8
Algeria	1.88	2.43	10.48	10.20	12.33	13.95	+13.1
Libya	1.97	2.90	11.03	9.61	11.42	12.88	+12.8
Nigeria	1.87	3.00	11.07	10.56	11.64	12.88	+10.6
Iran	1.36	2.08	8.72	10.14	11.16	12.12	+ 8.6
Iraq	1.51	2.76	8.91	9.55	11.09	12.52	+12.9
Kuwait	1.36	1.71	7.46	10.03	11.09	12.26	+10.5
Qatar	1.45	1.97	8.42	10.63	10.96	13.01	+18.7
Saudi Arabia	1.44	1.57	7.28	9.95	11.06	11.77	+ 6.4
U.A.E.	1.43	1.62	9.17	9.97	10.65	11.97	+12.4
Indonesia	1.24	2.57	8.71	10.61	12.27	10.96	-10.7

Source : Petroleum Economist Limited, July-August 1978.

10.9 Trend in International Reserves-World, Industrial countries, oil producing countries and India (1970 - 1978).

International Reserves (SDR million)

	As at the end of period							
	1970	1973	1974	1975	1976	1977 IV Qr.	1978 (March)	% growth March 1978 over 1973
1. Industrial countries	65806	95750	97935	104112	113482	139402	143592	50%
of which								
U.S.A.	11487	11919	13116	13568	15768	15965	15757	32%
Japan	4840	10151	11042	10947	14292	19149	23957	136%
France	4960	7070	7230	10757	8373	8392	8273	17%
Germany	13610	27497	26461	26510	29954	32713	34150	24%
Italy	5352	5335	5669	4078	5727	9556	8548	60%
U.K.	2827	5368	5667	4663	3641	17335	17002	217%
2. Oil exporting countries	5013	12033	38384	48292	56149	62133	59587	395%
of which								
Iran	208	1025	6847	7429	7603	10098	10094	885%
Iraq	462	1287	2673	2330	3960	5759	-	347% *
Kuwait	203	415	1143	1414	1660	2461	2587	523%
Libya	1590	1763	2953	1875	2759	4026	3909	122%
Saudi Arabia	662	3214	11667	19920	23261	24725	23229	623%
Venezuela	1021	1999	5320	7569	7383	6762	6729	237%
3. Other Countries	22429	44449	43728	41856	51268			
4. ALL COUNTRIES	93252	152262	180173	194453	222353	262423	267167	75%
5. India	1006	947	1082	1173	2646	4268	4535 (Feb. '78)	379%

Source:- International Financial Statistics of I.M.F.

* Percentage increase in 1977 over 1973.

10.10 International Reserves of Oil Producing/Exporting Countries.

(Million U.S. $)

Countries	1972	1973	1974	1975	1976	1977
1. Algeria	493	1143	1689	1353	1987	1917
2. Indonesia	574	807	1492	586	1499	2516
3. Iran	960	1236	8383	8897	8833	12266
4. Iraq	782	1553	3273	2727	4601	6996
5. Kuwait	363	501	1399	1655	1929	2990
6. Libya	2925	2127	3616	2195	3206	4891
7. Nigeria	376	583	5626	5603	5203	4262
8. Qatar	29	76	72	104	137	162
9. Saudi Arabia	2500	3877	14285	23319	27025	30034
10. U.A.E.	–	92	453	989	1929	824
11. Venezuela	1732	2412	6513	8861	8578	8214
12. Oman	162	107	194	239	309	401
13. Gabon	23	48	103	146	116	–

10.11 International Reserves of oil exporting countries

(Million SDRs)

Countries	1972	1973	1974	1975	1976	1977	1978 (March)
Oil exporting countries	10040	12033	38384	48292	56149	62133	59587
Algeria	454	948	1379	1155	1711	1579	1305
Indonesia	529	669	1219	501	1290	2071	1867
Iran	884	1025	6847	7600	7603	10098	10094
Iraq	720	1287	2673	2330	3960	5759	n.a.
Kuwait	335	415	1147	1414	1660	2461	2587
Libya	2694	1763	2953	1875	2759	4026	3909
Nigeria	346	483	4595	4791	4478	3509	3158
Saudi Arabia	2303	3214	11667	19920	23261	24725	23229
U.A.E.	–	76	370	845	1660	679	654
Venezuela	1595	1999	5320	7569	7383	6762	6729

n.a. = Not available.

