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# THE POLITICAL, ECONOMIC, SOCIAL, CULTURAL, AND RELIGIOUS TRENDS IN THE MIDDLE EAST AND THE GULF AND THEIR IMPACT ON ENERGY SUPPLY, SECURITY AND PRICING

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## Introduction

It has been more than six years since Iraq invaded Kuwait, but the legacy of the Gulf crisis and the disruption of oil supplies stemming from it linger on. The fact that an international economic crisis of the proportions seen in the 1970s did not arise from the Gulf war has led to complacency in Western capitals and in international oil centers. But such complacency may be misplaced as rising demand has absorbed the overhang of surplus oil inventory and productive capacity that shielded consumers in 1990 from the sudden loss of 4.5 to 5 million b/d of Kuwaiti and Iraqi production. Indeed, oil markets are more vulnerable today to a major short-term supply disruption than in any year since the late 1970s. Should a disruption take place today of even half the magnitude of the Gulf crisis, moderate prices would not be restored without relying on accommodation by the Saudi monarchy, a major stock release of the International Energy Agency or a UN vote to re-open Iraq to trade.

The tenuous nature of the current oil market raises the question of how such a situation was reached, and how policy-makers should react to it. In addition to this immediate concern it is necessary to look at both the short-term issue of the risks and costs of yet another temporary disruption as well as the longer-term outlook for the next several decades. In examining short-term risks, consideration must be given to the role that private and government inventories, spare productive capacity and producer competition play in maintaining market equilibrium at moderate price levels during periods of turbulence. A particularly important issue is the extent to which monopoly power exists and would be exercized in the Middle East.

Policies applied to manage short-term disruptions will not necessarily be useful in dealing with a prolonged disruption or with the longer term challenges. In particular, careful consideration must be given to factors that are now emerging that could potentially change the geopolitics of oil into the next century. These factors include the change in oil trade flows resulting from the rising demand for oil in Asia which have serious ramifications for future balance of power relations, particularly affecting Japan and China but also with implications for the US. The expanding dependence of Asia on energy imports will create new tests for the world political order.

There are also special economic and geopolitical risks associated with addressing the world's increasing thirst for oil by accepting expanded reliance on a concentrated geographical area, the Middle East gulf, which is fraught with political instability and socio-economic challenges. Such reliance raises the possibility of a more severe dislocation if the free flow of oil from the Middle East is threatened, making the maintenance of political stability in the Middle East region even more critical than to-day.

## Identifying Energy Security Risks

The term "energy security" has evolved in great measure since the 1950s when it was used to justify protection for US domestic oil production in order to ensure that adequate supplies would be available in the event of war. Today the focus of energy policy has moved beyond the military to include the effect of supply interruptions and oil price shocks on the economic performance of the US and in other major importing countries. It has been argued and is now a popular wisdom that the events of the 1970s, including the Arab oil embargo and the Iranian revolution, generated recessions, high rates of inflation and reduced growth rates in oil importing countries. This line of reasoning enlarged the scope of energy security concerns.

In the 1990s the term "energy security" has evolved into a complex set of concerns - both economic and political. The most common concern is that new events will produce a reoccurrence of the price shocks of the 1970s which were extremely large, unexpected and persistent. Perhaps a more realistic risk however, is the possibility of a sudden rise in oil prices in response to a short term disruption of supplies (or the threat of a disruption) due to political instability in a major oil producing area. In this case, the price of oil will rise to accommodate the (expected) shortfall in production but neither the shortfall, nor the price increase, are expected to be permanent. Finally, the energy security label is often used in reference to a longer term concern for the continuing availability of inexpensive oil. This concern arises out of the expected long run growth in the demand for oil in the context of diminishing supplies - or at least, supplies from the competitive fringe. These various aspects of the security debate have their roots in the fundamental imbalance in the location of world oil reserves. Three quarters of the world's oil reserves are located in the Persian Gulf region and these reserves represent the lowest cost supplies. Those who have focused attention on the energy security debate often point to predictions that the share of world oil supplied from Middle East countries is projected to rise from 28% (excluding NGLs) in 1994 to 35.6% by 2010. To the extent that a growing share of world oil supplies will come from the Middle East, the severity or cost of short run supply interuptions from that region will increase and the monopoly power of these countries over prices will grow, raising the issue of the continued availability of relatively inexpensive oil.

In this context oil security takes on a political dimension to the extent that some oil producing countries will earn large revenues which might be used to destabilize certain oil producers and terrorize all nations. Higher oil prices will aggravate this problem. Also, competion among importing countries to secure their supplies, particularly in Asia, raises other geopolitical issues which we discuss below.

Under current conditions of a liberal international economic system, it is unlikely that the world will experience another oil price shock similar in style and proportion to those of the 1970s, in large part because of changes which have occurred in the oil market. In recent years, the oil market has become commodified and globalized. Oil is no longer sold mainly through exclusive, long-term, fixed price contract arrangements with a handful of major suppliers but rather on a free market floating price basis with a multitude of players. In such a market, no single consuming country can insulate itself from oil price shocks, no matter its level of self-sufficiency (provided it does not impose import and export controls on energy). Price arbitrage would ensure one price in all markets. Thus, the focus on the share of imports in total consumption for a particular country, which is often cited as evidence of increasing energy dependence, does not make economic sense; the price shock experienced by any nation from a disruption will be independent of its import share of petroleum supplies so long as free trade in oil is permitted. Shortages will not manifest themselves by a physical shortfall but rather in the price of oil which will rise asit allocates available physical supplies to the highest bidders.

In the current free market environment, energy security has become a global matter which concerns itself with the health of the international economy and financial systems. The issue becomes one of the extent to which the international economy as well as individual countries are economically vulnerable to oil price shocks.

A consequence of increasing dependence on oil supplies from any one region of contiguous producers, in this case the Middle East, is that the severity, and possibly the frequency, of price shocks will increase. There are many volatile areas in the world but the probability that there would be simultaneous disruptions in several different areas outside the Middle East affecting say, three million barrels a day of production, is rather small. A disruption in one country will cause oil prices, both spot and forward, to increase in proportion to the amount of oil output being affected in that country. Markets (as well as most of us) tend to think of the Middle East as an area where events in one country can easily impinge on the fortunes of others. Markets, in reacting to news in one country, will factor in the probability that other producers will be affected. In general, these perceptions of interdependency, means that events in the Middle East will appear to, or actually, threaten larger quantities of oil and hence produce larger price reactions than one would expect from other non Middle East producing areas. Price reactions may be not only more severe, but also more frequent, again because markets, aware of the magnitude of supplies from this area as well as the interdependencies among producers in the area, will be quick to react to events in the Middle East that would not generate the same reaction in other, more isolated, parts of the world. Finally, as mentioned above, growing dependence on one or a few supplying regions will strengthen the monopoly power of those suppliers with consequences for the longer run price of oil.

## The Economic Costs and Benefits of Energy policy

In choosing policies to respond to the risk of larger or more frequent price shocks, governments must weigh the costs imposed by oil price increases against the cost of reducing the vunerability of the economy to that risk. It may appear that the US and other consuming countries bear no such costs for securing energy supplies, but there are choices to be made, each of which diverts resources away from other areas of economic activity. These costs include subsidies to oil industry (by means such as reductions in taxes or exemptions from environmental and other regulations), extensive investment to develop and produce oil outside the Middle East in order to diversify sources of output and reduce dependence on the Middle East, the maintenance of the SPR to moderate the price effects of supply interruptions, military expenditures to protect oil assets from disruption, and efficiency losses implicit in policies to shift the transport and other sectors to alternative fuels which are more costly, than oil, among others.

Against these costs of providing for energy security, one must consider the probability of oil shocks and the magnitude of their impact. To discuss the latter, the following distinctions between three kinds of price risks is useful. : 1) a sudden, large increase in oil prices of either short or long duration; 2) increased price variability (upward and downward) over a long period 3) a gradual sustained rise in the price of oil. Each of these kinds of shocks poses different challenges.

**The Economic Costs of Oil Price Increases**

The economic costs of an oil price increase depends on its magnitude as well as its duration. Moreover, the reaction and expectations of oil markets to an oil shock play a significant role in determining its economic impact. In analyzing the potential influence of oil price changes on economic performance, it is useful to distinguish between a sudden, large increase in the price of oil of either short or long duration, expectations arising from increased oil price variability (upward and downward) over a long period, and a gradual sustained rise in the price of oil. Each of these price behaviors poses different challenges.

The debate regarding the costs of unexpected oil price changes is rooted in the experience of the 1970s. Most economists have maintained the oil crises of 1973 and 1979 did have a negative impact on employment and GNP and contributed to inflation. A smaller group has argued that these oil shocks had no real effect and that the stagflation of the 1970s and 1980s was due to other factors such as monetary policy and price controls. The latter group can point to the fact that rapid economic growth continues in the West and Asia despite the 35% increase in oil prices last year as support for their position.

Few dispute the fact that economic output and oil price increases are correlated. Hamilton (1983) showed that all but one of the post WWII US recessions were preceded by an oil price shock. Burbidge and Harrison (1983) found a significant relationship between oil prices and GNP for Germany, Japan, and the UK. However,when these calculations are extended to the period of oil price declines in the 1980s, one finds that the relationship is no longer robust. Mork (1989) extended Hamilton's study of the US to include the period through the middle of 1988. He confirmed the statistically significant correlation between oil price increases and reductions in GNP but found that oil price decreases were not significantly correlated with GNP increases. Asymmetry has also been found for Canada, UK, Japan and West Germany (Mork, Olsen, and Mysen 1994). Curiously, output is less sensitive to oil prices in Japan and Germany than in the US.

Lee, Ni, and Ratti (1995), using a methodology that is similar to that of Hamilton and Mork, have found that the effect of an oil price shock is greater when prices have been relatively stable, and therefore change is unanticipated, as opposed to situations where prices movements have been frequent and erratic. In the latter case, the price change may contain little new information and hence, does not induce a response. While oil price changes do not correlate well with output growth, particularly since the mid 1980s, a statistically significant relationship is established when the effect of price variability is removed. Oil price increases were found to have a larger impact on output than oil price decreases, a result that is consistent with Mork's. The conclusion that oil price variability is an important determinant of output growth is also reached by Ferderer (1996).

In any case, correlation does not necessarily imply causality which can be determined only by constructing a testable model which spells out the mechanism by which oil prices affect the macro economy. The controversy over the relationship between oil price shocks and GNP, in large part, reflects differing views regarding this mechanism.

Several mechanisms or "channels" have been suggested to explain the correlation between oil prices and macro variables (Ferderer, 1996; Bohi and Toman, 1996). An important distinction exists between those factors which act independently of government policy and those which are the result of governmental response to oil price changes. Independent channels include the effect on aggregate demand of the reduction in consumer incomes resulting from the income transfers to oil exporting countries; the reduction in capital inputs which become uneconomic at higher energy prices; resource immobility, reflecting the cost of shifting specialized labor and capital necessitated by a change in the sectoral composition of demand generated by an oil price increase; inflexible prices and wages; the postponement of irreversible investments resulting from increased oil price uncertainty; and the effect of a decline in the money supply (real balances), caused by the oil price increase. Some of these factors such as the effect of oil prices on consumer income, and hence expenditures, and the costs associated with resource immobility should produce similar effects on GNP for both oil price increases and decreases and hence, cannot explain the observed asymmetric relationship between oil prices and GNP.

Channels depending on goverment response to oil price changes revolve primarily around the response of monetary and fiscal policy or the elimination of price controls and other regulations.

Models used to predict the macro response to an energy price rise must make assumptions about which channels are relevant and how they work. Since there is no concensus as to how one should model the economy, there is no agreement on which mechanisms are the most important. For example, some economists would argue that monetary policy affects the price level but not real variables such as output and employment and that labor markets always clear so that there is no involuntary unemployment. Since much of the work in this area was done in the 1970s and 1980s, most models are neo-Keynsian where oil price increases are modeled as a supply shock. These models are structured in such a way that there is a tradeoff between inflation and unemployment in the short run so that the immediate effect of a supply shock on output and employment can be ameliorated by monetary and fiscal policies. Also, many of these models assume that nominal wages are sticky in the downward direction so that labor markets do not clear in the short run, generating involuntary unemployment. While there is no consensus on what the model should look like, results based on neo-Keynsian models are useful in that they emphasize, by nature of their construction, the negative impact of a supply shock on aggregate output and employment. In this sense,these results reflect an upward limit of the real effects of an oil price shock.

The most comprehensive review of macro models of the effects of oil price increases on the economy was published in 1987 by the Energy Modeling Forum (EMF) at Stanford University (Hichman, Huntington, and Sweeney, 1987). This study included 14 prominent forecasting models of the US economy and examined the macro effects of various oil and energy price shocks as well as how these would be affected by various policy responses. It is important to note that all scenarios involved a permanent change in oil prices characteristic of the 1970s and not a temporary change which has become more typical in the last decade.

