SYNERGY

THE EXCELLENCE PLATFORM

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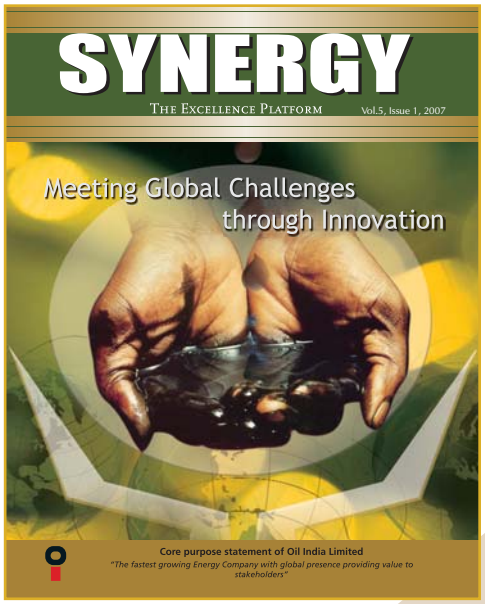
Meeting Global Challenges through Innovation

Core purpose statement of Oil India Limited

"The fastest growing Energy Company with global presence providing value to stakeholders"



Team Synergy

Mr. M. R. Pasrija – Patron
Mr. Arvind Jaini – Editor
Ms. Krishna Hazarika Rao – Sub Editor

OIL THROUGH THE AGES

347 A.D.	Oil wells are drilled in China up to 800 feet deep using bits attached to bamboo poles.
1264	Mining of seep oil in medieval Persia witnessed by Marco Polo on his travels through Baku.
1500	Seep oil collected in the Carpathian Mountains of Poland is used to light street lamps.
1594	Oil wells are hand dug at Baku, Persia up to 35 meters (115 feet) deep.
1735	Oil sands are mined and the oil extracted at Pechelbronn field in Alsace, France.
1815	Oil is produced in United States as an undesirable by-product from brine wells in Pennsylvania.
1848	First modern oil well is drilled in Asia, on the Aspheron Peninsula north-east of Baku, by Russian engineer F.N. Semyenov.
1849	Distillation of kerosene from oil by Canadian geologist Dr. Abraham Gesner. Kerosene eventually replaces whale oil as the illuminant of choice and creates a new market for crude oil.
1850	Oil from hand-dug pits in California at Los Angeles is distilled to produce lamp oil by General Andreas Pico.
1854	First oil wells in Europe are drilled 30- to 50-meters deep at Bóbrka, Poland by Ignacy Lukasiewicz.
1854	Natural Gas from a water well in Stockton, California is used to light the Stockton courthouse.
1857	Michael Dietz invents a kerosene lamp that forces whale oil lamps off the market.
1858	First oil well in North America is drilled in Ontario, Canada.
1859	First oil well in United States is drilled 69 feet deep at Titusville, Pennsylvania by Colonel Edwin Drake.

CONTENTS

These articles are the personal views of the authors. They do not in any way reflect the views of OIL's management.

Editorial

Dear Readers,

Hope you have enjoyed reading our last issue. The last six months have seen a lot of action in the hydrocarbon industry throughout the world. The price of crude oil is going through a see-saw movement, mainly due to the geopolitical situation. The Iran hostage crisis pushed up the prices once again after a brief correction. In India too the NELP-VI round saw a flurry of activity, with many big players entering the fray to win new acreages which were put on the block.

The increase in the use of fossil fuels is now a matter of concern globally. First the prices are putting a lot of pressure on the economies of the developing and the under developed states. Secondly the use of these is sounding alarm bells on the degrading environment and global warming. Scientists have gone as far as to say that we have crossed the tip and that the global warming is there to stay. The effort to use environment friendly ethanol by countries has its own story. Economists say that land used for cultivation of food crops is being diverted for growing crops used for conversion to ethanol. This will disturb the food supply chain creating another crisis of its own. Forests are also being razed down to grow sugarcane, maize etc which are used as feed stock to produce ethanol. Research is also on to produce "Treethanol", i.e. ethanol from trees. This involves the breaking down of the cellulose of the wood by enzymes, to sugar, for final conversion to ethanol. It is evident that a lot of research is going on to find better and renewable sources of energy. Mankind has always stood the test of time and has overcome crisis through innovative methods.

Coming to this issue of Synergy, we have for you articles on Bio-fuels, pricing of oil, and, construction of Numaligarh Refinery. We also have an article on the ancient city of Tripoli, where Oil India Limited established its first office abroad. Hope you like them. We also look forward to your feed back on the issue. Before I end, I would like to congratulate all the winners of the Quiz contest.

Happy Reading!

With Best Wishes

Arvind Jaini
Editor
SYNERGY

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"Iran and Euro - Pricing of Crude Oil" Is Petrodollar collapsing?

Sara Vakhshouri, Energy Analyst

Introduction:

It is a fact that the US currency accounts for approximately two thirds of all official exchange reserves. More than four-fifths of all foreign exchange transactions and half of all world exports are denominated in dollars. In addition, all IMF loans are denominated in dollars.

The more dollars circulate outside the US, the more the rest of the world has to provide the US with goods and services in exchange for these dollars. The dollars cost the US next to nothing to produce, so the fact that the world uses the currency in this way means that the US is importing vast quantities of goods and services virtually for free.

One of the stated economic objectives, and perhaps the primary objective, when setting up the euro was to turn it into a reserve currency to challenge the dollar so that Europe too could get something for nothing.

This however would be a disaster for the US. Not only would they lose a large part of their annual subsidy of effectively free goods and services, but countries switching to euro reserves from dollar reserves would bring down the value of the US currency.

Oil is one of the main commodities traded internationally; it is the lifeblood of all modern industrialized economies. If you don't have oil, you have to buy it. And if you want to buy oil on the international markets, you usually have to have dollars. Until some years back, all OPEC countries agreed to sell their oil for dollars only, but this is not the case any more especially after the 11th of September.

The purely economic arguments for OPEC members converting to the euro, at least for a while, seem very strong. The Euro-zone does not run a huge trade deficit nor is it heavily indebted to the rest of the world like the US and interest rates in the Euro-zone are also significantly higher. The Euro-zone has a larger share of world trade than the US and is the Middle East's main trading partner. And nearly everything you can buy for dollars you can also buy for euros - apart, of course, from oil. Furthermore, if OPEC members were to convert their dollar assets to euro assets and then require payment for oil in Euros, their assets would immediately increase in value, since oil importing countries would be forced to also convert part of their assets, driving the prices up. For OPEC, backing the euro would be a self-fulfilling prophesy. They could then at some later time move to some other currency.