Source: International Financial Statistics, June 1978.

11.1 Oil facility drawings from I.M.F. (1974-1977) by group of countries, and cumulatively upto 31 May 1978

(In million SDRs)

	1974	1975	1976	1977	Net oil facilities drawing upto 31st May 1978
1. Industrial and other European countries	865.7	1662.8	1596.4	-	4124.9
2. Australia & Newzeland ..	85.7	106.1	46.9	-	238.7
3. Other less developed areas of which:	764.5	1274.4	500.1	-	2538.9
A. Latin American countries, etc.	156.1	306.1	156.1	-	618.2
B. Middle-East other than oil exporting countries ..	15.7	152.1	61.1	-	228.9
C.(i) Asian countries other than oil exporting countries	462.7	577.3	187.2	-	1027.0
(ii) of which India	200.0	201.3	-	-	401.3
D. African countries other than oil exporting countries ..	130.0	238.9	95.7	-	464.6
TOTAL WORLD	1715.9	3043.3	2143.3	-	6902.4

Source :- I.M.F.'s International Financial Statistics- July, 1978.

11.2 Major oil facility drawings from I.M.F. during 1974 - 1976

(Million SDRs)

Countries	1974	1975	1976	Total drawing upto end of 1977	Outstanding oil facility 31.12.1977 (Mn. $)
1. Italy	675.0	780.2	-	1455.2	1748
2. U.K.	-	-	1000.0	1000.0	1215
3. Spain	-	496.2	75.9	572.1	695
4. Turkey	-	169.8	91.5	261.3	317
5. Yugoslovia	139.0	16.2	185.5	340.7	313
6. Newzeland	85.7	106.1	46.9	238.7	290
7. Other less developed countries	764.5	1274.4	500.1	2538.9	n.a.
. of which Chile	41.5	156.8	45.4	243.7	292.9
8. Bengladesh	40.4	36.9	14.7	92.0	110.8
9. India	200.0	201.3	-	401.3	245
10. Pakistan	97.9	103.4	34.7	236.0	284
11. Philippines	-	96.9	55.2	152.0	185
12. Srilanka	34.0	31.3	12.4	77.6	93
13. Kenaya	32.0	28.8	3.1	63.9	33.9
14. Sudan	28.7	18.3	-	47.0	56.4
15. Tanzania	28.4	23.8	-	52.1	61.4
WORLD TOTAL	1715.9	3043.2	2143.4	6902.4	

n.a. = Not Available.

Source: International Financial Statistics, July 1977.

12.1 WORLD TANKER FLEET AT END 1977@ (10000 long Tons.D.W. and over)

(Excluding 47.7 Million D.W.T. Combinded Carriers)

Flag	Oil Company	Pri-Vate.	Govt.	Others.	Total 1977	Total 1976	%Change 1977 over1976
	(Million long ton Dead weight)						
Liberia.	33.6	73.7	-	0.2	107.5	99.7	+7.8
Norway	0.8	27.8	-	0.1	28.7	29.6	-0.9
U.K.	19.0	9.5	0.1	0.3	28.9	30.8	-1.9
Japan.	4.6	24.8	-	-	29.4	32.4	-3.0
U.S.A.	5.9	6.0	1.2	-	13.1	11.6	+1.5
Panama.	4.9	5.2	-	-	10.1	10.1	-
France.	10.2	4.6	0.1	-	14.9	14.7	+0.2
Greece.	0.2	17.8	-	-	18.0	17.0	+1.0
Other Western Europe.	14.6	26.3	0.1	0.1	41.1	39.5	+1.6
Other Western Hemisphere	7.1	0.2	0.3	0.1	7.7	6.6	+1.1
U.S.S.R. E.Europe & China.	-	-	10.0	-	10.0	9.3	+0.7
Other Eastern Hemisphere.	8.6	14.3	-	0.2	23.1	19.4	+3.7
Total:-	109.5	210.2	11.8	1.0	332.5	320.7	+11.8
Fleet as at end 1976	104.8	204.2	11.0	0.7	320.7		
Net Increase 1977	4.7	6.0	0.8	0.3	11.8		

@= By flag and ownership.