Table 1 below shows the median results for the 14 models to a 50% increase in the price of oil when there is no policy response by government or the Federal Reserve. (The 50% price shock represents an increase in oil prices of $18 to $54/bl based on the reference price of $36 in 1983). The table shows the effects for the first four years after the price shock. The response is substantial and is concentrated in the first two years. At the end

Table 1: Impact of a 50% oil price shock

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| % Change in GNP in constant 1983 dollars | -1.42 | -2.90 | -2.54 | 2.07 |
| % Change in Implicit GNP Price Deflator | 1.13 | 2.02 | 2.25 | 2.01 |
| Absolute Change in the Unemployment Rate | 0.56 | 1.21 | 1.04 | 0.88 |

Median result for year(s) following the shock of the first year after the shock, output has decreased by 1.42%, prices and the unemployment rate are respectively 1.13% and .56 percentage points higher than would have been the case if oil prices had not increased. By the end of the second year after the price shock GNP has fallen by 2.9%, inflation has risen by 2.02 percentage points and the unemployment rate has increased by 1.21 percentage points. Losses continued into the fourth year (the last year for which the models were simulated) where output is still 2.07% below the pre-shock level, the implicit price deflator is 2% and the unemployment rate .88 percentage points higher than in the no price shock scenario. Note that output and employment begin to recover in the third year whereas the inflationary effects do not begin to suside until the fourth year. Over the four year period cumulative losses in GNP ranged from $141 to $608 billion 1983 dollars. The average loss was $328 billion. Simulations of a 20% price increase or decrease produced roughly proportional effects on GDP.

In addition to losses in GNP, the models measure the loss due to the adverse shift in the terms of trade which requires the US to export more goods and services to import any given quantity of oil. The average cumulative terms of trade loss was $124.7 billion. Cumulative losses from both sources over the four year period ranged from $246 to $747 billion in 1983 dollars. The average loss was $452 billion in 1983 prices, approximately $2,000 for each US resident. Typically, the terms of trade effect accounted for 30% of the loss while the decline in output accounted for 70%.

These results are most likely to overestimate the macro effects of a price shock to-day for a number of reasons. First, the results are derived from the assumption that any price increase would persist, a realistic assumption for the 1970s when many experts thought that we were exhausting supplies of natural resources and spoke of the consequential "limits to growth". To-day, few observers expect a sudden increase in oil prices of say 100% which would last for as long as several years. Current assumptions, which of course could be in error, are that supply disruptions will be temporary and that the long run oil price trend is reasonably flat. Since the response of economic agents to a price shock will depend on their expectations regarding its durability, reactions to-day will be less severe than in the 1970s. A second reason to believe that the results of Table 1 overstate the expected outcomes of an oil price shock to-day is that the parameters of the models were estimated from data gathered in the 1960s and 1970s and reflect the structure of the economy and the pattern of resource use that existed at that time as well as price controls imposed during the first Nixon term. To-day the composition of output has shifted from relatively energy intensive manufacturing to less energy using services, and all sectors have become much more energy efficient. Energy now accounts for a smaller share of the total cost of producing any good or service than in the 1970s and early 1980s. In addition to more efficient processes within the production sector of the economy, vast improvements have been made in the energy efficiency of automobiles and other consumer goods. As a result, a given price shock will have a smaller impact on consumer incomes, aggregate demand, or inflation. In other words, the elasticity of output with respect to oil prices will be lower to-day than predicted by these models

The EMF also examined the extent to which economic policies, such as an expansionary monetary policy, an increase in the investment tax credit, and reductions in income and payroll taxes, would affect the response of output, employment and inflation to a price shock. For all but two of the models, there was a trade off between inflation and decreases in output and employment. Monetary policy could reduce the losses in output and employment at the cost of a temporary increase in the rate of inflation. For example, at the end of the first year real output and the price level would be .72% and .11percentage points higher respectively than in the case where monetary policy was neutral. In other words, the loss in output can be cut in half at the cost of a modestly higher increase in the price level. The tradeoff is somewhat more disadvantageous by the end of the fourth year where output is 1.33% higher but the price level is also 1.24 percentage points higher than in the policy neutral scenario. With respect to fiscal policies, the effect of payroll tax cuts and increases in the investment tax credit, because they affect the supply side of the economy, have the effect of reducing both the decline in output as well as the increase in the price level that would occur in the policy neutral case. However, the benefits of tax cuts come at the cost of a higher government budget deficit.

The effect of monetary policy in ameliorating the effects of an oil price shock has also been studied by Brown, Oppedahl, and Yucel (1996). They analyzed the effect of monetary policy on the transmission of oil price shocks on aggregate economic variables for eight OECD countries for the period 1973 through 1994. They also found that a country can delay and mitigate but not eliminate the effect of a permanent oil price increase on output and employment, by engaging in a more expansionary monetary policy. Furthermore, they found that the lower a country's ratio of energy consumption to GDP or the shorter the period that oil prices remain higher, the lower the cost of the trade off between inflation and GDP loss. This finding is based on a retrospective look at the experience of oil prices and output over the past twenty years. Since the model did not include a variable regarding whether or not price changes and the subsequent monetary response were anticipated, one cannot conclude that a fully anticipated monetary policy would be effective or have similar results to those revealed in the historical data. Again the result of this study should be viewed as a possible upper limit on what monetarypolicy can achieve.

Bohi (1989, 1991) has been the most prolific challenger to the notion that oil price shocks must lead to recessions. He notes, for example, that Japan did not experience a recession after the 1979-80 price shock even though the US, UK and Germany did; despite the fact that both the US and UK were significant oil producers (and the UK an exporter) so that there were offsetting benefits to the price increase. The experience of Japan strongly suggests that policy matters. Bohi also points out that since energy costs are a small proportion of GDP, the direct effect of an oil price increase cannot be large, accounting for at most 14% and 9.5% respectively of the observed decline in US growth following the 1973 and 1979-80 price shocks. He is skeptical that indirect effects (such as those produced by monetary and fiscal policies, nominal wage rigidity, increased obsolescence of the capital stock, and postponement of investment) are sufficient to explain the remainder of the growth decline.

Other studies which question the inevitability of a causal link between oil price increases and short term output and employment losses include that of William Nordhaus (Nordhaus 1980), which concluded that the GDP growth rate during 1973-79 was only 0.15% per annum lower as a result of the 1973 oil crisis. Since GDP growth declined from 5.0% per annum over the period 1963-73 to 2.68% over 1973-79, the oil price increase in 1973 accounted for only 6.5% of the total observed decline in the GDP growth rate over the two periods. Similarly, he found that only 11.4% of the increase in inflation and 10.5% of the increase in the unemployment rate can be attributed to the oil crisis. Instead, other factors including economic policy were seen as responsible for most of the negative effects on the macro economy.

While the quantitative significance of oil price shocks has not been settled, the research reinforces the conclusion that an increase in oil prices which is expected to be temporary will not have significant short run effects on output, employment, and/or inflation. Longer lasting price increases will have a smaller impact on output and employment than in the 1970s while sensible economic policies, including an accommodative monetary expansion or supply side tax cuts, can mitigate the effects of the price shock , albeit at the cost of larger increases in the general price level or higher government deficits. (A more detailed study of the Japanese response to the earlier price shocks might be instructive).

While a given price shock is likely to have a smaller impact to-day as compared with the 1970s, other changes have reduced the likely effect of a given supply interuption on price. That is, for the same disruption, the price shock will be smaller and shorter. One such factor is the implementation of the International Energy Agency (IEA) agreements to have available substantial government strategic petroleum stocks which can be used to reduce the peaks of oil prices rises. These stocks were not readily available in the 1970s. Meanwhile improvements in exploration and development technology in the oil industry has reduced the cost as well as the time required to find and develop new oil reserves. These developments have the potential to not only shorten the average period of a price shock but also to limit the extent to which prices can rise over the longer-term. (For example, the lead time in new oil field development in traditional areas has shrunk from 5 to 8 years down to 2 to 3 years given improvements in data processing, drilling technology and project management while falling for some frontier areas from 10 years to 5 years).

The longer term economic consequences of a more gradual real price increase is less clear. In this case, the economy will be able to adjust gradually to oil price changes and hence avoid many of the costs associated with an abrupt change, such as losses due to short run resource immobility. On the other hand, a permanently higher energy price level would, all other things remaining the same, reduce future incomes below what they would otherwise have been. This loss, however, is likely to be offset by technical innovations, induced by higher energy prices, which would continue to reduce the impact of the higher oil prices.

Capping the upside potential of long-term oil price movements, technological change has reduced the cost of alternative energy sources as compared with the levels prevailing 20 years ago. For example, analysts believe the costs for developing resources such as tar sands have fallen dramatically from $32-35/bbl in the early 1980s to $20 to $25 today. In fact, Canadian oil sand operations have a production cost of $10./bbl. to-day and development costs are roughly $1 to $3 per recovered barrel. However, development of higher cost alternative energy resources will require that investors be confident that oil prices remain above their costs long enough for them to recapture the enormous investments required of these projects.

A third source of cost results from the increased oil price volatility such as experienced since the mid 1980s. Unlike the 1970s when oil price changes were expected to be permanent, price variability today is accompanied with the bias that price increases are unlikely to be sustained. To the extent that agents do not believe oil prices will remain high, output losses may be minimal. But if price uncertainty becomes a regular feature of the economy, agents will divert real resources towards activities that deal with the risks arising from that uncertainty. Firms may hold larger stocks or shift risk onto others in the futures market; in either case real costs are incurred. Higher uncertainty may also reduce the level of output in the long run by reducing the profitability of investment or requiring investors to seek a higher rate of return to compensate for oil price risks. Thus, those who argue that price variability poses no risks to the economy may not prove correct if such volatility continues for an extended period of several years.

In addition to the costs discussed above, oil price increases will reduce real incomes in energy importing nations because they must export a larger share of overall economic output in order to pay for the increased cost of oil imports. Although it is not the purpose of this paper to investigate the political as opposed to the economic consequences of a transfer of wealth to oil producing countries, it should be pointed out that, that the DOE forecasts oil revenues of the Gulf States to rise from $90 billion to-day to $200-$250 billion in 2010. For some countries, large increases in income would facilitate their support for terrorist and dissident groups, an increase in the size of their military, and their acquisition of nuclear, bacterial and chemical warfare technology. In such cases, higher oil prices could produce less stability in the Middle East as well as elsewhere. This growing instability and the diplomatic and military costs of dealing with it is another cost to the US and other consuming countries of oil price increases.

**Lessons from the Gulf War: Exorcizing the Complacency Myth**

Several world events have led to major oil disruptions in the past two decades or so but not always with significant economic impacts: the 1973 Arab oil embargo, the Iranian revolution (1979), the eight year Iraq-Iran war, and Iraq's invasion of Kuwait and the subsequent embargo on Iraqi supplies. Other more recent events include the frequent bombing of the main export pipeline of Colombia, the massive explosion on the Piper Alpha platform in the North Sea, civil war in Angola, weather-related or export policy inspired shut-offs of Russian oil exports, a prolonged oil workers strikes in Nigeria, and hurricane damage to Mexican oil installations in 1995. Still, when adjusted for inflation, average crude oil prices remained relatively constant between 1986 and 1994 at levels significantly lower than in the early 1980s.

Many of these events failed to have major impact because they occurred at a time when the industry was experiencing an oversupply of inventory and/or productive capacity. At the time of the Gulf War, when markets were temporarily deprived of 4.5 to 5 million b/d, oil prices rose from $16 to about $36. But by the time the United Nations coalition began its aerial war against Baghdad, oil prices had fallen back to $20, leaving oil market participants and policy-makers alike complacent that "markets work" and that moderate oil prices were here to stay.

The problem with this argument is that at the time of Iraq's invasion of Kuwait, markets were experiencing a major supply glut as indicated by the number of days of forward demand that could be covered from stockpiles - the oil industry's measure of its commercial inventories. Oil markets were cushioned by an extra three to four days of cover of excess commercial stocks beyond historical, seasonal norms. Besides that extra oil in the hands of private oil companies, market oversupply had also led to an accumulation of tens of millions of barrels of unsold cargoes from Saudi Arabia and Iran that were floating toward consumer markets in search of buyers. Beyond those immediately available stocks, Opec held about 4 million b/d of spare capacity that could quickly be put into production. In addition, the market had the benefit of a Saudi leadership willing to spend the money to bring on incremental capacity as needed to balance world demand. These multiple factors greatly ameliorated the effects of the loss of Iraqi and Kuwaiti crude in 1990 but do not exist to the same extent today.

In contrast to 1990, commercial inventories of crude in January 1997 stood at historical lows in terms of days of forward demand cover at roughly 72 days versus an industry norm of 77 to 82 days in past winters leaving the market highly vulnerable to short-term dislocation. The lingering effect of oil sanctions, economic constraints in oil producing countries and unexpectedly strong demand growth have reduced Opec's cushion of spare productive capacity such that only about 2 million b/d or so remains readily accessible, the vast majority of it in three countries, Saudi Arabia, Kuwait and the United Arab Emirates. Of the three, only Saudi Arabia could muster replacement of more than several hundred thousands of barrels a day. Table 2 shows current sustainable capacity and production at the end of 1996 for several Opec countries.