Over view:

The rise of the euro as a prominent trading currency has offered an opportunity for OPEC to reconsider pricing of its crude oil in this new currency. The main consideration in making such a policy change by the oil exporters is the ability to maintain their purchasing power of a barrel of their oil exports in an era of persistent dollar decline, and to avoid uncertainty regarding their oil revenues in real terms.

While the majority of oil exporting countries trade with non-dollar areas, particularly with European countries, switching to euro - based oil prices seems to be a realistic possibility. However, for countries such as Venezuela, which trades mainly with the United States, this strategy would be counter productive. Therefore, such a shift in strategy would not be Pareto optimal and would result in disadvantage for the countries having United States as a major trading partner.

In the spring of 2003, Iran had started to sell its oil in euros. Iran's move to the euro, as mentioned above, is logical if we realize that Iran sells 30 percent of its oil production to Europe and the rest mainly to India and China. The Iranian oil price was still labeled in US dollars, but customers did not have to exchange their money into dollars anymore.

Why Euro:

The Euro has become the second most important currency in the world since it was created. A series of factors contribute towards promoting the use of the Euro as an international currency. The first such factor is the grand scale of the economy of the Euro zone, which represents 16% of the world GDP. The Euro zone has the second highest GDP in the world, since USA GDP represents 21% of the world GDP, while the corresponding figure for Japan is 8%. These three economies show similar figures in regards to participation in the world goods and services trade.

The second factor promoting the Euro to its international status is its stability, which reflects the sound foundation of the economy of the Euro zone. The third factor is the intensive integration of national financial markets in Europe, which leads to the creation of pan-European financial markets of high liquidity; such markets will reinforce the role of the Euro in the sector of international loan and borrowing activities.

A **petroeuro** is a petroleum trade valued in the euro as opposed to the US dollar (petrodollar). Trading of any natural resources, including petroleum, is controlled through trading partnerships involving both exporters and importers of the resource, in a defined marketplace, and through a trade agreement. The major countries holding petroleum reserves since the decline of US production are dominated by OPEC, and hence, OPEC may choose dollars, euros, yen, or any currency providing perceived advantage, politically or economically. As of 2005, OPEC continues to trade in petrodollars, but some OPEC members (such as Iran and Venezuela) have been pushing for a switch to the euro.

Since the beginning of 2003, Iran has required Euros in payment of exports toward Asia and Europe, though prices are still expressed in US dollars. Iran is planning to open an International Oil Bourse (IOB, exchange), on the free trade zone on the island of Kish, for the express purpose of trading oil priced in other currencies, including Euros. This will establish a Euro based pricing mechanism, or "oil marker" as it is called by traders. The three current oil markers are US dollar denominated, which include the West Texas Intermediate crude (WTI), North Sea Brent Crude, and the UAE Dubai Crude.

Although the opening of the IOB had been planned for 20 March 2006, but has been delayed. In this regard, Iran has decided that it will continue to price its oil sales in dollars but can receive payment in other foreign currency needed by the central bank.

On the other hand, a petrodollar is a dollar earned by a country through the sale of petroleum. The term was coined by Ibrahim Oweiss, a Professor of Economics at Georgetown University, in 1973. Oweiss felt there was a need for a word to describe the situation which was occurring in the OPEC countries, where it was entirely the sale of crude oil which allowed these countries to prosper economically and to invest in the economies of the countries which purchased their oil.

Recently, speculation has arisen that OPEC may switch from the US dollar to the Euro, inaugurating the Petroeuro. So far, OPEC has resisted this move although some OPEC members, such as Iran and Venezuela, have been pushing for a switch to the Euro. The question emerges here what is the impact of switching to the Euro? Simply, such a move from the dollar towards the euro could cause a great damage to the USA economy; why, because the US's negative balance of trade is largely offset by its role as a reserve currency. On the other hand, the demand for petrodollars is a significant factor in increasing the US' trade deficit in the first place, and it also increases inflation. Given the general tendency for crude oil prices to raise and become more volatile in recent years, it may even be argued that crude oil trading may, in the long term, be a significant liability for the stability of the currency in which the trade is conducted.

Monetary Hegemony:

Monetary hegemony is an economic and political phenomenon in which a single state has decisive influence over the functions of the international monetary system. The functions influenced by a monetary hegemon are:

a. Accessibility to international credits.

b. Foreign exchange markets, and

c. The management of balance of payments problems, in which it operates under no balance of payments constraint.

The term Monetary Hegemony appeared in Michael Hudson's Super Imperialism, which was first published in 1972. Monetary Hegemony describes not only the asymmetrical relationship that the US dollar has to the global economy, but the strictures of this hegemonic edifice that support it, namely the IMF and the World Bank. The US dollar continues to underpin the world economy and is the key currency for medium of international exchange, unit of account (e.g. pricing of oil), and unit of storage (e.g. treasury bills and bonds) (wikipedia encyclopedia, 2006).

OPEC

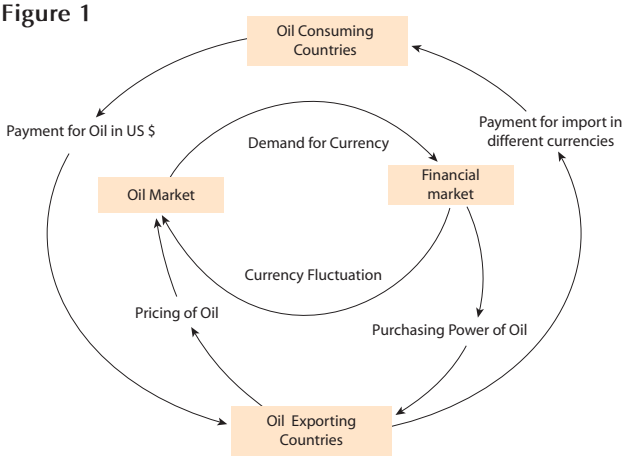
Oil pricing:

Two decades back, there has been a debate within OPEC members on whether to continue the pricing of crude oil in US dollars or to shift to an alternative currency. This debate eventually led to the discussion of benchmarking oil prices to a basket of currencies to maintain the buying power of crude oil. The limited liquidity of other currencies was a major concern as it implied a shift to an alternative currency which would lead to excessive fluctuations of the same.