Source:-BP Statistical review of the world oil industry,1977.

12.2 WORLD SCALE FREIGHT AFRA RATES

(Percentage)

Year	General purpose 16500-24999 dwt	Medium range 25000-44999 dwt	L.R.1 45000 -79999 dwt	L.R.2 80000 -159999 dwt	VLCC 160000- & above
1971					
Average-1971	130.0	122.1	102.1	87.8	-
1972					
Average-1972	115.5	101.9	80.5	69.5	-
1973					
Average-1973	174.4	151.3	112.1	100.5	-
1974					
Average-1974	211.2	179.4	120.6	97.0	78.6
1975					
Average-1975	139.5	124.8	83.2	62.7	56.9
1976					
January	130.9	118.2	77.8	58.1	51.4
February	136.2	119.8	79.0	58.4	51.5
March	127.9	119.9	76.8	59.8	52.1
April	130.1	119.6	75.5	58.9	51.5
May	131.4	117.1	76.0	56.4	50.7
June	126.1	116.1	77.0	58.0	50.1
July	129.6	117.9	77.2	56.1	50.1
August	130.9	119.9	78.3	56.7	50.5
September	133.2	116.6	78.5	57.3	49.4
October	137.8	115.7	77.4	56.4	48.8
November	137.1	114.4	76.3	53.9	49.2
December	140.8	116.0	75.7	54.1	48.7
Average-1976	132.7	117.6	77.1	57.0	50.3
1977					
January	143.5	115.1	74.6	54.1	47.4
February	156.8	121.2	81.2	57.8	48.9
March	160.7	119.8	81.0	56.1	49.1
April	160.1	128.3	82.0	57.2	48.9
May	162.1	117.3	77.8	56.0	48.3
June	151.2	111.3	75.1	55.5	47.8
July	149.5	111.5	72.8	55.0	47.8
August	145.3	110.3	71.5	53.5	47.5
September	138.8	108.8	71.7	53.4	46.8
October	149.1	108.4	70.8	53.1	47.2
November	148.4	111.5	69.4	52.9	47.6
December	155.3	112.5	68.3	52.7	47.4
Average-1977	151.7	114.7	74.7	54.8	47.9
1978					
January	151.5	106.2	66.1	50.9	44.0
February	160.3	117.0	72.9	52.1	44.3
March	154.2	108.0	69.9	52.5	45.2
April	152.8	112.6	68.4	51.3	44.5
May	152.6	110.6	68.1	51.3	44.5
June	149.0	111.1	68.0	51.1	44.6
July	148.8	111.1	70.4	53.0	44.3
August	146.2	112.2	69.4	52.3	44.4
Average-1978 (Jan./Aug.)	151.9	111.1	69.2	51.8	44.5

13. INTERNATIONAL EXCHANGE RATES

13.1 The SDR: Weights and Sample Valuation

Currency	Weights assisgned to each currency in one SDR	Currency Units per SDR Sept. 13, 1974	Currency amounts under Rule O-3	Value of the SDR: Exchange rates *	Value of the SDR: US dollar equivalent	Currency units per SDR, September 13, 1976
Australian dollar	1.5	0.795866	0.0120	0.80209	0.014961	0.924144
Austrian schilling	1.0	22.3392	0.2200	17.80000	0.012360	20.5050
Belgian franc	3.5	46.7562	1.6000	38.73000	0.041312	44.6148
Canadian dollar	6.0	1.16870	0.0710	1.02410	0.072711	1.12356
Danish krone	1.5	7.42274	0.1100	6.03470	0.018228	6.95310
Deutsche mark	12.5	3.15520	0.3800	2.50940	0.151431	2.89035
French franc	7.5	5.70290	0.4400	4.92870	0.089273	5.67712
Italian lira	6.0	783.945	47.0000	840.50000	0.055919	968.653
Japanese yen	7.5	357.641	26.0000	287.45000	0.090451	331.180
Netherlands guilder	4.5	3.21297	0.1400	2.62200	0.053394	3.02088
Norweigian krone	1.5	6.57925	0.0990	5.46550	0.018114	6.29639
Pound Sterling	9.0	0.511360	0.0450	1.74820	0.078669	0.659038
South African rand	1.0	0.827867	0.0082	0.86953	0.009430	1.00185
Spanish peseta	1.5	68.2939	1.1000	67.92000	0.016196	78.2411
Swedish krona	2.5	5.30424	0.1300	4.37960	0.029683	5.04460
U.S. dollar	33.0	1.18385	0.4000	1.00000	0.400000	1.152132

* Exchange rates in terms of currency units per U.S. dollar except for the pound sterling and the Canadian dollar, which are expressed as U.S. dollars per currency unit.