In an environment of lean inventories, the oil supply response options for even a limited disruption are quite small, leaving markets highly volatile. With so much of the world's spare capacity centered on the three Gulf nations, the political stability of these states and their ability and willingness to make incremental oil available in times of crisis takes on an overwhelming influence on oil price changes. Any threat to the free flow of oil from these states would have rapid and profound affect on prices, starting with speculation in the futures markets.

A repeat of 1990, where a real loss of exports from the Mideast Gulf or elsewhere occurred, would wreak havoc on oil markets under today's circumstances. A closure of the Straits of Hormuz, for example, would necessitate the release of government strategic stocks. If Saudi supplies were cut off or if domestic and/or regional factors were to convince the kingdom not to provide a supply backstop in the event of a major supply disruption, the world would experience a different scenario from the orderly replacement of production seen during the Gulf crisis.

Table 2

| | OPEC PRODUCTION AND CAPACITY | |
|---|---|---|
| | Sustainable Capacity** | Production: End of 1996 |
| Saudi | 9.50 | 8.30 |
| Iran | 3.80 | 3.65 |
| Iraq | 1.20* | 1.20* |
| Kuwait | 2.40 | 2.10 |
| UAE | 2.40 | 2.23 |
| | | |

| | | |
|---|---|---|
| Qatar | 0.50 | 0.49 |
| Venezuela | 3.40 | 3.40 |
| Nigeria | 2.07 | 2.05 |
| Indonesia | 1.40 | 1.40 |
| Libya | 1.42 | 1.40 |
| Algeria | 0.83 | 0.83 |
| TOTAL | 28.92 | 27.05 |
| | | |
| *includes 600,000 b/d of humanitarian oil sales plus domestic use and smuggling; further shut-in capacity of 1.4 to 2.4 million b/d due to embargo. | | |
| **Sustainable capacity is that which is attainable within 30 days and sustainable for 3 months | | |

In sum, the optimistic presumption that oil markets will always return to equilibrium at moderate prices because it happened in 1990 is unreasonable. The factors that go into the determination of oil prices have changed, and policy-makers must respond to the new realities.

## The Imperatives of Diverse Supplies

Much has been written about the decline in Opec's influence on world oil markets as its share of world markets has been held in check by rising non-Opec supply. Indeed, over the last two years, Opec production rates have been so stable that variations in non-Opec production growth and seasonal demand trends appeared to be larger factors affecting oil price trends. However, it would be a mistake to infer from this observation that a cohesive group of oil producers does not have sufficient market power to maintain oil prices above their marginal costs or to influence short term oil price movements. Oil prices have been substantially above marginal costs, which are estimated to be around $5/bl for most Mid-east producers, for several decades (Adelman, 1993). The decision by certain Gulf Arab countries to hold back production potential during the past year, despite a rapid growth in demand, is the most recent demonstration of the ability to maintain and increase price levels.

How Opec exercises its influence on oil prices is in setting production limits below maximum capacity to support an overall higher price level. "The core (of Opec) attempts, through the supply plan to steer the oil price towards a target level, or more realistically, towards a target zone." (Mabro 1990). Through its supply plan in which Saudi Arabia, Kuwait and the United Arab Emirates agree to hold back productive capacity, Opec generates a price above the long run competitive price of oil. In a freely competitive market, low cost supplies would be developed while high cost development would be abandonned. In such a case, Saudi Arabia and other Gulf producers whose low cost reserves represent two thirds of world reserves, would have raised investment in capacity and produced a vastly higher amount of oil.

A host of factors, including sanctions policy, has limited the playing field within Opec, leaving the role of constraining production in the hands of only a few members. Several major competing Opec producers such as Iran, Libya and Iraq no longer have the ability to immediately increase oil export levels and therefore do not push for the kind of self-interested market share increases that fed the market surpluses in the 1980s.

During the 1980s, domestic pressures and competition among the major oil producing states of the Middle East Gulf for political power and leadership prerogatives, pitted Iran, Iraq, Libya, Saudi Arabia, Kuwait, and the United Arab Emirates against each other in a struggle to delineate who was entitled to increase output under Opec's production quota allocation system during times of market strength. Each player wanted to maximize the gain in its market share in a complex zero sum interaction which generally resulted in quota cheating and oil price competition that benefitted consumers. By contrast, to-day spare capacity within Opec has been greatly reduced and the majority of Opec countries are producing at at their maximum rates. This means that the majority of Opec players are in a position where higher prices are the only means of enhancing revenues. Under such circumstances countries such as Libya or Iran (and some day Iraq once the embargo against its oil oil exports is lifted) have every incentive to use political or other means at their disposal to try to convince the Gulf Arab players with spare capacity not to use it.

The absence of market share rivalry within Opec has focused attention on Saudi policy and the Kindom's close relations with the West. In earlier days of greater competition among Opec countries for quotas, Saudi Arabia's efforts to seek higher production for itself was viewed as stemming from regional power politics and a desire to maintain or expand its market share relative to other regional powers such as Iran and Iraq. Now that this competition for market share has been eliminated by capacity constraints in other Opec countries, the pursuit of higher market share by Saudi Arabia is interpreted differently. In particular, Iran and Islamic opposition groups have accused the Gulf leaders of seeking higher production rates to accommodate Western economic interests at the expense of the needs of local populations, creating domestic pressures against a moderate price stance. When more producers had shut-in capabilities, pressure to increase production within Opec could find support from more than one quarter, deflecting such criticism.

Today’s political conditions within Opec do not change the reality of the group’s ability to influence price trends at the margin if the political will is present. Monopoly power is enhanced during a supply disruption as both the elasticity of demand and the elasticity of supply outside the Middle East is extremely low in the short term. The existence of government-held strategic oil stocks in consuming countries may therefore serve as a useful deterrant to the use of this power. While countries in the Middle East and elsewhere willingly supplied extra production during the 1990 Gulf crisis, this effort was not a purely altruistic decision given the existence of consuming country strategic stocks. Had Opec's members with excess capacity not raised output following Iraq's invasion of Kuwait, consuming countries would have released strategic stocks, thereby garnering the revenue from the oil sales for themselves. In effect, Opec would have sacrificed those sales and transferred the windfall gain to the consuming country governments.

The importance of stocks, held by consuming nations, as a deterrant factor is dependent on their credibility. Stocks levels that would not permit oil importers to replace a large loss of production for an extended period of time would not prove effective. They must be large enough to convince producers that the opportunity cost of waiting out the stock release is quite high. Moreover, producers must also believe that the potential magnitude for a sustained stock release is enough to transfer a significant portion of the economic gains of the crisis to consuming countries.

**Determinants of Monopoly Power**

The extent to which a monopolist can sustain a price above marginal cost is inversely related to the elasticity of demand he faces for his product. The relationship is :

$\underline{MC}$ = { 1 - 1/ Ed} where Ed is the demand elasticity for the

P

monopolists product. Thus, for example if Ed is 2, price will be twice the marginal cost; if Ed is 1.2, price is six times marginal cost.

The elasticity of demand facing a monopolist in a world where there is a competive fringe of suppliers who produce where price equals marginal cost is a function of the world elasticity of demand and the elasticity of supply of the competitive fringe. This relationship is expressed in the following formula:

$Eopec = (Qw / Qopec) (Ew) + (Qcf / Qopec) (Ecf)$

where Eopec is the elasticity of demand facing OPEC, Ew is the elasticity of demand, over all, for oil, and Ecf is the elasticity of supply of the competitive fringe. These latter two elasticities are weighed by the ratio of total world production to Opec production and the ratio of fringe production to Opec production respectively. Thus, to take reasonable values for these parameters, if Opec's share in total world production is 40%, the elasticity of supply of the competetive fringe is .3, and world price elasticity of demand is unitary, then OPEC'S price elasticity is 2.95 and price will be 1.51 times marginal cost. While prices during the past several decades are more that 1.5 times higher than Saudi marginal cost, it must be remembered that the above equations implicitly assume that the monopolist is one decision making entity while Opec, of course, is a cartel where each of its members have different costs and hence, different interests in terms of optimal price and output levels. To use the equation in this context, one could assume that the marginal cost for the cartel is equal to the marginal cost of the highest cost member. This assumes that other members would be willing to sacrifice profits in the short run (by reducing output) in order to sustain a price such that the most disadvantaged member can make a monopoly profit. This would require a great deal of cohesion among cartel members or at least the ability of higher cost producers to intimidate other members.

A price elasticity of demand of 2.95 means that ceterus paribus Opec will lose approximately 3% of it's sales for each one percent it increases prices. An increase in price would therefore increase the revenue per barrel sold by less than the decrease in revenue due to the decline in the number of barrels sold. It is the decline in consumer demand as well as the increase in production by the competitive fringe that limits the cartels ability to raise prices. But this analysis is based on "longterm" elasticities, i.e. they represent the demand and supply response to a price change which occurs over a period of several years. Short term elasticities representing the response that might occur over a period of say one year or less, will be much smaller. Consumers require time to alter their consumption patterns and fringe producers may require years to bring on new projects. If producers had been anticipating permanent oil price increases they would have projects "in the pipeline" and supply would increase quickly in response to the anticipated price increases. However, given that few producers expected the recent price increases and have typically based development projects on the assumption of reasonably constant real prices, the short term supply response has, as one would expect, been modest. In a situation such as the current one, with unexpectedly high demand growth, lean inventories, and little excess production capacity outside of the middle East, collusive behavior among producers to raise price will be tempting.

Table 3 below gives values for Eopec and P/MC for alternative values of OPEC share, the world elasticitiy of demand, and the elasticity of competitive fringe supply.

Table 3

| E(opec) | Q(w) | E(w) | Q(cf) | E(cf) | P/MC |
|---|---|---|---|---|---|
| | Q(opec) | | Q(opec) | | |
| 2.95 | 2.5 | 1 | 1.5 | 0.3 | 1.51 |
| 3.25 | 2.5 | 1 | 1.5 | 0.5 | 1.44 |
| 2.00 | 2.5 | 0.5 | 1.5 | 0.5 | 2.00 |
| 2.30 | 2 | 1 | 1 | 0.3 | 1.77 |
| 2.50 | 2 | 1 | 1 | 0.5 | 1.67 |

| | | | | | |
|---|---|---|---|---|---|
| 1.50 | 2 | 0.5 | 1 | 0.5 | 3.00 |
| 0.90 | 2.5 | 0.3 | 1.5 | 0.1 | -9.00 |
| 0.83 | 2.5 | 0.3 | 1.5 | 0.05 | -4.71 |
| 1.50 | 4 | 0.3 | 3 | 0.1 | 3.00 |
| 0.95 | 4 | 0.2 | 3 | 0.05 | -19.00 |

Note that the monopoly power of a producer group like Opec is enhanced as its share in world output increases, as the elasticity of supply of the competitive fringe is reduced and as the elasticity of world demand goes down. (The IEA and DOE project an increase in Opec's share of world oil supply from 40% to 50% by the year 2010. If world demand and fringe supply elasticity's do not change, Opec's market power will increase and prices will rise). However, this analysis does not take into account shifts in the supply curve of the competitive fringe due to technological change in the exploration and production of oil. One way to incorporate this effect is to increase the share of world oil production for the competitive fringe and reduce the share of Opec. Unless the shift in the supply curve decreases the elasticity of non-Opec supply, its effect will be to increase the elasticity of demand facing Opec and hence, reduce its market power. From the energy security point of view, then, it is beneficial for consuming countries to encourage production from as diverse a base as possible from within the competitive fringe countries, to enhance technology transfer to those countries and to support technology improvements.

In the very short run, world demand and competitive fringe supply elasticities will be small. For example, if short term world demand elasticity is .3 and the elasticity of supply of the competitive fringe .05, then the short run elasticity of demand facing Opec would be .83. While elasticities below unity imply that producers could increase revenues and profits by reducing output, this opportunity is only available in the very short run. Longer run elasticities will be greater than short term elasticities, and over time, consumers will respond to higher prices by further reducing demand, and fringe suppliers will invest in additional capacity. The fact that these adjustments will not be fully reversible once consumers have invested in energy efficient goods and fringe producers have made investments in additional production capacity, will temper the desireability for Opec to exploit short term inelasticities of consumer demand and non-Opec supply.

Although this analysis demonstrates that Opec has some market power, many of the countries in its core face different constraints today than in the 1970s suggesting that their ability and willingness to restrict output to enfore price discipline will be much weaker in the future. As data on Mid-East countries given in the appendix show, most of these countries have very young populations with over 40% below the age of 15. Over the next decade, they will be faced with the task of generating meaningful employment for the large numbers who will be entering the labor force. Furthermore, population continues to grow at rates exceeding 3% per annum. Finally, with enormous public debts, these countries will no longer be able to provide a decent and growing income for its people by running large government budget deficits. These factors suggest that these Middle East countries will be under considerable pressure to increase income from oil exports. In the short run, with little excess capacity, there will be pressure on Saudi Arabia and Kuwait to restrain output and permit prices to rise. In the longer run, these countries are likely to engage in a competitive race to increase capacity and market share. Given the experience in the 1980s, such competion will put downward pressure on oil prices. Continued sanctions on important oil producers will help Opec to maintain discipline amongst its members and slow down the growth of rivalry amongst members.