The emergence of the euro has opened the debate on this issue once again. Given the breadth of the exchange of euro, the number of countries using this currency, and the extent of trade relations of these countries with oil exporting countries, re-examination of the issue of currency choice in oil pricing has re-surfaced.

Analysis of the shift in the pricing of oil from US dollar to euro would require focusing on two groups of countries and two different markets. These four entities are: oil exporters (OPEC countries and non OPEC countries), oil consumers, oil market and the financial markets. Changes by any of the above four or new external shock (price/currency fluctuations) would affect the corners of the diamond in Figure 1.

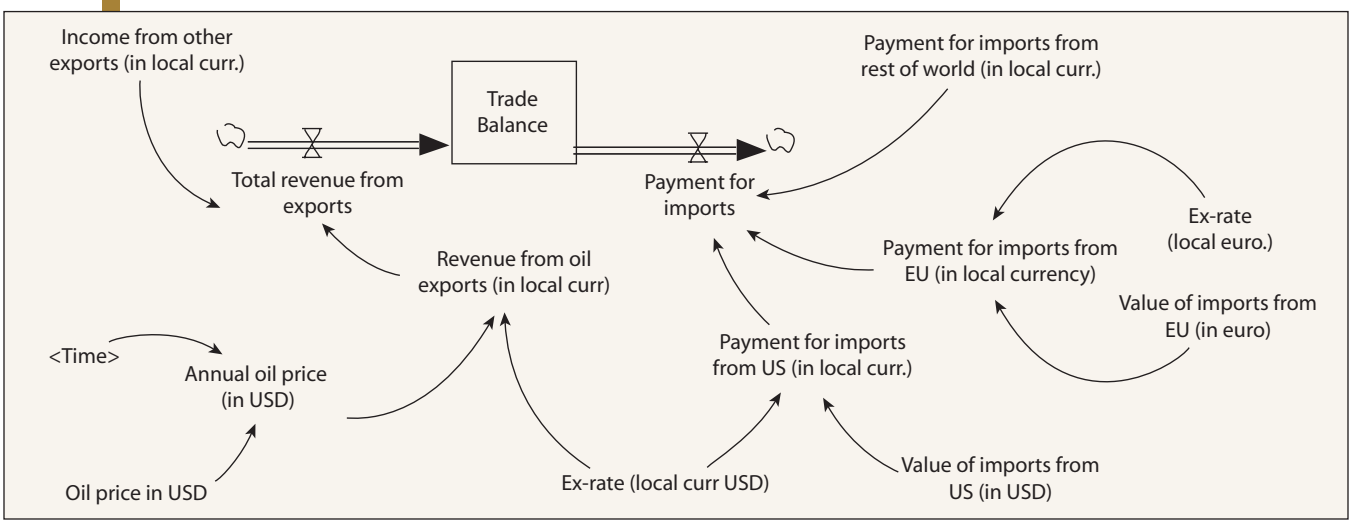
Figure 1



Different levels of interactions are identified as illustrated in the Figure 1. In the innermost level, currency fluctuations affect the dollar prices of oil, which in turn alters the demand for oil which leads to the stability of the oil market. This instability in the oil market is transferred to the financial market by way of the changing demand and supply of dollars, which would again feed into the dynamics of the oil market. In the middle level, an oil-exporting country are added to the oil market-financial market loop because they react to the changes in the currency fluctuations in the financial market and alters the price of oil. In the outermost level, oil exporting countries and oil consuming countries interact with each other in their trading relationships. Various factors are affecting these three levels of interaction. The variation in the exchange rate is a destabilizing factor for the oil market. (Samii, Massood & others, 2004).

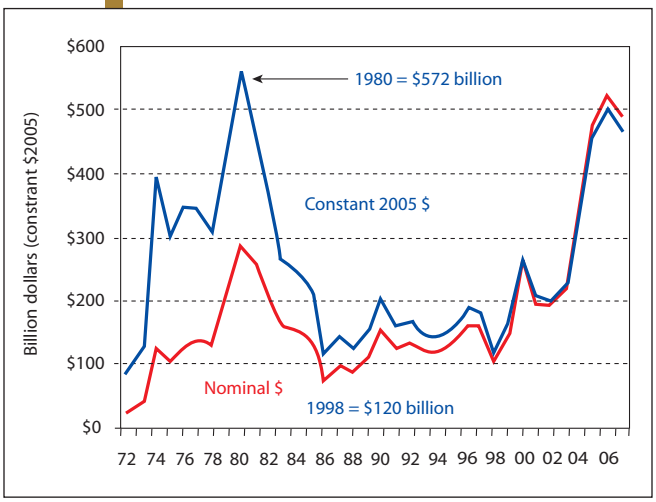
Figure 2 presents a system dynamics model to simulate in a non-linear fashion, the effect of exchange rate on the trade

Figure 2 A System Dynamics Model of Exchange Rate Impact on OPEC's Trade



balance of OPEC members. Trade balance is represented as the net of total exports and total imports. This simulation model helps in understanding the role of exchange rate in the import of goods and services and export revenues. (Same source)

Figure 3 OPEC Net Oil Export Revenues, 1972-2007



Revenues:

OPEC net oil export revenues for 2005 are now estimated at around $473 billion, up 43 percent from 2004 levels. For 2006 and 2007, OPEC net oil export revenues are forecast at $522 billion and $495 billion, respectively. Several major world events during 2004 and 2005 affected world oil markets and contributed to the spike in OPEC oil export revenues. These included: 1) low OECD oil inventories held in commercial storage, particularly in terms of days forward consumption; 2) uncertainty about the flow of Iraqi oil exports in the face of the high level of turmoil within that country; 3) damage inflicted on US Gulf Coast and offshore oil installations last fall following a series of destructive hurricanes (Ivan, Katrina, Rita, etc.); 4) an unexpectedly strong surge in world oil demand, particularly in China; and 5) capacity constraints (production, refining, and transportation).