Rate sources: London moon rates except for the yen, which is the Tokyo representative rate.

Source: I.M.F. Survey 20th September, 1976, supplment to the issue.

Data: IMF Treasurer's Department.

13.2 Exchange Rates U.S. $ Vs. SDR

(U.S. dollar per SDR)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Year
1971	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.0857	1.0857
1972	1.0857	1.0857	1.0857	1.0857	1.0857	1.0858	1.0858	1.0857	1.0857	1.0857	1.0857	1.0857	1.0857
1973	1.0857	1.2064	1.2064	1.2064	1.2064	1.2064	1.2064	1.2064	1.2064	1.2064	1.2064	1.2064	1.2064
1974	1.2064	1.2064	1.2064	1.2064	1.2064	1.2064	1.2030	1.1846	1.1871	1.1951	1.2069	1.2244	1.2244
1975	1.2389	1.2604	1.2475	1.2417	1.2468	1.2364	1.1910	1.1870	1.1643	1.1858	1.1710	1.1707	1.1707
1976	1.1688	1.1687	1.156	1.1507	1.1423	1.1461	1.1469	1.1508	1.1571	1.1547	1.1498	1.1618	1.1618
1977	1.1523	1.1560	1.1592	1.1622	1.1616	1.1659	1.1714	1.1619	1.1635	1.1800	1.1834	1.2147	1.2147
1978	1.2151	1.2267	1.2367	1.2261	-	-	-	-	-	-	-	-	-
					(SDR per U.S. dollar)								
1971	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	.9970
1972	.9211	.9211	.9211	.9211	.9211	.9211	.9211	.9211	.9211	.9211	.9211	.9649	.9211
1973	.9211	.8290	.8290	.8290	.8290	.8290	.8290	.8290	.8290	.8290	.8290	.9211	.8388
1974	.8290	.8290	.8290	.8290	.8290	.8290	.8283	.8376	.8437	.8387	.8324	.8290	.8315
1975	.8072	.7934	.8016	.8054	.8024	.8023	.8241	.8413	.8491	.8434	.8480	.8239	.8236
1976	.8556	.8556	.8648	.8684	.8710	.8743	.8733	.8707	.8668	.8660	.8665	.8538	.8662
1977	.8678	.8650	.8627	.8604	.8609	.8577	.8537	.8607	.8595	.8475	.8450	.8232	.8232
1978	.8230	.8152	.8086	.8156	-	-	-	-	-	-	-	-	-

Source: International Financial Statistics, June 1978.

13.3 Currency Units per SDR

Currency	July, 1977	26th July, 1978
Australian dollar	1.0461	1.0885
Austrian schilling	19.1503	18.568
Belgian franc	41.9628	40.6030
Canadian dollar	1.2424	1.4105
Danish krone	7.0510	-
Deutsche mark	2.7022	2.5753
French franc	5.7029	5.5252
Italian lira	1034.92	1059.68
Japanese yen	309.849	244.101
Netherlands guilder	2.8788	2.7861
Norwegian krone	6.2063	6.7627
Pound sterling	0.6812	6.7627
South African rand	1.0187	
Spanish peseta	81.7672	96.9992
Swedish krona	5.1368	5.6884
United States dollar	1.1715	1.2550
Argentine peso	463.308	1068.67
Bahrain dinar	0.4635	0.4869
Brazilian cruzairo	16.7283	22.9794
Ecuadoran sacre	29.2863	31.3755
Guatemalan quetzal	1.1715	1.2550
Indonesian rupiah	486.152	520.833
Iranian rial	82.7337	88.4475
Irish pound	0.6812	0.6522
Kuwaiti dinar	0.3361	0.3415
Malaysian ringgit	2.9050	0.3415
Malta pound	0.4968	0.4867
Mexican peso	26.9016	28.669
Qatar riyal	4.6358	4.8676
Omani riyal	0.4046	0.4335
Saudi Arabian riyal	4.1352	4.2733
U.A.E. dirham	4.5663	4.8670
Venezuelan bolivar	5.0285	5.3872
Swiss franc	2.8419	2.2299