## The Failures of Forecasting and Outlook for the Future

For well over a decade, analysts have underestimated the supply elasticity of the competitive fringe, leading to industry concensus predictions of a profile of rising real prices over time. As noted, real prices have not risen on a sustained basis between 1984 and 1994. In 1986, in the aftermath of the 1985 price collapse, the US Department of Energy (DOE) predicted nominal oil prices would rise to $40 by 1995 in a typical forecast of the day. Nominal prices in 1995 were in fact of $17 per barrel. As shown in Table 4 below, oil consumption, excluding the centrally planned economies, was projected to increase over the same period by 4 million b/d ( from 34.2 mb/d to 36.5 mb/d) but in actuality rose by over 8 million b/d (to 42.3mb/d). The forecasting error reflects, in large measure, the effect on demand of lower oil prices than assumed and the underestimation of the growth in Asian demand. Non OECD demand which had been projected to grow at 14%, actually grew at 36%, more than twice the forecasted rate. On the supply side, non-Opec, non CPE (centrally planned economies) production was expected to decline by 3.6 million b/d or about 13%. In actuality, it rose by over 4 million b/d or about 15%. In the DOE forecasts and others at the time, North Sea production was expected to peak in 1986 but instead is still continuing to rise and is now projected to peak in the early 2000s.

The now legendary predictions in the 1970s, that oil prices would top $100 derived from the premises that oil demand was nearly inelastic both in the short and long term, that economic growth would continue for decades without interruption and that oil resources would "run out." None of these assumptions proved accurate. Economic growth follows an uneven pattern, and permanent improvements in energy efficiency came about more rapidly than had been anticipated. Both the elasticity of demand and the elasticity of supply from the competitive fringe turned out to be much larger than all but a few experts expected.

Table 4

| | US DOE 1986 Forecast for 1995 | | | | | | |
|---|---|---|---|---|---|---|---|
| | Actual 1985 | DOE Forecast 1995 | DOE Actual 1995 | DOE Forecast Change 1985-95 | | DOE actual Change 1985-95 | |
| | 1985 | Forecast 1995 | Actual 1995 | mb/d | % | mb/d | % |
| Consumption | | | | | | | |
| OECD | 34.20 | 36.50 | 42.26 | 2.20 | 6.43% | 8.06 | 23.57% |
| Other | 12.50 | 14.00 | 16.98 | 1.80 | 14.40% | 4.48 | 35.84% |
| Total non CPE | 46.70 | 50.50 | 59.24 | 4.00 | 8.57% | 12.54 | 26.85% |
| | | | | | | | |
| Supply | | | | | | | |
| | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| US | 11.20 | 8.30 | 9.35 | -2.90 | -25.89% | -1.85 | -16.52% |
| Canada | 1.80 | 1.60 | 2.42 | -0.20 | -11.11% | 0.62 | 34.44% |
| Europe | 4.30 | 3.50 | 6.46 | -0.80 | -18.60% | 2.16 | 50.23% |
| Other | 9.50 | 9.80 | 12.73 | 0.40 | 4.21% | 3.23 | 34.00% |
| Total Non-OPEC | 26.80 | 23.20 | 30.96 | -3.50 | -13.06% | 4.16 | 15.52% |
| CPE net exports | 2.00 | 0.90 | 0.60 | -0.90 | -45.00% | -1.40 | -70.00% |
| OPEC | 17.40 | 26.40 | 27.63 | 9.20 | 52.87% | 10.23 | 58.79% |

Current projections of future energy demand continue to be based on aggregate relationships between consumption of energy and GDP calculated from past experience. However, energy intensity levels will reflect changes in the composition of output and should plateau as countries move from being an industry to a service based economy. Oil demand analysis that assumes a constant elasticity of energy demand with respect to GDP throughout the course of economic maturation may by virtue of its methodology overestimate future oil requirements. An analysis of the relationship between output and oil demand and how it changes in response to shifts in the structure of output as per capita income increases would have particularly significant bearing on the question of trends in Asian oil demand given the rapid shift to industrialization being experienced there. Such an analysis is not within the scope of this study but warrants further research.

The persistent predictions that non-Opec production will peak in the near future and decline thereafter have similarly not been borne out. What analysts missed in expecting the non-Opec phenomenon to be short lived was that technological advances would significantly lower the costs of developing marginal reserves and improve the chances for new discoveries while at the same time enhancing recovery rates from the existing resource base.

Adelman (1992) has argued that thinking of oil reserves as a finite stock leads to such error. It is more appropriate, he suggests, to think about oil reserves is as a "flow" that is extracted and used up on one end and replaced at the other. As long as price exceeds incremental cost, there is every incentive to develop and replace reserves. Many analysts continue to think in terms of finite resources and are pessimistic about future non Middle East production. This point of view is reflected in the work of Rivas (1995), Campbell (1995), Mac Kenzie (1996),and Cleveland and Kaufman (1991). These analyses are heavily influenced by the Hubert Curve model which does not take account the effect of technological advance (or of a change in oil prices or tax regimes) in predicting the time path of production from their present day world proven reserve statistics.

In the 1970s, Opec (and many energy forecasters) learned that higher prices invited greater investment in incremental resources, pushing the supply curve to the right. Companies not only had higher cash flow to apply to additional investment projects but also projects which were marginally profitable at one price became more profitable at the higher price. It was the impressive supply response from non-Opec, shown in the table above, which, in combination with reduced demand, lead to the deterioration of Opec’s market share from 49% in 1979 to 37% ten years later, and generated the steady deterioration in prices. With the exception of Griffen, Steele, and Daley (1982) the level of supply response and its sustainability were unanticipated in forecasts from the late 1970s and early 1980s Instead, analysts predicted that Opec would be able to regain its market share within five years as new production discovered and brought on line in response to the 1970s oil shocks fell into natural decline and low prices discouraged further exploration.

The United States presents a typical illustration of this phenomenon of the underestimation of technological factors. In the DOE's long-term forecast from the late 1980s a decline rate in the mature province of the US was projected at 2.5-4% by the 1990s. However, the US production decline in 1996 was only 1.3% according to DOE data, following the application of advanced technology and the discovery and development of new frontier areas like the US deepwater which were technologically inaccessible or uneconomical in the early 1980s. Some analysts now believe US production will plateau and even possibly increase slightly by the turn of the century when US deepwater production will hit 1 million b/d from the 21 developments which have already been publicly announced. US deep water has 36 confirmed discoveries to date and current research is attempting to develop the means to drill in ever deeper water. Also, if technology now under study were to unlock the mysteries of finding and developing oil deposits under salt sheets in the US, US production would most certainly be able to make a recovery. Some oil company analysts are now predicting that subsalt resources could provide an additional 300,000 b/d to production by the year 2000. Alaska is also expected to make some modest gains as the Northstar and other new programs are implemented. On the other hand, while US mature areas are declining at a slower rate of 1-2%, resulting from technology-oriented workover of dying or abandoned fields, this may not prove sustainable.

In sum, technological advances have meant that older fields can "grow" over time with increased knowledge and improved drilling methods, allowing them to produce in excess of previously established reserves. Reserve additions can come about through addition of new compartments of the field or identification of satellite deposits or through the use of horizontal drilling methods that render a larger number of reserves economically recoverable. Moreover, reclassification of "oil in place" to status as "proven" reserves -- as defined as reserves that are part of the oil in place that can be produced economically using current technology and assuming the current tax regime and oil price-- can take place as a result of technology-induced cost reductions. For example, in Norway's Oseberg field proven reserves were estimated at only 159 billion barrels following appraisal drilling but this estimate was increased to 254 billion barrels by 1992, following gas injection and application of horizontal drilling techniques, according to the IEA. Measurement of the rate of technological improvements and their impact on the supply curve would be a fertile subject for future inquiry.

On the demand side, analysts similarly underestimated the impact that technological advances would have on energy efficiency as well as the joint effect of technology and oil prices on the substitution of other fuels, particularly natural gas, for oil. US energy efficiency as measured by the amount of energy used per constant dollar of GNP, for example, has declined from $16.47 in 1980 to $13.44 in 1995. The decline in petroleum used, measured in terms of thousands of BTUs per dollar GDP declined even more radically from 15.15 to 8.43. These changes reflect a change in the structure of GDP towards services which are less energy intensive, as well as the substitution of gas for oil, and improvements in the energy efficiency of homes and appliances and in the industrial sector. These factors have substantially changed the pattern of energy use by sector over time. For example, the share of petroleum consumed by the buildings sector (residential and commercial) has gradually declined from 15% in 1970 to 6% in 1995 as gas and electricity have been substituted for residual oil as a source of energy for heating. (see tables and graphs in appendix). The transportation sector accounts for an increasing share of petroleum use rising from 52% in 1970 to 66% in 1995. This is expected to increase to 70% by 2010. Efficiency has increased in the transportation sector where average miles per gallon has increased from 15.1 in 1983 to 19.8 in 1994.

In Oecd Europe energy consumption grew at a rate of only 0.8% per annum over the period 1973 to 1993, far below the rate of growth in output. Again this reflects the shift in the composition of output: the share of manufacturing in GDP fell from 40.6% to 32.8% between 1971 and 1990 while the share of services rose from 53.9% to 63.8%, as well as an increase in efficency: energy use per $ GDP fell by approximately 20% between 1971 and 1993.

The substitution of natural gas for oil can be seen by looking at the composition of energy production world wide. The share of oil (including NGLs) has declined from 49.5% in

1973 to 39% in 1993 while the share of natural gas has increased from 18.2% to 21.5% over the same period.

The combination of underestimated supply elasticity, unseasoned optimism about economic health in the Western economies and unanticipated energy efficiency gains rendered forecasts for sustained rises in oil prices and for augmented Opec influences into the 1980s as way off the mark. Indeed, even last year's significant improvement in oil price levels would not have been likely were it not for the assets held off the market due to the international sanctions on Iraq.

## The Outlook for 2000 and Beyond

Forecasts for the year 2000 and beyond suffer from the same limitations as prior efforts. Most presume economic growth will continued unfettered, especially in Asia. Few incorporate or predict further rapid improvements in drilling technology or in alternative sources. Nor has the oil industry shown itself to be particularly astute at predicting the timing when rapid physical declines will occur at major mature oil provinces. Those caveats aside, a study of major forecasts reveals that, if the world is to avoid an ever increasing dependence on the Middle East, technological advances and heightened investment in production outside the Middle East will be critical to the development of adequate resources to meet the rising demand for oil into the 21st century.

The argument is often made that the giant oil basins found in the 1970s are being rapidly depleted, and that no new resources of major consequence have been identified. Field discovery sizes are said to be getting smaller and smaller, until some day, it will become clear that the countries outside of the Middle East are "running out of oil." This argument holds as its major premise, predictions that the largest provinces of the North Sea will peak and rapidly decline into the 2000s. UK analysts Wood MacKenzie Consultants Ltd indeed project that oil production in the UK will peak in 1999 at about 3 million b/d and could fall precipitously to 1.2 million b/d by 2005 and 350,000 b/d by 2010 based on probable prospects assuming flat real oil prices $17. However, Wood MacKenzie notes that future discoveries and even recent finds, if developed, could extend production.

Norwegian production is forecast to peak in 1997 at around 3.4 million b/d and drop gently thereafter to 1.5 to 2 million b/d by 2005. The International Energy Agency also expects North Sea flows to peak around 1999 or 2000 but at higher levels. In its latest report Global Offshore Oil Prospects to 2000, the IEA predicts UK offshore oil production will rise to 3.49 million b/d by 2000 and start leveling off quickly after that. Norwegian flows are seen jumping to 3.7 million b/d by 2000 and only slowly deteriorating. The IEA also concludes that while the North Sea accounted for two thirds of the offshore growth in the first half of the 1990s, it will drop to only one-third of the expansion expected over the second five years of this decade as supplies from the US Gulf of Mexico, West Africa, and Australia grow rapidly.

Critics of the IEA's more optimistic forecast of North Sea potential point out that only a few large fields in the UK and Norway will contribute to gains of around 100,000 b/d or more. Much of the remaining additions are projected to come from small, fast depleting fields whose development could be constrained by lack of readily available drilling rigs or floating platform systems conversions that would be needed to complete the necessary well completions. Indeed, one assessment projects that 54 new small satellite fields would have to be brought on in three to four years despite the tight rig market for the IEA's North Sea projections for 2000 to prove correct.

Debate remains on the fate for the large, mature fields of the North Sea such as Forties, Brent and Statfjord. Some believe that forecasts are too optimistic and project too slow a rate of natural decline in the coming years. However, this pessimistic view presumes that no new technological methods will be developed to further arrest declines in these fields. Such techniques as 4-D seismic and extended reach drilling raise the prospects that more might be able to be done even with the most mature provinces.