OPEC net oil export revenues in real (inflation adjusted) terms are currently running nearly triple the average annual revenues seen during the 1990s, but remain below the peaks reached in 1980 and 1981. The boom-bust cycle of oil revenues seen over the past 30 years (the 1973 and 1979 oil price shocks; the 1985/86 oil price collapse; the 1990/91 Iraq crisis and oil price spike; the 1997/98 Asian economic crisis and oil price collapse; the current uncertainty regarding terrorist threats, Middle East instability, surging oil demand, etc.), makes long-term budgetary planning a challenge in many OPEC countries, and also complicates efforts to deal with balance of payments deficits, accumulated debt, budget problems, economic reform and rapid population growth.

Since their collapse to under $10 per barrel in December 1998, the lowest oil price since prior to the Arab Oil Embargo of 1973, oil prices have rebounded strongly, to over $60 per barrel for West Texas Intermediate as of early January 2006. The OPEC "basket" price (a weighted average of Algeria's Saharan Blend,

Figure 4 OPEC Net Oil Export at a Glance

	Nominal Dollars (Billions) Change				Constant $2005 (Billions)				
	2005/2004	2005E	2006F	2007F	1972	1980	1998	2006F	2007F
Algeria	52%	$36.0	$41.6	$41.1	$5.0	$26.4	$6.4	$40.9	$39.7
Indonesia	N.A.	($1.0)	($0.6)	($0.9)	$3.3	$30.4	$3.5	($0.6)	($0.8)
Iran	45%	$46.6	$50.1	$46.5	$15.3	$26.8	$11.2	$49.2	$44.9
Iraq	31%	$23.4	$24.9	$23.7	$5.4	$55.3	$7.7	$24.5	$22.9
Kuwait	41%	$39.0	$44.1	$41.1	$10.3	$38.4	$9.1	$43.3	$39.7
Libya	52%	$28.3	$31.2	$29.9	$10.9	$45.5	$6.7	$30.7	$28.9
Nigeria	40%	$45.1	$52.7	$51.1	$7.8	$48.8	$10.0	$51.7	$49.3
Qatar	28%	$19.1	$23.3	$23.0	$1.7	$11.0	$3.9	$22.9	$22.2
Saudi Arabia	49%	$153.3	$162.0	$150.2	$17.2	$213.6	$36.9	$159.1	$144.9
UAE	44%	$45.6	$53.0	$52.2	$3.9	$38.5	$11.5	$52.1	$50.4
Venezuela	32%	$37.7	$39.4	$37.2	$11.3	$37.2	$13.6	$38.7	$35.9
Total	43%	$473.1	$521.9	$495.2	$92.0	$571.8	$120.7	$512.5	$477.8

Figure 5 Crude Oil Prices: Real and Nominal

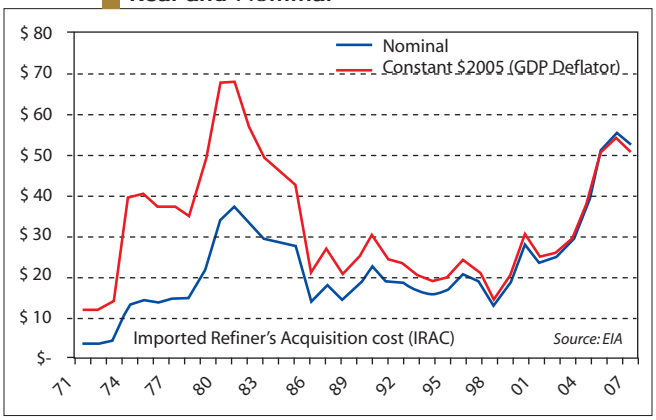
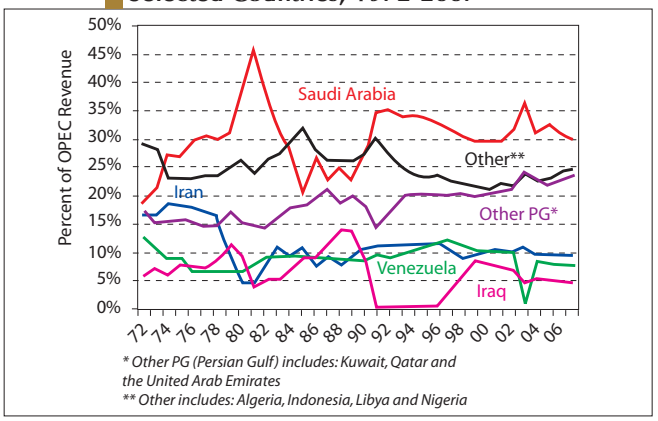


Figure 6 Share of OPEC Net Oil Export Revenues for Selected Countries, 1972-2007



Indonesia's Minas, Nigeria's Bonny Light, Saudi Arabia's Arabian Light, Dubai's Fateh, Venezuela's Tia Juana, and Mexico's Isthmus), for instance, averaged about $51 per barrel during 2005, more than four times its 1998 level. For 2006 and 2007, EIA forecasts the OPEC basket average around $55.25 and $52.50 per barrel, respectively. (It is worth noting that the relationship of the OPEC basket to other world oil prices has shifted somewhat recently; this is believed to be the result of a number of factors, including world refinery constraints and a reduction in OPEC spare production capacity for the light, sweet crude that constitute the "marginal demand barrel" worldwide. Also, please note that OPEC recently redefined the basket, which is now heavier and more "sour" -- higher sulfur -- than the previous basket.)

World oil price spikes and crashes are, in many respects, cyclical, as they affect oil supply and demand. For example, the oil price collapse of 1998 led to a large number of well closures (as well as a reduction in oil exploration and production) in non-OPEC countries. The price collapse also tended to stimulate world oil demand.

Higher oil prices since 1999

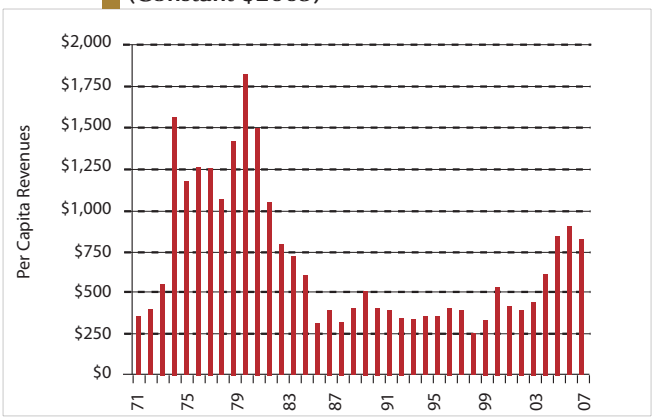
All else being equal, increased oil prices tend to result in improvements in OPEC countries' economic situations, budgets, and trade balances. Higher oil export revenues also tend to lessen pressures for economic reforms, and make it easier for OPEC countries to increase their spending. However, the impact of higher oil prices is tempered by memories of past price collapses (i.e., 1998), as well as a general understanding that oil prices can be highly volatile.