Note: The value of the SDR in terms of the US dollar is determined as the sum of the dollar values, based on market exchange rates, of specified quantities of the first 16 currencies shown above. The value of the SDR in terms of any currency other than the US dollar is derived from that currency's exchange rate against the US dollar and the US dollar value of the SDR.

Source: I.M.F.'s Treasurer's Department, July 18, 1977 and and IMF's July 1978.

13. Market rate for currency units per U.S. dollar.

Country	Unit	1977(May)	1978(May-April)
Algeria	Dinar	4.16	4.01
Ecuador	Sucre	25.00	25.00
Gabon	CFA Franc	247.33	230.60
Indonesia	Rupiah	415.00	415.00
Iran	Rial	70.625	70.475
Iraq	Dinar	0.2953	0.2953
Kuwait	Dinar	0.2874	0.2771
Libya	Dinar	0.2960	0.2960
Nigeria	Naira	0.6514	0.6211
Qatar	Riyal	0.3953	0.3876
Saudi Arabia	Riyal	3.530	3.445
U.A.E.	Dirham	3.898	3.878
Venezuela	Bolivar	4.293	4.293

13.5 India's exchange rate vis-a-vis U.S. dollar and S.D.R.(Market rate/par or Central rate)

Year	End of the period	
	Rupees per SDR	Rupees/U.S. $
1971	7.833	7.214
1972	8.695	8.008
1973	9.808	8.130
1974	9.890	8.078
1975	10.462	8.937
1976	10.318	8.881
1977	9.971	8.209
1978		
January	9.797	8.063
February	9.965	8.123
March	10.429	8.433
April	10.520	8.580
May	10.255	8.407

13.6 CUSTOMS RATE OF EXCHANGE OF FOREIGN CURRENCIES AND THEIR RS.100 EQUIVALENT EFFECTIVE JULY'78 AND OCTOBER,1978.

S.No.	Foreign Currency	Rate of exchange of foreign currency equivalent to Rs. 100 effective.	
		JULY' 78	October' 78.
1.	2.	3.	4.
1.	Austrian Schillings	176	172
2.	Australian Dollars	10.29	10.63
3.	Bolgian Francs	383	373
4.	Canadian Dollars	13.36	14.56
5.	Danish Kroners	66.60	65.90
6.	Deutsche Marks	24.60	23.90
7.	Dutch Guilders	26.40	26.00
8.	French Francs	54.00	53.70
9.	Hong Kong Dollars	55.00	58.10
10.	Italian Lire	10150	10140
11.	Japanese Yen	2440	2330
12.	Malaysian Dollars	28.00	28.20
13.	Norwegian Kroners	63.90	63.30
14.	Pound Sterling	6.4835	6.3190
15.	Swedish Kroners	54.30	54.20
16.	Swiss Francs	22.10	18.60
17.	U.S.A. Dollars	11.99	12.43

14.1 ACTIVE RIGS IN THE ASIAN REGION

RIG	TYPE	LOCATION
Owner	WD DD	Operator Remarks
Big John Atwood Oceanics	D-barge 600 20,000	Indonesia Marathon Due mid-May
Brinkerhoof I Brinkerhoff Maritime	D-Ship 600 20,000	Indonesia Cities Service -
Chris Segar Reading & Bates	J-up 200 20,000	Brunei Shell Term Contract
D M Saunders Reading & Bates	J-up 600 20,000	Indonesia Liapco -
Diamond M Dragon Diamond Dragon Drilling	D-ship 1000 25,000	Pakistan, June for Alaska, 1-yr contract with Marathon
Discoverer III		Indo-ONGC.
Explorer Santa Fe	J-up 150 20,000	Indonesia Arco-Arjuna field -
Fredericksburg Atwood Oceanics	D-ship 600 20,000	Indonesia Agip Two wells, then Marathon
Fairbanks Rowan International	D-barge 20 25,000	Indonesia total Term contract
Gettysburg Atwood Oceanics	D-ship 600 25,000	India ONGC Term contract Marathon
Glomar Challenger Global Marine	D-ship - -	Japan Scripps Mining-cont to 8/78
Glomar Tasman Global Marine	D-ship 600 25,000	Phillippines-Palawan Amoco -
Grand Large Forex-Neptune	Tender - -	E Malaysia-Sabah Shell Term contract