## The Potential Frontier

Moreover the assumption that non-Opec production will finally peak and begin to decline in five or ten years time underestimates the significance of new Basins unearthed in recent years in South America, Africa and the former Soviet Union and major deposits of oil that have been found in new strata under existing fields, in deep water, or suspected to lie in new challenging frontier areas such as under salt or in polar regions. Among the Basins not yet fully explored and exploited are the Russian Arctic, Sakhalin Island, the Caspian Sea, Timor Gap, Malvinhas Straits, the Atlantic Front in northeast Europe, salt formations in Louisiana, the Norwegian More and Voring Basins and the Barents Sea, to name a few.

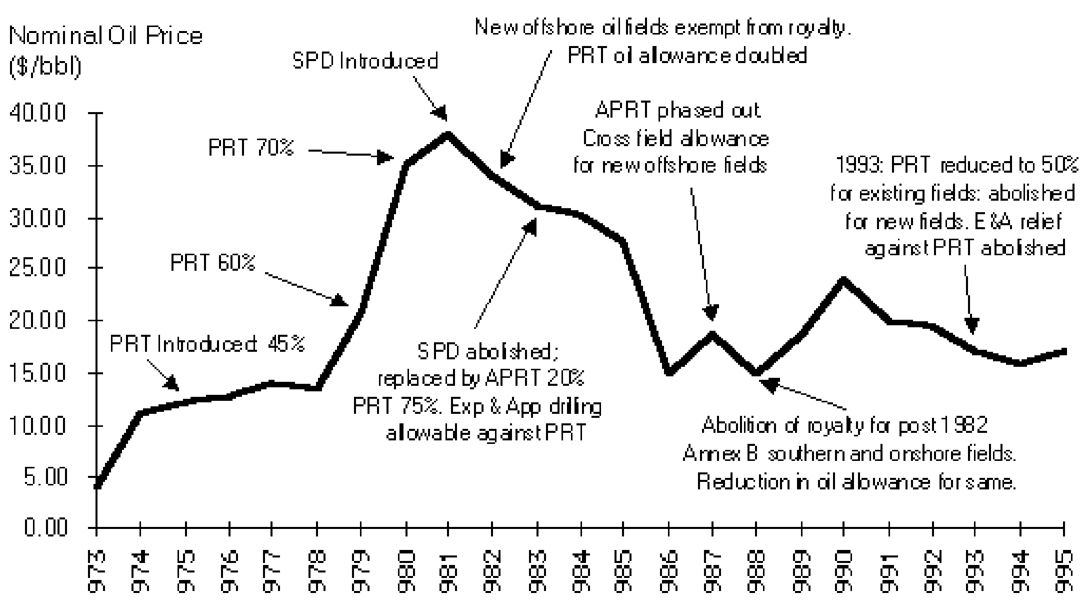
On a more futuristic note, science continues to improve its understanding of the migration patterns of oil under the ground. Roger Anderson (1993) points to recent reseach which has discovered that reservoirs in the Gulf of Mexico are being refilled by migrating oil "from a much deeper source". By drilling into the source of this migrating oil so as to extract the oil before much of it seeps out to uneconomic areas one would increase the amount of oil that is eventually recovered. He suggests that this "new PLAY concept, if successful, promises to book some 20 billion barrels of newly found hydrocarbons in the Pleistocene Gulf of Mexico".

Modeling the rate at which technological advances are contributing to increased world output and projecting future trends from that rate is outside the scope of this study but could be an interesting inquiry for future work. Nonetheless, an informal industry survey of geologists revealed that the majority felt there were limits to what technology can add to geology. Moreover, it was noted that not all fields will show the same level of progress, making it difficult to generalize and extrapolate improvements in rates of recovery. In his article, "Are we running out of oil?" Edward Porter (1995) notes the rise in oil recovery rates from about 35% recovery to 55% in some instances and argues that a dramatic increase in global oil production will occur as 3-D seismic, multilateral drilling techniques and enhanced recovery methods are applied to more regions. Improved technology has already allowed the industry to increase reserve estimates for a wide variety of fields such as the North Sea fields over the past few years, suggesting that the wider the application of such methods to more remote areas like Russia, the Far East and Africa, the larger the gains that might be possible in non-Opec production. However, the geology of one region may be strikingly different than that of another, with some areas not lending themselves to a substantial technological boost. Moreover, there is no guarantee that the pace of technological improvement will continue to provide the same extent of recovery gains over time and continually delay the process of depletion of mature fields in the US, the UK and elsewhere.

## The Role of Tax Policy

In considering the outlook for non-Opec producers in general, taxation and fiscal regimes within these countries will also play a major role in determining how much incremental production will be available in the future. As the figure below (prepared by Wood MacKenzie Consultants Ltd.) shows, the United Kingdom has altered its tax rates on oil production accordingly as prices have risen and decreased.

## Major Oil Taxation Changes




In other countries, fiscal regimes generally were not as flexible in limiting the impact on the oil industry of the price decline, and they unintentionally magnified the impact of falling oil prices on oil producer returns (Eckbo 1987). Since the mid 1980s, competition amongst countries for limited oil production investment dollars has brought about an improvement in fiscal terms and conditions for oil producers. However, taxes remain substantial in many producing countries so that there is still has room for further improvement. Encouraging investment in exploration, development and production by having a non-punitive fiscal regime is an important step in ensuring ample oil supplies from geographically diversified areas and should be an integral part of an energy security policy.

Morris Adelman (1992) has argued that geology, that is, the existence of oil in the ground, is unlikely to be the deciding factor for the future supply of oil. The question is, rather, at what price can these resources be produced? This latter question is the major challenge facing policy makers today. The revamping of the UK Petroleum Revenue Tax (PRT) in 1993 is thought to have contributed to a more rapid development of a larger number of new fields in the North Sea, for example. Tax policy becomes an especially important matter for consideration at this time given the constrained availability of drilling equipment that could affect costs in the next few years. New York investment banker Bear Stearns, for example, is predicting a 30% increase in dayrates for offshore drilling rigs in 1997 alone, coming on the heels of substantial increases in 1995 and 1996 (Energy Perspectives, December 27, 1996).

**Removing Legal and Political Barriers**

Certain prolific areas face either economic barriers, legal and political risk obstacles or lack of access to investment capital due to nationalistic concerns or from embargos levied by other nations. The removal of investment barriers in Venezuela is a dramatic example of what can happen when such impediments are removed. Prior to Caracas' initiation of its new policy of "opening" (which allowed foreign oil companies to make investments in identified Venezuelan oil fields on a production sharing basis), investment in oil field development had to be handled by the state monopoly Petroleos de Venezuela (PDVSA). However, difficult economic conditions in Venezuela limited the level of investment in the oil sector that PDVSA could undertake. As late as 1995, forecasters were predicting Venezuelan oil production would rise to 3.5 million b/d by the year 2000 before the impact of the policy of "opening" was fully understood. Now that PDVSA has had time to assess the programs of foreign oil companies entering its upstream sector, it currently expects oil production to hit 5 million b/d by the year 2000 and 6.2 million b/d by 2006, from 3.4 million b/d at present, and companies active in Venezuelan oil field projects confirm that such targets are relatively realistic.

It is the domain of the policy-maker to identify areas where such obstacles can be removed or lessened for, as discussed above, oil markets would be less vulnerable to a major disruption under conditions where 1) a larger percentage of oil is produced outside the volatile Middle East, 2) where Opec or any organization that might develop to replace it is relatively weak and 3) where oil production capacity exceeds demand by a substantial measure and is geographically dispersed, thereby mitigating the impact of a loss of output from any particular location.

Russia and the Central Asian Republics have tremendous potential but legal, political and geographic constraints makes predicting the accessibility of these resources a risky proposition. In Russia alone, a study by Troika Energy Services commissioned by the US Department of Energy concluded in 1994 that up to 600,000 b/d of Russian productive capacity could be restored through simply the repair of idle wells at a cost of about $1,000/daily barrel. US foreign policy towards Iran further complicates the ability to develop Caspian resources. The potential resources of Iraq and Iran are also curtailed by political factors. Political risk thwarts promising export projects in Sudan, central Africa, the Spratly islands, and to a lesser extent Algeria among other places. In addition, several countries face financial constraints and/ or impediments to technology transfer and foreign investment that inhibits full utilization of available resources such as Mexico, China and Nigeria, among others. The costs of exploring Arctic regions and frontier deep water remain high at this juncture and might require additional fiscal incentives.

The importance of removing political and technological barriers to the development of production capacity outside the Middle East can not be overstated. The resources of Russia and Central Asia are particularly critical as Daniel Yergin and Joseph Stanislaw (1993) have argued. Perhaps the best way to illustrate the point is to look at the range of forecasts for the year 2000 and beyond and see the effect of a larger pool of non-Opec production on the global oil supply-demand balance. For the purpose of this illustration, we articulate this difference by measuring the impact on a single residual supplier, Saudi

Arabia. For the purposes of our exercise, we assume that Saudi Arabia would like to continue producing at the same level as today (8 million b/d) or higher without suffering any major loss in revenue. In the following scenarios illustrated in Table 5, the extent to which Saudi Arabia's residual market share would fall below 8 million b/d should be interpreted as the extent to which oil markets would experience an oversupply, and therefore, a more "secure" situation during supply disruption (comparable to the 1990 surplus). The extent that Saudi Arabia's residual market share moves above 9 to 10 million b/d, the kingdom's current sustainable capacity, represents the level of shortfall that might be experienced in markets were the kingdom not make the appropriate investments to expand its output abilities.

| | Table 5 | | | | | Scenarios For 2000 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 Base | DOE | Pessimistic | | Pessimistic Without Iraq | | Conservative | | Planned | | Optimistic | | |
| Annual Demand Increase | | | 2% | 3% | 2% | 3% | 2% | 3% | 2% | 3% | 2% | 3% | |
| Global Demand | 70.0 | 76.8 | 77.3 | 81.1 | 77.3 | 81.1 | 77.3 | 81.1 | 77.3 | 81.1 | 77.3 | 81.1 | |
| | | | | | | | | | | | | | |
| Global Supply | 70.0 | 76.8 | 77.3 | 81.1 | 77.3 | 81.1 | 77.3 | 81.1 | 77.3 | 81.1 | 77.3 | 81.1 | |
| Non-Opec Supply | 44.8 | 44.2 | 46.0 | 46.0 | 46.0 | 46.0 | 49.0 | 49.0 | 52.0 | 52.0 | 55 | 55 | |
| Opec Supply | 25.2 | 32.5 | 31.1 | 35.1 | 31.3 | 34.1 | 28.3 | 32.1 | 25.3 | 29.1 | 22.3 | 26.1 | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Iran | 3.6 | 4.3 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.8 | 3.8 | |
| Iraq | 0.6 | 4.4 | 3.1 | 3.1 | 1.0 | 1.0 | 3.1 | 3.1 | 3.5 | 3.5 | 4.5 | 4.5 | |
| Kuwait | 2.0 | 2.9 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.3 | 2.3 | 32.5 | 32.5 | |
| UAE | 2.2 | 3.1 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.3 | 2.3 | 2.5 | 2.5 | |
| Venezuela | 2.7 | 3.3 | 4.5 | 4.5 | 4.5 | 4.5 | 4.8 | 4.8 | 5.1 | 5.1 | 5.2 | 5.2 | |
| Other Opec | 5.9 | 8.0 | 6.7 | 6.7 | 6.7 | 6.7 | 6.7 | 6.7 | 7.1 | 7.1 | 7.3 | 7.3 | |
| Residual Saudi Share | 8.0 | 6.6 | 9.1 | 12.9 | 11.1 | 14.9 | 5.8 | 9.6 | 1.4 | 5.2 | -4 | 0 | |
| For DOE forecast, all Opec members except for Saudi Arabia are assumed to be at DOE's forecast for maximum output | | | | | | | | | | | | | |

Applying the US Department of Energy's conservative estimate for non-Opec output of around 44 million b/d would leave the need for an additional 3 million b/d to 8 million b/d from the residual supplier depending on whether demand grows by 2% per annum or 3% per annum between 1995 and the year 2000. If Iraq does not return to the market, the gap would be even larger. Conversely, were policy-makers to step-up efforts to remove legal, fiscal and political barriers to resource development in non-Opec, leading to the fruition of all projects now on the books to push non-Opec production up to the 55 million b/d estimated by respected forecasters, Petroleum Industry Research Associates, market oversupply could be as high as 8 million b/d, meaning the world could do without

ANY production from a supplier as large as Saudi Aabia and still experience relatively moderate oil prices.

**The Geographic Distribution of Future Supplies**

To further demonstrate the geopolitical stakes of a high production profile for countries outside the Middle East versus a low production profile, it is useful to look at sample forecasts for global oil supply and demand for 2000 and beyond that have been divided not along the traditional Opec/non-Opec lines but along geographic lines. Such analysis shows striking disparities emerging among the various regions and highlights what is likely to be an increasing dependence on Middle East supplies from Asian powers at the same time as US reliance on such supply may shrink. Again, the outlook for output capacity outside the volatile Middle East remains a critical factor in this equation, and forecasts vary as to the level of non-Opec supplies that will be available in 2000 and beyond by region. However, even the wide range of forecasters data reveals agreement on the basic trend that Asia's oil supply imbalance could be anywhere from three to ten times larger than that of the Western Hemisphere.