In real terms (constant $, 2005), OPEC revenues peaked in 1980, at $572 billion (see graph). OPEC's worst revenue year in constant dollar terms since the early 1970s ($80 billion in 1971) was 1998, when revenues fell to only $123 billion, slightly below the previous low revenue year of 1988 ($121 billion) following the oil price collapse of late 1985/early 1986. For the 1990s as a whole (1991-2000), OPEC net oil export revenues (in constant $, 2005) were $1.7 trillion, compared to $2.3 trillion in the 1980s, and $3.0 trillion in the 1970s. Thus, total OPEC oil export revenues in real terms during the 1990s were less than 60 percent of revenues in the 1970s. So far, OPEC oil export revenues (in constant $, 2005) for 2001-2005 are averaging $291 billion per year, about 70 percent above the annual average during the 1990s.

Individual OPEC members' shares of total oil export revenues have fluctuated over the past three decades, but several trends are apparent (see graph). First, Saudi Arabia consistently has earned more oil export revenues than any other single member of OPEC, with the Saudi share ranging from below around 16 percent in 1971 to as high as 46 percent in 1981, and 32 percent in 2005. Second, Iran's revenue share fell after the 1978/79 Iranian Revolution (followed soon thereafter by the Iran-Iraq War for much of the 1980s). Today, Iran accounts for about 10 percent of total OPEC net oil export revenues, down from 17 percent - 19 percent in the 1970s. Third, Iraq's oil export revenue share has fluctuated sharply, from a high of around 14 percent in the late 1980s, to basically 0 percent for several years following its August 1990 invasion of Kuwait (and the subsequent UN oil embargo, which continued until May 2003).

In inflation adjusted terms, OPEC per capita oil export revenues are far below the peaks reached in the late 1970s/early 1980s. For OPEC as a whole, per capita oil export revenues (in constant $, 2005) are estimated to have reached $844 in 2005, up 39 percent from 2004, but still less than half the $1,821 per capita revenues achieved in 1980. The decline in per capita oil export revenues has had significant implications for OPEC oil price preferences and policies, especially given that many OPEC countries, despite their seeming oil wealth, are paying off large debt burdens (accumulated in part as a result of low oil prices for most of the period from the mid 1980s through the late 1990s, combined with economic mismanagement, war, corruption, etc.).

Figure 7 OPEC - Per Capita Crude Oil Export Revenues (Constant $2005)



(Source: Energy Information Administration, 2006)

As with OPEC countries, major non-OPEC producers also are affected by fluctuating world oil prices. Russian oil export revenues, for instance, have surged sharply after reaching a low point in 1998, with tremendous economic and political consequences. This has resulted from increases in both oil prices and production since that time. Russian net oil export revenues surged by 44 percent in 2005 over 2004, to $122 billion (in constant $, 2005). Russia's projected oil export revenues for 2006, at $133 billion (in constant $, 2005), would be more than seven times greater than their low point in 1998.

Iran's oil euro-pricing

Iran is planning to open a commodity exchange (Iran Petroleum Exchange or Iranian Oil Bourse) for the express purpose of trading oil, petrochemicals and gas in various non-dollar currencies, primarily the Euro. If successful, this would establish a euro-based pricing mechanism for oil trading, or oil marker as it is called by traders.

The two major oil bourses are the New York Mercantile Exchange (NYME) in New York City and the International Petroleum Exchange (IPE) in London. The proposed Iranian bourse would establish a fourth oil marker, denominated by the euro.

Iran has already taken a step toward establishing an oil market denominated in euros. If Iran demanded payment for its oil in euros, this could lead central bankers around the world to convert some dollar reserves into euros, possibly causing a decline in the dollar's value. The Iranian plan which has been developed in 2004, was meant for competing with (NYMEX) as well as (IPE). Despite this Iran 's decision to establish the oil bourse in March 2006, Iran still trades in dollar for its crude oil exports.

There is one technical obstacle concerning the use of a euro-based oil exchange system, which is the lack of a euro-denominated oil pricing standard, or oil "marker" as it is referred to in the industry. Although the three current oil markers are US dollar denominated, yet this did not stop Iran from requiring payments in the euro currency for its European and Asian oil exports since spring 2003.

A successful Iranian bourse will solidify the petro-euro as an alternative oil transaction currency, and thereby end the petrodollar's hegemonic status as the monopoly oil currency. For the United States, issue of using euro by various OPEC members and other countries like Russia and China is a matter of time and technical arrangement. Therefore, the United States should, instead of using false accusations and intervening in the internal affairs of the UN sovereign states, reach a logical strategy of compromise with EU and OPEC towards a dual-pricing system for the international crude oil trades. Yes, the dollar is a dominating currency in the international trade, but it is the right for any state to trade in any currency it sees appropriate.

By 2008, from a purely economic, trade and monetary perspective, it will become logical for some OPEC producers to transition to the euro for oil pricing. Of course that will reduce the dollar's international demand/liquidity value, and hurt the US's ability to fund its massive debt unless US policy makers begin to make difficult fiscal and monetary changes right away - or use massive military power to force events upon OPEC.

It is understood why poor countries wish to trade and save in dollars. They often have international debts, and these debts are usually denominated in dollars (in the case of IMF debts this is always the case). This means that if their currency devalues against the dollar, their debts go up. As a result, poor countries often denominate their exports in dollars, so that they can acquire dollars, without exchange risk. These are used to repay debts, conduct trade (including, in particular, buying oil), and protect their own currencies.

For Iran (as the second oil producer in OPEC), nothing prevents the country from trading its crude oil in euro, particularly when we understand that most of its crude oil is exported to European and Asian countries. As a matter of fact, Iran began selling oil in euro to Europe in 2003. Given that Iran is seen as a hostile country by the current US administration, is another logical reason that makes Iran sells its oil in currency other than dollar.