Hakuryu II Japan Drilling	Semi 1000 30,000	Taiwan CPC Contract ending
Hakuryu III Japan Drilling	Semi 1000 30,000	Japan Union oil -
Hakuryu IV Japan Drilling	J-up 300 27,000	Sakhalin Sodeco -
Hakuryu V Japan Drilling	Semi 1000 30,000	Japan-off Kasumi Gulf new site
Investigator Zapata	D-ship 450 18,000	Indonesia Phillips -
IJ Pierce Reading & Bates	Tender - -	Brunei Shell Term contract
J W Nickle Reading & Bates	Tender - -	Brunei Shell Term contract
Kantan I PRC	Catamaran 250 -	China PRC Works only for PRC
Maersk Endurer Maersk	J-up 250 20,000	Australia Wapet Four wells
Maersk Assister Maersk	Tender - -	Brunei Shell -
Margie Atwood Oceanics	Semi 600 20,000	Malaysia-Sarawak shell -
Morgan City Rowan International	D-barge 20 30,000	Indonesia Total -
Nanhai I PRC	J-up 300 25,000	China PRC Works only for PRC
Nanhai II PRC	J-up 300 25,000	China PRC Works only for PRC
Neddrill I Neddrill	D-ship 1000 25,000	Malaysia Exxon -

Rig Owner	Type WD DD	Location Operator Remarks
Ocean Endeavor Odeco	Semi 600 25,000	Australia Esso -
Pai Lung PRC	Semi8 - -	China PRC Works only for PRC
Penrod 74 Penrod	Semi 2500 30,000	New Zealand Hunt International Term contract
Pinhai II PRC	D-barge - -	China PRC Works only for PRC
Pohai I PRC	J-up 100 18,000	China PRC Works only for PRC
Pohai II PRC	J-up 175 15,000	China PRC Works only for PRC
Pohai IV PRC	J-up 300 25,000	China PRC Works only for PRC
Regional Endeavor Drillships Ltd (Atwood)	D-ship 1000 20,000	Australia-NW shelf Woodside Term contract
Rig I Aquadril/Maersk	Pack unit for Plat 25,000	Malaysia-Sabah Shell Term contract
Rig II Robray	Tender - -	E Malaysia-Sarawak Shell Term Contract
Sagar Samrat ONGC	J-up 260 20,000	India-Arabian Sea ONGC Works only for ONGC
Scan Queen Scan Drilling	D-ship 1000 20000	Indonesia Total Six wells
Sedco 135A sedco	Semi 600 25,000	E Malaysia-Sarawak shell Term contract

Rig Owner	Type WD DD	Location Operator Remarks
Sedco 135E Sedco	Semi 600 25,000	Brunei Schll Term contract
Shenandoah Atwood Oceanics	J-up 300 20,000	India ONGC Term contract
Taimaron Tropic Drilling	D-ship 1000 30,000	Gulf of Thailand Texas Pacific -
Trident I Forex-Neptune	J-up 250 18,000	E Malaysia-Sabah Shell Contract to 1/79
Wodeco VI Western Offshore	D-barge 600 20,000	Malaysia-Trenggamu Exxon Accommodations barge
Wodeco VII Western Offshore	D-barge 1500 20,000	Malaysia-Trengganu Exxon -
Wodeco VIII Western Offshore	D-barge 1500 20,000	Taiwan CPC well to well contract

Cont = contract DD=drilling depth D-barge=drillbarge

D-ship=drillship na=information not available. J-up=jack up

Plat=platform Semi=semisubmersible WD=water depth

Source:-Petroleum News Southeast Asia June,1978