Forecasts from several well known sources were chosen to show a wide range of outcomes based on different assumptions made by forecasters for economic growth and oil prices up through 2010. In addition, adjustments had to be made so that fair comparisons could be made and it is not expected that these adjustments, which involved reaggregating data and in certain limited cases providing limited missing country data that was representative of concensus forecasting, will have biased the results. A survey of forecasts on the Asian oil market shows consumption projected to grow from 17.8 million b/d up to between 25 to 33.3 million b/d by 2010. (see Jetro paper "The Asian Oil Imbalance") On the supply side, regional oil production is expected to peak at between 6 to 8 million b/d by 2010 from about 6 million b/d currently. This will leave a large deficit of 15 to 25 million b/d that may have to come mainly from the Middle East, since shipping costs of oil via tanker are a significant input in determining what supplies are most economical.

Middle East exporters have a cost advantage in location over other oil exporters in Africa, Latin America and Europe in supplying the Asian market. However, oil quality is also a factor in determining the flow of oil East of Suez. Environmental restrictions and refining configurations which dictate the type of oil imported will encourage Asian importers to purchase low-sulfur crude supplies from more distant suppliers in Africa and Europe, particularly in certain seasons, despite the higher costs. In addition, strong demand for low-sulfur crude may induce countries like Indonesia and Malaysia to import lower quality Middle East crude and export their low sulphur crude to environmentally sensitive markets. Such a strategy already takes place on a small scale.

However, given market forces, it can be assumed that regional refiners will find it advantageous to improve their refining systems to handle additional high-sulfur crudes from the Middle East, and that the bulk of the supply gap will be filled by Middle East sourced oil. Some analysts are suggesting that dependence by Asia-Pacific region on Middle East supplies could rise from 75% in 1994 to 84% in 2000 and 95% in 2010 (Naitoh, 1996). On the refining side, removing bottlenecks and commissioning new facilities in the Asia-Pacific region led to current regional industry overcapacity of about 600,000 b/d. A further 2 million b/d of new refining capacity is expected by 1998 in Korea, Malaysia, Thailand, the Phillippines, Taiwan, China and India, and the Energy Institute of Japan is projecting the region's refining capacity will be sufficient at least until 1999.

## The Asian Supply Gap

In table 6, we have assembled forecasts of world oil supply-demand from several respected sources. These forecasts agree with the Asian survey (see JETRO paper) that the gap between Asian oil consumption and regional supply will grow exponentially in the coming years. When broken into geographic sectors, the data highlights the complementary, exportable surplus of oil supplies that will be available from Africa and the Middle East, rising from about 20 million b/d in 1994 to about anywhere from 22 to 33 million b/d by 2000 depending on overall performance within other non-Middle East regions. Significantly, the competition for such supplies from the US could be somewhat limited under optimistic scenarios for the Western Hemisphere which show that regional may be close to self-sufficient by 2000 and beyond (see PIRA forecast). As this balance was of particular interest to our analysis, we have contacted industry officials involved in exploration and development programs in the key areas of the US, Canada and Latin America. These officials support the authors' views that anticipated production increases in the US Gulf of Mexico, Brazil, Colombia, Venezuela, Ecuador and Canada may indeed reach 26.4 million b/d based on known prospects and therefore may not be overstated in our forecast. Thus, as a majority of forecasters believe Western hemisphere oil demand is also likely to reach about 27 million b/d in the same time frame, it is appropriate to consider at this juncture the geopolitical implications of the Asian supply gap when coexistent with a US balance that could draw almost exclusively on regional supplies.

One implication of higher imports to the US from nearby suppliers is that US refiners will be able to operate with leaner operational inventory than when supplies were from the Middle East which takes 50 days to arrive in the US. During a disruption, leaner inventories will result in a larger price response.

The forecasted outlook for Europe and the Former Soviet Union is relatively static with a deficit of around 5 to 7 million b/d expected to continue into the next decade.

Europe will probably continue to meet this deficit with purchases of African and Middle East crudes.

Table 6: Forecast Comparison

Table 6 Forecast Comparison

| Year | 1994 | 2000 | 2005 | 1994 | 2000 | 2005 | 2010 | 1993 | 2000 | 2005 | 2010 | 1994 | .2000 | 2005 | 2010 | 1994 | 2000 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Base | | | Base | | | | Base | | | | Base | | | | Base | | |
| Demand | | | | | | | | | | | | | | | | | | |
| Western Hemisphere | 25.7 | 28.5 | 30.8 | 22.1 | 24.2 | 25.8 | 26.9 | 24.4 | 27.3 | 29.1 | 30.5 | 25.5 | 27.3 | 28.6 | 29.8 | 25.6 | 28.6 | 32.3 |
| Europe/FSU | 19.9 | 22.2 | 24.2 | 17.8 | 17.9 | 18.8 | 19.9 | 20.6 | 20.4 | 21.9 | 23.0 | 19.9 | 20.8 | 21.7 | 22.6 | 19.9 | 21.3 | 24.5 |
| Asia | 17.2 | 22.9 | 27.7 | 15.2 | 20.1 | 24.1 | 28.7 | 16.0 | 22.2 | 26.2 | 29.5 | 17.0 | 20.7 | 23.8 | 27.2 | 17.2 | 21.1 | 29.8 |
| Africa/Middle East | 6.1 | 6.8 | 8.1 | 6.1 | 7.1 | 8.4 | 10.5 | 5.7 | 6.8 | 7.6 | 8.6 | 6.0 | 6.7 | 7.4 | 8.2 | 6.1 | 7.5 | 10.2 |
| | | | | | | | | | | | | | | | | | | |
| Production | | | | | | | | | | | | | | | | | | |
| Western Hemisphere | 20.7 | 26.5 | 30.2 | 16.2 | 18.7 | 19.2 | 18.6 | 20.5 | 21.5 | 22.1 | 22.7 | 19.6 | 22.2 | 23.5 | 24.5 | 22.2 | 23.6 | 24.6 |
| Europe/FSU | 14.1 | 17.1 | 17.8 | 12.5 | 14.5 | 15.8 | 16.8 | 13.6 | 14.6 | 14.7 | 15.2 | 13.5 | 14.1 | 15.3 | 16.2 | 13.5 | 15.8 | 17.0 |
| Asia | 6.0 | 8.7 | 10.1 | 6.8 | 6.1 | 7.4 | 7.7 | 7.0 | 7.7 | 7.5 | 7.0 | 6.9 | 6.5 | 8.8 | 9.0 | 8.5 | 7.9 | 8.9 |
| Africa/Middle East | | | | | | | | | | | | | | | | | | |
| Non Opec | 6.1 | 8.6 | 10.2 | 11.8 | 12.2 | 13.9 | 14.8 | 3.8 | 10.7 | 10.9 | 10.8 | 3.9 | 4.4 | 4.6 | 4.7 | 3.9 | | |
| Opec | 20.7 | 19.3 | 22.6 | 20.8 | 22.7 | 26.8 | 30.5 | 21.9 | 22.2 | 29.6 | 35.9 | 23.1 | 25.4 | 27.8 | 31.7 | 23.8 | | |
| Total | 26.8 | 27.9 | 32.8 | 32.6 | 34.9 | 40.7 | 45.3 | 25.7 | 32.9 | 40.5 | 46.7 | 27.0 | 29.8 | 32.4 | 36.4 | 27.7 | 31.3 | 47.2 |
| | | | | | | | | | | | | | | | | | | |
| Regional Balances | | | | | | | | | | | | | | | | | | |
| Western Hemisphere | -5.0 | -2.0 | -0.6 | -5.9 | -5.5 | -6.6 | -8.3 | -3.9 | -5.8 | -7.0 | -7.8 | -5.9 | -5.1 | -5.1 | -5.3 | -3.4 | -5.0 | -7.7 |
| Europe/FSU | -5.8 | -5.1 | -6.4 | -5.3 | -3.4 | -3.0 | -3.1 | -7.0 | -5.8 | -7.2 | -7.8 | -6.4 | -6.7 | -6.4 | -6.4 | -6.4 | -5.5 | -7.5 |
| Asia | -6.1 | -14.2 | -17.6 | -8.4 | -14.0 | -16.7 | -2.1 | -9.0 | -14.5 | -18.7 | -22.5 | -10.1 | -14.2 | -15.0 | -18.2 | -8.7 | -13.2 | -20.9 |
| Africa/Middle East | 20.7 | 21.1 | 24.7 | 26.5 | 27.8 | 32.3 | 34.8 | 20.0 | 26.1 | 32.9 | 38.1 | 21.0 | 23.1 | 25.0 | 28.2 | 21.6 | 23.8 | 37.0 |
| | | | | | | | | | | | | | | | | | | |
| DOE projections are the Reference Case | | | | | | | | | | | | | | | | | | |
| DOE forecast of production of all Opec members, except for Saudi Arabia, are assumed to be at capacity. | | | | | | | | | | | | | | | | | | |

China was a minor importer of crude oil in 1995 but is forecast to become a large importer by 2010 as demand rises to 6 million b/d to 7 million b/d. Western projections for China's production for 2005 and beyond range from unchanged at 3 million b/d to up to 4 million b/d, implying a gap of 2 to 4 million b/d that will have to be made up by imports, mainly from the Middle East. The China National Petroleum Corp. expects oil production to reach 3.5 million b/d in 2000 with demand 1 million b/d higher. A larger gap of 2.4 million b/d is anticipated by 2010 and 3.6 million b/d by 2015 (Xu, 1996). At the same time, because of popular domestic objections to additioal nuclear plants, Japan's oil needs are expected to grow by about 1 million b/d, despite government targets calling for a drop in oil use in the next ten years. South Korean demand will increase gradually by about 500,000 b/d over the next fifteen years to 2.5 million b/d. India will see bigger gains from 1.5 million b/d currently to 2.7 million b/d in 2010.

## The Geopolitics of Future Asian Oil Needs

As regional oil markets tighten, competition for supplies will intensify, creating potential for severe strains between Asian powers. Changing supply routes for northeast Asian importers may spark geopolitical rivalries along the vulnerable sea-lanes that link Asia with the Middle East." (Calder, 1996). Such maritime concerns have already been studied in depth by the National Defense University's Institute for National Strategic Studies (Noer, 1996) which concludes that "If access to key southeast Asian SLOCs is ever denied, freight rates would increase worldwide, at least as a result of long-term blockage of world shipping around there" giving the issue strategic and economic significance for all trading nations.

It is not difficult to imagine how such rivalries for energy supplies might intensify in the coming years, especially a major disruption from the Middle East. The imperative to relax such rivalries is brought home when consideration is given to the fact that territorial disputes over oil resources have already erupted between China and its neighbors. The danger from the point of view of maintaining a stable world economic and political order, is that Asian countries may react to their energy vulnerability by taking precautionary steps to ensure that adequate supplies are under their sphere of influence. Such steps could involve forming alliances with Middle East nations and increasing military capability and projection of power. China, South Korea and Japan have all in recent years taken steps to enhance their naval presence. The US naval presence in Asian and Indian Ocean waters, as well as a protector of the Strait of Hormuz, complicates the challenge of power politics to the Asian energy import question.

US policy makers have several challenges to address in America's foreign policy role in energy security into the 21st century. US-led sanctions on Iraq and Iran, which in the latter case have been extended at least on the books to include secondary boycotts, have contributed to a weakening of Japan's traditionally strong economic links with these two major producers. To the extent that China deepens its military sponsor-client relationship with Iran and Iraq, a conflict between either of those Mideast nations and a US ally in the region would take on superpower connotations reminiscent of the 1970s. Moreover, as the US considers its future role as the protector of the free flow of oil from the Mideast and into Asia, it will have to address domestic constituencies that may not fully understand the global nature of oil economics and will as such, question US military policies in an environment where the imports entering the US may not in great measure be from the Mideast but rather from Venezuela, Mexico, Canada and Latin America.

China may also wish to extend its influence beyond Asia and Iran to other nearby oil producing regions and support eastward oil and gas projects from Russia, Central Asia and Southeast Asia. Projects have been investigated from Russia's Krasnoyarsk, Irkutsk and Yakutsk to the China Yellow Sea, and possibly onto Korea and Japan, and from Turkmenistan to east China.

It would be natural and prudent for Asia nations to assert influence with oil suppliers either through alliances or militarily unless formal arrangements could be worked out that provided some assurance of oil supplies in the event of supply disruptions. Building regional institutions that encourage cooperation among the Asian Pacific nations will be crucial as a policy to counter tendencies towards rivalry and competitive military buildups. In the oil industry context, eliminating barriers to improved oil and gas resource development in Indonesia and China deserves priority. To the extent that CNPC has begun investigating strategic alliances with western oil companies in oil-rich West China, Western governments should support and encourage such efforts. Some analysts (Salameh 1996) have advocated that the provision of technology and investment be given conditional to peaceful resolution of maritime and territorial disputes, but it is unclear whether China would submit to such bargaining. Official development aid is not viewed by regional parties as likely to be an effective measure in the case of China but could help prod enhanced Indonesian investment incentives in the energy sector that are considered necessary to improve the outlook in Jakarta.