The Iranian Oil Bourse move will, in short time make the World eagerly adopt this euro dominated oil system. The Europeans will not have to buy and hold dollars in order to secure their payment for oil, but would instead use with their own currency. The Chinese and the Japanese will be especially eager to adopt the new exchange. It will allow them to drastically lower their enormous dollar reserves and diversify them with Euros. The Russians have economic interest in adopting the Euro – the majority of their trade is with European countries, with oil-exporting countries, with China, and with Japan. Adoption of the Euro will immediately take care of the first two blocs, and will over time facilitate trade with China and Japan. The Arab oil-exporting countries will eagerly adopt the Euro as a means of diversification against rising mountains of depreciating dollars.

Their trade is mostly with European countries, and therefore will prefer the European currency both for its stability and for avoiding currency risk.

In this context, what will be the American reaction to adopting the euro that seals the fate of the dollar? The United States may use a vast array of strategies to halt or hobble the exchange's operations:

- Sabotaging the Exchange: this could be a computer virus, network, communications, or server attack, various server security breaches, or a 9-11-type attack on main and backup facilities.
- Coup d'état: this is by far the best long-term strategy available to the Americans.
- Negotiating Acceptable Terms & Limitations: this is another excellent solution to the Americans. Of course, a government coup is clearly the preferred strategy, for it will ensure that the exchange does not operate at all and does not threaten American interests. However, if an attempted sabotage or coup d'etat fail, then negotiation is clearly the second-best available option.
- Joint UN War Resolution: this will be, no doubt, hard to secure given the interests of all other members of the Security Council. Recent rhetoric about Iranians developing nuclear weapons undoubtedly serves to prepare this course of action.
- Unilateral Nuclear Strike: this is a terrible strategic choice for all the reasons associated with the next strategy, the Unilateral Total War
- Unilateral Total War: this is obviously the worst strategic choice. First, the US military resources have been already depleted with two wars. Secondly, the Americans will alienate other powerful nations. Third, major reserve countries may decide to quietly retaliate by dumping their own mountains of dollars, thus preventing the US from further financing its militant ambitions. Finally, Iran has strategic alliances with other powerful nations that may trigger their involvement in war; Iran reputedly has such alliance with China and Russia.

Iran is the fourth largest oil producing country in the world, the second-largest in the Organization of Petroleum Exporting countries and controls about 5 percent of the global oil supply, so it has a measure of influence over international oil markets. Iran also partially controls the Persian Gulf's Strait of Hormuz through which much of the world's oil supply must pass. One of the aims of Iran's euro oil bourse is to reduce the dollar influence over its economy. Initial analysis indicates that many countries in Europe and Asia would welcome a euro-denominated oil market for many different reasons, not the least of which is to get out from under the thumb and influence of the unstable American dollar.

With the world economy depending so much on oil, the black gold itself can be seen as a reserve currency that will be handed out against only the best collateral in the future. In July 2005, the Federal Reserve Bank of San Francisco published a paper about the progress of the diversification of central banks' reserves around the world. It concluded that the dollar's position is on the decline in many countries. China, the industrial giant, has officially declared that it will diversify a part of its FOREX holdings into oil by building a strategic petroleum reserve. Construction of storage tanks has begun last year and will take several years until completion.

Iran holds a strong hand as the No. 2 producer of crude behind Saudi Arabia, pumping 5% of the world's oil demand. Politicians there will also keep in mind that dollar deposits might become a burden in the future, if the US steps up its current war of words to the level of economic sanctions in the attempt to halt construction of Iran's nuclear power plants. Money in the bank does not help when you have no access to it. Substituting Iran's domestic oil demand partly with nuclear power will place the country in a win-win situation. Cheaper nuclear energy and increases in oil exports from the current level of roughly 2.5 million barrels a day will result in a profitable equation for Iran.

Only one major actor stands to lose from a change in the current status quo: the US, which with less than 5% of the global population, consumes roughly one third of global oil production. Oil in euros would benefit millions more in the EU and its trading partners, though. And it would loosen the grip the US has on OPEC members.

Conclusion:

The rise of the euro as a strong international reserve currency is having a profound impact on the oil market. The euro zone is the largest trading block in the world and, in particular, by far the largest trader with OPEC members. Several members of OPEC seek using the euro for their oil exports. Iran, supported by various members of OPEC, has taken concrete steps towards this move - Oil Bourse. It is expected that this bourse will have a positive impact on oil sale by not only Iran but the whole Persian Gulf region. Iran's argument is that while 60 per cent of the global oil and 25 per cent natural gas need was covered by the Persian Gulf states, oil dealing in either New York or London would have no meaning.

The economic arguments for Iran and other OPEC members plan to convert to the euro are very strong. The Euro-zone does not run a huge trade deficit nor is it heavily indebted to the rest of the world like the US and interest rates in the Euro-zone are also significantly higher. The Euro-zone has a larger share of world trade than the US and is the Middle East's main trading partner.

The issue raises here is whether the revenue from oil exports to United States and European Union adequately compensates for the goods and service imports from these regions respectively. If OPEC countries import a major share of their needs from the United States, then the dollar revenues from oil export could be employed to pay for these imports. On the contrary, if a majority of OPEC's imports originates from non-dollar areas, then the dollar revenues need to convert to pay for the imports. As the value of the dollar is subject to uncertainty, the purchasing power of the dollar revenues also becomes unstable. The decrease in the dollar value would worsen the situation for OPEC because it buys a large share of its goods and services from non-United States suppliers that deal in euros or yen.

One of the key choices of which currency to be used for pricing oil depends on the imports of OPEC members. Since more than 39% of OPEC members imports are from European countries, which is much more than their imports from the US, then explains the plans to use euro instead of dollar which has the dominance over their economy.

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Biodiesel : A Promising Alternate Source of Energy

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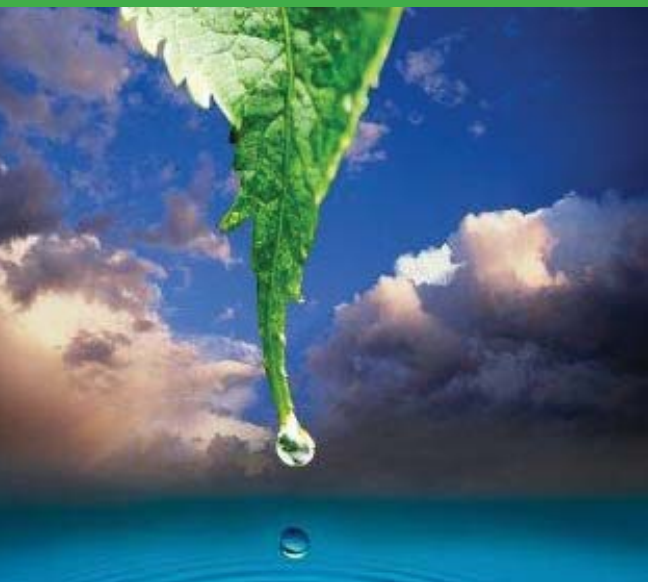


Backdrop

Biodiesel, an eco-friendly alternative to diesel fuel, is made from virgin or used vegetable oils (both edible & non-edible) and animal fats. Just like petroleum diesel, biodiesel operates in combustion ignition engine, which essentially requires very little or no engine modifications because biodiesel has properties similar to petroleum diesel fuels. Biodiesel can be blended in any ratio with petroleum diesel fuel. It can be stored just like petroleum diesel fuel and hence does not require separate infrastructure. The use of biodiesel in conventional diesel engines results in substantial reduction of unburned hydrocarbons, carbon monoxide and particulate matters. Biodiesel is considered clean fuel since it has almost no sulphur, no aromatics and has about 10% built in oxygen, which helps it to burn fully. Its higher cetane number improves the ignition quality even when blended in petroleum diesel.

Biodiesel has been most thoroughly investigated as an alternative fuel, which has been promoted to mitigate environmental problems and fulfill energy security need without sacrificing operating performance. The properties of bio-diesel like high cetane, low sulphur content and better lubricity than petro-diesel make it an excellent fuel for diesel engines [1]. Several countries have active biodiesel programs, with European Union and United States as the leaders. Several countries have given legislative support and have drawn up national policy on biodiesel development.

Towards Energy Security

Oil security and its continued availability has become area of extreme concern for the world at large and especially for oil importing countries, after the gulf crisis and recurrent price manoeuvres thereafter. Volatile political situations can also cause supply disruptions. Therefore, several countries embarked on programmes for alternative source development. There are already some reports, which suggest that we have achieved the plateau of oil production and in another 2-3 decades the oil resource will become scarce and alternative source of energy, though expensive today, will compete with mineral oil.

Biodiesel as an alternative to diesel or as a part replacement of diesel offers several advantages as compared to other alternative fuels like CNG and LNG. Unlike, CNG and LNG, which require major modifications in existing diesel engines, biodiesel can be easily used without major modifications. In fact most of the diesel engine manufacturers have cleared the use of biodiesel to the extent of 20% in the existing engines

using conventional diesel without any modifications. Biodiesel needs no separate infrastructure for storage and dispensing and the existing tankage and dispensing stations of conventional diesel can be used. Biodiesel is safe to handle and in fact flash points of biodiesel is higher than conventional diesel and on this point of safety it scores very well over CNG, LNG and ethanol.

The demand of transport fuel is increasing continuously, and energy for 95% of transportation is provided by petroleum crude. The present demand of motor spirit is approximately 10 MMT and is likely to increase to 13 MMT in 2011-12 (Table 1). The requirement of diesel is also likely to increase from the present 50 MMT to grow to 66 MMT in 2011-12. Only 22% of the national demand could be satisfied by domestic supply the rest will have to be met by import. Dependence of our country on imported oil and petroleum products will continue to increase in the foreseeable future.

Table 1 Biodiesel Requirement

Year	Diesel Demand (MMT)	Biodiesel Requirement (MMT)		
		5%	10%	20%
2004-05	46.97	2.35	4.70	9.40
2005-06	49.56	2.48	4.96	9.92
2006-07	52.33	2.62	5.24	10.48
2011-12	66.90	3.35	6.69	13.38

(Source: Planning Commission of India)

The crude prices and availability are subject to great volatility depending upon the international situation and, therefore, attempts are required to be made to reduce dependence on imports. This challenge is much more pertinent, when the crude oil prices have already once touched $70 per barrel and are still roaming around $55.

Production of biodiesel is increasing in the USA and European countries continuously. In European countries the biodiesel production increased from 1.1 MMT in 2002 to 3.2 MMT in 2005.

Table 2 shows the detail production status of biodiesel in different European Countries in 2006. It is observed that production of biodiesel has almost been double within a year.

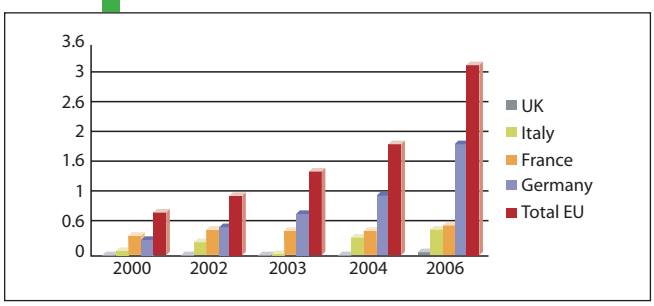
Table 2 Biodiesel Production in EU Countries 2006

Country	Biodiesel Production (MMT)*
Austria	0.134
Belgium	0.085
Czech Republic	0.203
Denmark	0.081
France	0.775
Germany	2.681
Greece	0.075
Italy	0.857
UK	0.445
Poland	0.150
Portugal	0.146
Slovakia	0.089
Spain	0.224
Sweden	0.052
Other Countries	0.072
Total	6.069

**Calculation based on 330 working days per year, per plant.*

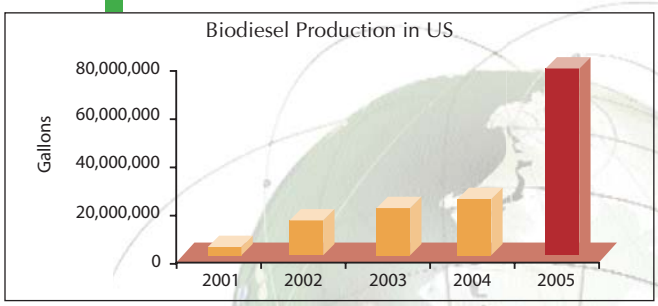
The above figures represent an overall picture of the EU-25 biodiesel capacity on July 1,2006 (source- European Biodiesel Board). In the USA, the market for biodiesel is growing at an alarming rate. Biodiesel consumption in the U.S. grew from 25 million gallons per year in 2004 to 78 million gallons in 2005. Biodiesel production in the U.S. is expected to reach 300 million gallons by the end of 2006, and to reach approximately 750 million gallons per year in 2007.