While the focus of this paper is primarily on the economics of energy security it is clear that political and economic factors are interlinked. And while our expertise is not in politics or international relations it would appear that a serious examination of US sanctions policies should be undertaken. In the current situation of rapid demand growth, lean inventories and constant output by Saudi Arabia and other Gulf states with excess capacity, the effect of sanctions is to reinforce upward pressure on prices and to transfer a large amount of income from consuming to producing countries, some of which are subject to sanctions. Assume for example, that if sanctions were removed from Iraq, the increase in Iraqi production to 2.5mb/d would lead to a decline in oil prices of say $5. This is a reasonable assumption given the short run inelasticity of demand and supply. If prices are higher by more than $5/barrel, the following numbers would have to be increased accordingly. At present oil flows, the additional $5/barrel costs the US approximately $35 million per day for the 7mb/d of imports or about $13 billion per year. For Oecd countries as a whole, net imports amount to roughly 21 mb/d which cost an additional $38 billion per year. Beneficiaries of these transfers are oil exporters: Iran, for example, gains about $6.6 billion per year; Saudi Arabia is gaining $15 billion per year. With the exception of Iraq, it is not clear whether the objects of US sanctions are, on balance, gaining or being hurt by them. The loss in income from the reductions in output due to the cut off of access to Western capital and technology must be weighed against the gain in income generated by higher oil prices. Western powers also should ask whether the benefits of the sanctions policies are worth the substantial cost of higher energy prices. Also, by imposing sanctions the US is creating incentitives for other nations such as China to form special relationships with the sanctioned nations. As pointed out above, these relationships could potentially exacerbate tensions involving both Asian and Mid East countries.

Another issue that needs to be examined is the maintenance of oil stocks in the IEA countries. Recent and further planned sales from the SPR by the US government has already created some debate on this issue. The existence of the SPR and similar stockpiles in other countries serves, as we have discussed above, to reduce the short term magnitude of a price shock, and hence, the cost to the economy of the shock. In addition the existence of these reserves gives governments a tool to maintain orderly oil markets in the event of panic induced by surprises in oil markets and to reduce the temptation of suppliers with monopoly power from taking advantage of short term tightness in oil markets by threatening releases from these stocks.

It may be useful to examine this issue by using an example, based on somewhat realistic numbers. Costs of maintaining reserves are equal to storage and handling costs plus the opportunity cost of the resources tied up in oil inventories. At the end of 1994 Oecd countries held over 3.5 billion barrels in inventory (IEA 1996). At $20/barrel the monetary value of these reserves would be $7 billion. At an interest rate of say, 5% the opportunity cost of the resources invested in the inventory would be approximately $3.5 billion per year. Even when adding storage and handling costs it is clear that the SPR and similar stockpiles in other countries are not costly to maintain. Over a ten year period costs may aggregate to $44-50 billion. One of the benefits is the reduced number and magnitude of price spikes and the associated loss in output induced by them. If there were one major price shock which lasted one year and release of the oil stocks reduced this cost by as little as .1% of aggregate GDP, savings for all of the Oecd countries would be in the range of $15 to $25 billion. Savings from the prevention of a price shock could be even larger. The economic reasonableness of maintaining reserves will then depend on the probability of a major supply interuption and the extent to which that probability is reduced by the existence of those reserves and the resulting savings. While a more informed statement regarding the economic efficacy of maintaining reserves would require a rigorous cost-benefit analysis this simple example suggests that the reserves are probably viable from an economic perspective.

## Conclusions

1) The Gulf war experience has generated complacency about energy security but the present oil market supply-demand balance is precariously tight. Unlike the conditions of 1990 when an overhang of surplus oil inventories and productive capacity shielded consumers from the sudden loss of 4.5 to 5 million b/d of Kuwaiti and Iraqi production, no such surpluses of inventory or production are evident at present. Therefore, a major supply disruption would likely produce a more pronounced price response than seen in 1990, especially if Saudi Arabia was involved or did not choose to utilize its spare capacity to compensate for any decrease in production from other sources.

2) Temporary disruptions are a common occurrence in oil markets. Only a few have had major price impact due to the existence of supply surpluses in recent years. Consuming nations would benefit from the reestablishment of surplus inventory and production.

3) Only very limited spare sustainable shut-in productive capacity exists within Opec today and is in great measure located in a single country, Saudi Arabia. No spare productive capacity of any significance exists outside the Middle East.

4) Oil demand is growing at a brisk pace, faster than forecasted, and continued growth could put upward pressure on oil prices in the years to come if planned investments in the Middle East and the competitive fringe outside the Middle East do not come to fruition.

5) Opec, or a smaller group within Opec, still has the power to influence price trends, mainly to the upside by implementing a supply allocation plan. Opec does not currently have enough spare productive capacity on line to knock out marginal high cost production.

6) Asia will experience a growing gap between regional oil production and demand, potentially aggravating geopolitical rivalries between the big Asian powers. Asian dependence on Middle East and African supplies will rise significantly. At the same time, Western hemisphere oil markets could become relatively geographically self-sufficient given oil field development plans in the US offshore, Canada, Venezuela and elsewhere in South America.

7) Oil consumers benefit when oil production comes from as diverse a base as possible, reducing reliance on any one particular geographic country or center, lessening the potential for a large scale disruption from any one area and increasing the chances that replacement supplies may be readily available. If all known prospects were developed on schedule in the competitive fringe, the amount of oil needed from the Middle East would be greatly reduced.

8) Political, legal, economic and geographic constraints currently block development of vital resources in several oil prolific countries in the competitive fringe outside the Middle East.

9) Technology transfer to countries in the competitive fringe outside the Middle East could greatly enhance available oil supplies in the coming years, and has already played a major role in staving off declines in major provinces in the US and North Sea

10) In an open, global market, energy security becomes a matter of price, inflation, economic growth rates and wealth transfers. Sophisticated oil arbitrage ensures one price in all markets so that the sizable loss of supplies to any major consuming country will have ripple effects on the oil prices to all consumers. This means that any one country's dependence on Middle East imports has little bearing on the question of what oil prices that country will experience during a disruption. Lower dependence by one nation will not translate into lower prices while higher dependence will not by necessity translate into higher prices for that country alone. At the same time, countries cannot assume that a free market in oil would continue in the event of a crisis. History has shown that governments do intervene. Consuming nations will take the historical lesson into account in formulating their energy policies.

11) For many countries improvements in energy efficiency and substitution of other energy sources for oil has reduced exposure to oil shocks today than they were 20 years ago. Benefits exist in extending the scale of these improvements in the OECD and sharing technology with other major consuming nations such as China.

12) Economic costs remain from oil price shocks, particularly those that last beyond several months. Among these costs are the higher risk that oil price increases will reduce investment, eventually leading to lower rates of growth in output and income. Oil price increases also reduce real income due to the shift in the terms of trade in favor of oil exporting countries.

13) Monetary and fiscal policy can reduce and delay the extent to which an oil shock is transmitted into the economy in the form of decreases in output and employment.

## Policy recommendations

* Consuming countries benefit from the existence of strategic stocks and privately-held stocks but clearer agreement is needed on when and how to use these stocks. The International Energy Agency would also benefit from reconsidering the circumstances under which a limited release by one or more member countries would be preferable to a worldwide release.

*The IEA should study the benefits of increasing its membership to extend beyond the OECD to include the emerging economies of Asia including China.

*The IEA should lay the groundwork for providing know-how on strategic oil stockpiling and emergency response measures to Asian countries and function as a medium for transferring energy conservation technology.

*US policy makers should review the costs and benefits of imposing oil sanctions on several oil producing countries simultaneously. Effectiveness of sanctions in meeting targetted goals should also be reviewed. Iran's influence on the question of exports from Central Asia should also be revisited.

*The US government and other Western powers should help promote political stability in the Middle East. Achievement of economic progress in the region and resolution of the

Arab Israeli conflict are critical to the development of such stability. A paucity in economic, social and political opportunity in the Middle East is increasingly creating an

audience for extremist groups. Market liberalization and enhanced regional trade may serve in the long run to alleviate some of these trends.

*Energy policy makers should continue to identify and pursue options to promote the development of oil and gas resources outside the Middle East, with special attention paid to fields in Asia or near Asia. Investigation should be made of means to remove barriers to investment in oil and gas resources outside the Middle East, and trade activities that promote technology transfer in the oil sector should be encouraged. This can be done in many ways including:

a) educating countries on the means and benefits of improving investment incentives in the energy sector

b) continuing to develop diplomatic initiatives that assist with the removal of political, legal and technological barriers to investment in oil prolific countries such as Russia, Central Asia, Indonesia, China, and Mexico

c) promoting and encouraging the participation of the Western service industry in assisting development of oil fields and technology transfer to oil producing countries

that cannot or will not consider production sharing/jont venture participation by private oil companies

*The US, Japan and the IEA should engage in a dialogue with China on matters of energy cooperation, including joint research on coal liquification, and other clean-coal technology, biomass and solar technologies and hydroelectric power. Collaboration in construction of large-scale energy infrastructure like long-distance pipelines would also be of benefit.

*Monetary policy should be used judiciously during oil price spikes to limit the impact on output.

*US policy makers should review the costs and benefits of imposing oil sanctions on several oil producing countries simultaneously. Effectiveness of sanctions in meeting targetted goals should also be reviewed. Iran's influence on the question of exports from Central Asia should also be revisited.

*Energy policy makers should continue to identify and pursue options to promote the development of oil and gas resources outside the Middle East, with special attention paid to fields in Asia or near Asia. Investigation should be made into means to remove barriers to investment in oil and gas resources outside the Middle East, and trade activities that promote technology transfer in the oil sector should be encouraged. This can be done in many ways including

a) educating countries on the means and benefits of improving investment incentives in the energy sector b) continuing to develop diplomatic initiatives that assist with the removal of political, legal and technological barriers to investment in oil prolific countries such as Russia, Central Asia, Indonesia, China, and Mexico c) promoting and encouraging the participation of the Western service industry in assisting development of oil fields and technology transfer to oil producing countries that cannot or will not consider production sharing/joint venture participation by private oil companies

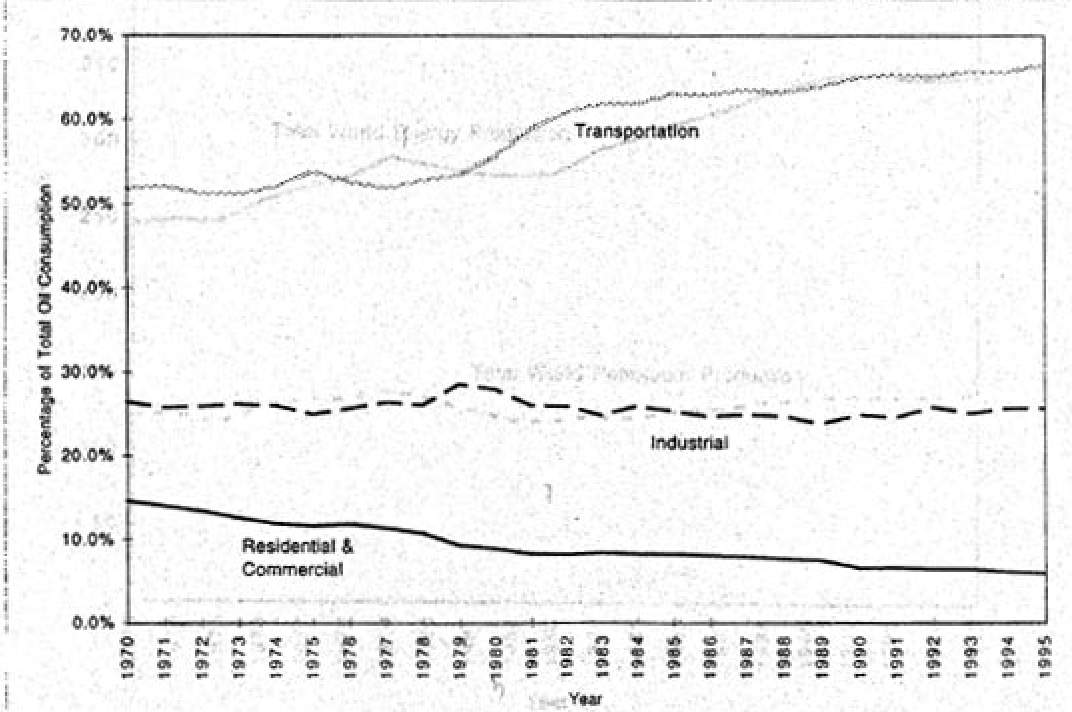
*Continued increases in energy efficiency should be considered as an alternative to finding and developing more oil. Research should be undertaken which determines which is the most efficient approach to ensuring reasonable energy prices over the long run.

## Appendix Tables

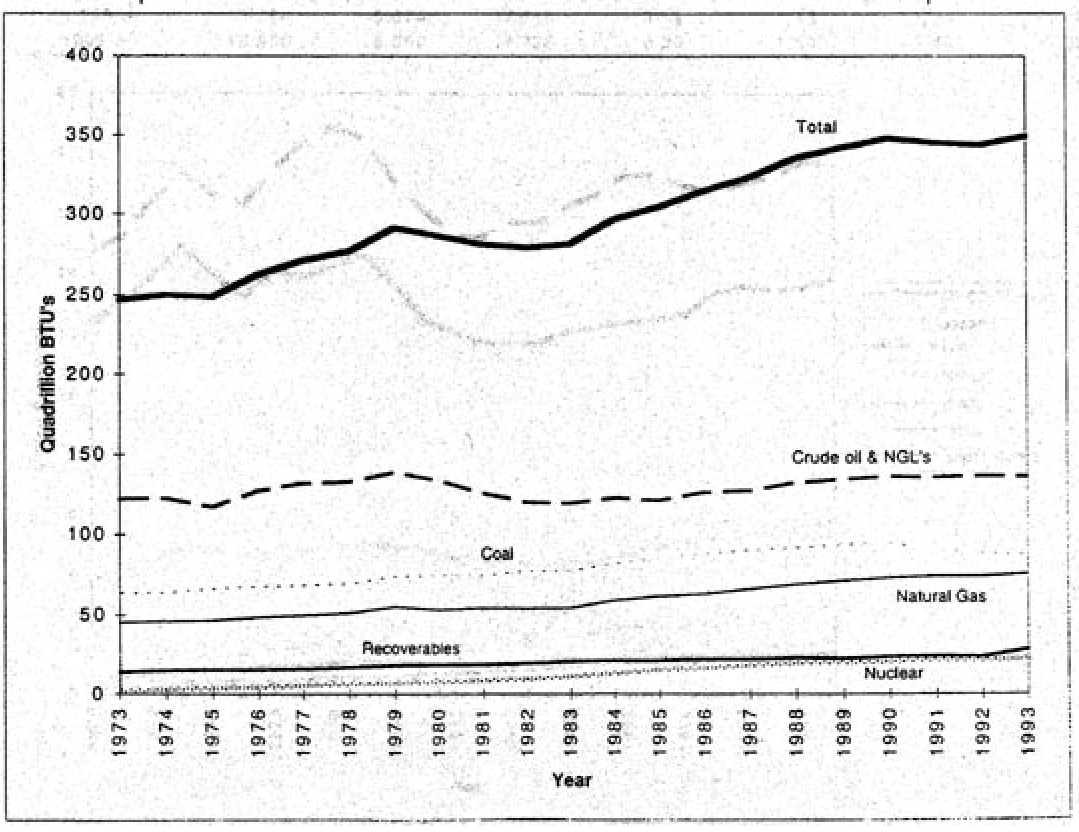
Statistics: Middle Eastern Countries

**Oil Consumption by Sector as a Percentage of Total Oil Consumption for the United States, 1970-1995**

| Year | Residential & Commercial | Industrial | Transportation |
|---|---|---|---|
| 1970 | 14.6% | 26.4% | 51.9% |
| 1971 | 14.0% | 25.7% | 52.1% |
| 1972 | 13.4% | 25.9% | 51.3% |
| 1973 | 12.6% | 26.1% | 51.2% |
| 1974 | 12.0% | 26.0% | 52.0% |
| 1975 | 11.6% | 24.9% | 53.8% |
| 1976 | 11.9% | 25.6% | 52.6% |
| 1977 | 11.3% | 26.3% | 51.8% |
| 1978 | 10.7% | 26.0% | 52.8% |
| 1979 | 9.3% | 28.5% | 53.4% |
| 1980 | 8.9% | 27.9% | 55.6% |
| 1981 | 8.2% | 26.0% | 58.9% |
| 1982 | 8.1% | 25.8% | 60.9% |
| 1983 | 8.3% | 24.7% | 61.9% |
| 1984 | 8.2% | 25.8% | 61.9% |
| 1985 | 8.2% | 25.3% | 63.1% |
| 1986 | 8.0% | 24.6% | 63.0% |
| 1987 | 7.9% | 24.8% | 63.5% |
| 1988 | 7.6% | 24.6% | 63.2% |
| 1989 | 7.4% | 23.8% | 63.9% |
| 1990 | 6.5% | 24.8% | 65.0% |
| 1991 | 6.5% | 24.5% | 65.3% |
| 1992 | 6.4% | 25.8% | 65.0% |
| 1993 | 6.3% | 25.0% | 65.6% |
| 1994 | 6.0% | 25.5% | 65.6% |
| 1995 | 5.8% | 25.6% | 66.5% |

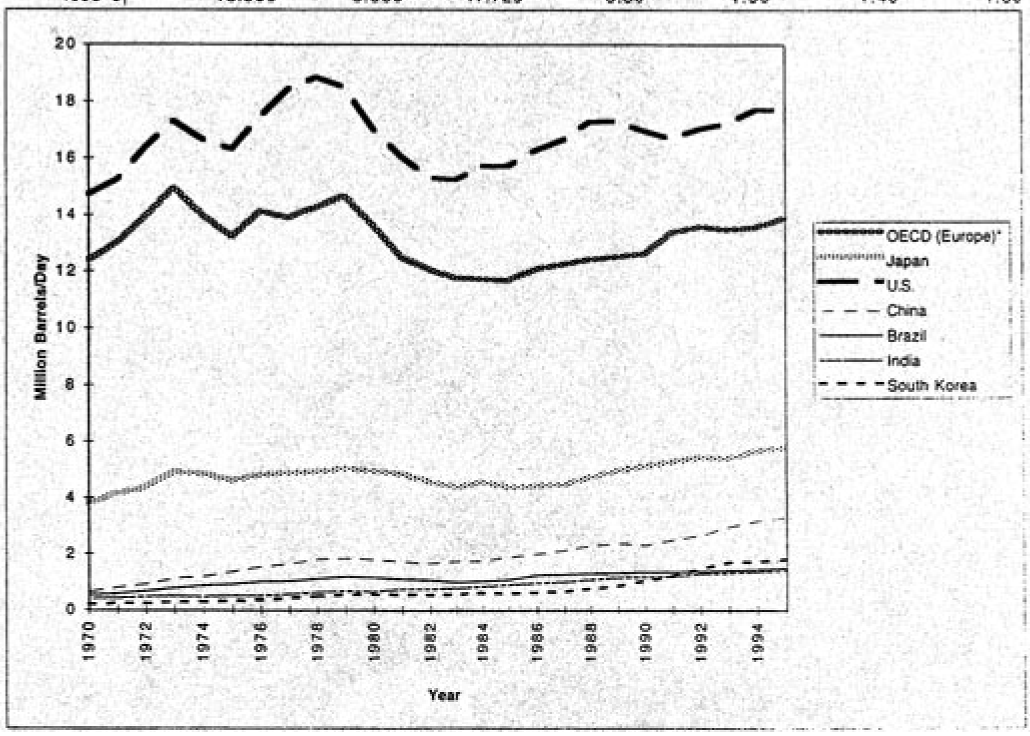


| Year | Coal | Natural Gas | Crude Oil & NGL's | Nuclear | Recoverables | Total |
|---|---|---|---|---|---|---|
| 1973 | 63.87 | 45.00 | 122.06 | 2.15 | 13.73 | 246.81 |
| 1974 | 63.79 | 45.82 | 122.44 | 2.87 | 15.06 | 249.98 |
| 1975 | 66.20 | 46.17 | 117.10 | 3.85 | 15.28 | 248.60 |
| 1976 | 67.33 | 48.14 | 126.96 | 4.52 | 15.36 | 262.31 |
| 1977 | 68.47 | 49.35 | 132.03 | 5.41 | 15.83 | 271.09 |
| 1978 | 69.55 | 50.79 | 132.93 | 6.43 | 17.08 | 276.78 |
| 1979 | 73.80 | 54.44 | 138.66 | 6.69 | 18.03 | 291.62 |
| 1980 | 74.48 | 52.65 | 133.22 | 7.58 | 18.45 | 286.38 |
| 1981 | 74.51 | 53.87 | 125.52 | 8.53 | 18.77 | 281.20 |
| 1982 | 77.15 | 53.48 | 119.85 | 9.51 | 19.26 | 279.25 |
| 1983 | 77.56 | 53.76 | 119.31 | 10.72 | 20.23 | 281.58 |
| 1984 | 81.58 | 58.79 | 122.57 | 13.00 | 20.88 | 296.82 |
| 1985 | 85.77 | 61.38 | 121.22 | 15.37 | 21.16 | 304.90 |
| 1986 | 88.06 | 62.60 | 126.36 | 16.34 | 21.69 | 315.05 |
| 1987 | 90.27 | 65.61 | 127.48 | 17.80 | 21.78 | 322.94 |
| 1988 | 91.92 | 68.78 | 132.56 | 19.30 | 22.56 | 335.12 |
| 1989 | 93.92 | 71.20 | 134.66 | 19.82 | 22.37 | 341.97 |
| 1990 | 94.97 | 72.91 | 136.35 | 20.30 | 23.31 | 347.84 |
| 1991 | 90.43 | 73.99 | 135.93 | 21.27 | 23.57 | 345.19 |
| 1992 | 88.62 | 73.80 | 136.46 | 21.30 | 23.46 | 343.64 |
| 1993 | 87.60 | 75.10 | 136.20 | 22.10 | 28.10 | 349.10 |



## Crude Oil Consumption of Selected Nations

| Year | OECD (Europe)* | Japan | U.S. | China | Brazil | India | South Korea |
|---|---|---|---|---|---|---|---|
| 1970 | 12.404 | 3.817 | 14.697 | 0.62 | 0.53 | 0.40 | 0.20 |
| 1971 | 13.005 | 4.142 | 15.213 | 0.79 | 0.58 | 0.42 | 0.23 |
| 1972 | 13.943 | 4.363 | 16.367 | 0.91 | 0.66 | 0.46 | 0.23 |
| 1973 | 14.925 | 4.949 | 17.308 | 1.12 | 0.78 | 0.49 | 0.28 |
| 1974 | 13.988 | 4.864 | 16.653 | 1.19 | 0.86 | 0.47 | 0.29 |
| 1975 | 13.217 | 4.621 | 16.322 | 1.36 | 0.92 | 0.50 | 0.31 |
| 1976 | 14.124 | 4.837 | 17.461 | 1.53 | 1.00 | 0.51 | 0.36 |
| 1977 | 13.916 | 4.880 | 18.431 | 1.64 | 1.02 | 0.55 | 0.42 |
| 1978 | 14.290 | 4.945 | 18.847 | 1.79 | 1.11 | 0.62 | 0.48 |
| 1979 | 14.667 | 5.050 | 18.513 | 1.84 | 1.18 | 0.66 | 0.53 |
| 1980 | 13.634 | 4.960 | 17.056 | 1.77 | 1.15 | 0.64 | 0.54 |
| 1981 | 12.515 | 4.848 | 16.058 | 1.71 | 1.09 | 0.73 | 0.54 |
| 1982 | 12.053 | 4.582 | 15.296 | 1.66 | 1.06 | 0.74 | 0.53 |
| 1983 | 11.765 | 4.395 | 15.231 | 1.73 | 0.98 | 0.77 | 0.56 |
| 1984 | 11.736 | 4.576 | 15.726 | 1.74 | 1.03 | 0.82 | 0.59 |
| 1985 | 11.681 | 4.384 | 15.726 | 1.89 | 1.08 | 0.90 | 0.57 |
| 1986 | 12.102 | 4.439 | 16.281 | 2.00 | 1.24 | 0.95 | 0.61 |
| 1987 | 12.255 | 4.484 | 16.665 | 2.12 | 1.26 | 0.99 | 0.64 |
| 1988 | 12.427 | 4.752 | 17.283 | 2.28 | 1.30 | 1.08 | 0.73 |
| 1989 | 12.531 | 4.983 | 17.325 | 2.38 | 1.32 | 1.15 | 0.84 |
| 1990 | 12.629 | 5.140 | 16.988 | 2.30 | 1.34 | 1.17 | 1.03 |
| 1991 | 13.391 | 5.284 | 16.714 | 2.50 | 1.35 | 1.19 | 1.20 |
| 1992 | 13.605 | 5.446 | 17.033 | 2.66 | 1.37 | 1.28 | 1.46 |
| 1993 | 13.492 | 5.401 | 17.237 | 2.96 | 1.40 | 1.31 | 1.69 |
| 1994 | 13.584 | 5.674 | 17.718 | 3.18 | 1.43 | 1.34 | 1.70 |
| 1995 e | 13.900 | 5.800 | 17.720 | 3.30 | 1.50 | 1.40 | 1.80 |



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