Figure 1 European Biodiesel Production 2005



Source: European Biodiesel Board

Figure 2 U.S. Biodiesel Production



(Ref. National Biodiesel Board, USA)

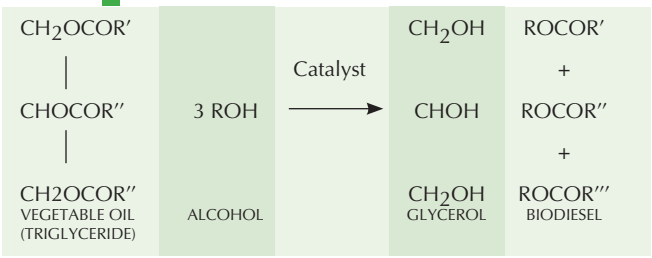
Production of Biodiesel

Chemically all vegetable oils, whether edible or non-edible, and fats are made up of fatty acid triglycerides of fatty acids of C16 to C22. This means that even though there is a change in the source of edible oils, chemically these remain almost same. These triglycerides when reacted with alcohol (usually methanol or ethanol) in the presence of an acid or a base catalyst at elevated temperature very readily give quantitative amounts of fatty acid esters. This reaction is called transesterification and the product obtained, i.e., fatty acid esters is called biodiesel as these esters of fatty acid showed striking similarity with diesel in combustion properties.

The process of transesterification was developed almost a century ago and is in use by the chemical industries very frequently. The catalyst to be used for transesterification/ esterification depends on the free fatty acid content of the vegetable oil or fat. Biodiesel synthesis process can be divided into three categories:

- Base catalyzed transesterification with low fatty acid oils and fats.
- Acid esterification followed by transesterification of low or high FFA (free fatty acid) fats and oils.
- Acid catalysed esterification of high FFA fats and oils.

Figure 3 Transesterification Process

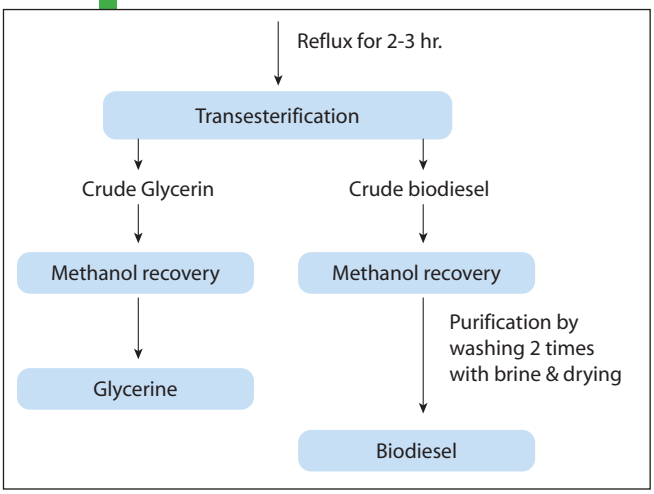


Blending

Since biodiesel is to be used a fuel, it must meet standard fuel specifications before it can be blended in petro-diesel. Initially, the ASTM specifications were almost universally adopted for quality control of biodiesel. However, with the progress of biodiesel industry outside the US, Europe and several other countries have made their own specification. Concerns of automobile manufacturers were also taken into account while drafting the specifications and more and more criteria were added into the standards. Bureau of Indian Standards (BIS) also adopted specifications for biodiesel for use in India – IS 15607. Although the basic transesterification reaction to produce biodiesel is quite easy and approachable, lot of precaution is still required to be taken to meet all the laid down specifications for biodiesel. The basic target for all technologies aims to produce biodiesel in the most cost effective manner while meeting all the specifications. Therefore it is essential to remove as far as possible all the glycerine, soaps, water, alcohol and any remaining acid or triglycerides from synthesized biodiesel.

Worldwide research is going on for development of suitable process for biodiesel synthesis. A successful and commercial biodiesel production technology should be flexible to undertake some variations in the feedstock quality. In general, most of the biodiesel today is produced by either base catalyzed reaction, by acid treatment followed by base catalyzed reaction or by using heterogeneous catalyst. Sodium hydroxide is the most commonly used base catalyst, followed by potassium hydroxide. Generally methanol is used as alcohol, but ethanol has also been used. The quality of feed oil, especially the amount of free fatty acid present, is the deciding factor for the type of technology to be employed for transesterification. Feedstocks having large amount of free fatty acids consume the base catalyst to produce soap and any water present interferes with the reaction by formation of emulsions. Technological advances have taken care of all these factors and now it is possible to produce biodiesel meeting desired specification from low and high FFA oils.

Figure 4 Biodiesel Basic Technology



There are some reports on use of straight vegetable oil in place of transesterified oil. As the boiling point and viscosity of vegetable oil is much higher compared to transesterified oil or petro-diesel, that will lead to incomplete burning in internal combustion engine. Incomplete combustion of fuel leads to formation of coke, especially around fuel injection nozzle and subsequent restriction in atomization of fuel. This results in more smoke and unburnt particles. By the process of transesterification molecular weight of vegetable oil is reduced to one-third of original and thereby most of these problems are sorted out.

Indian Scenario

The biodiesel program of the US is basically driven by availability of excess of soybean oil available in that country while in

Europe it is sunflower and rapeseed. Malaysian biodiesel program is based on palm oil. Since India is a net importer of edible oils and also for increased production of edible oils a regular irrigated farm of land is required, in all wisdom, the Indian biodiesel program is based upon nonedible oil seeds like Jatropha and Karanjia, which can grow on marginal lands. More emphasis is being given on Jatropha as it is a hardy plant, well adopted to arid and semi arid conditions. These trees do not require much care like use of fertilizer and moisture.

To meet the energy demand of our country a "National Mission of Biodiesel" is being setup under the aegis of Planning Commission of India. Table 3 shows the future requirement of biodiesel and the area to be covered by plantation to produce that amount of biodiesel.

Table 3 Potential Biodiesel Demand & Area of Plantation*

Year	% Blend	Biodiesel Requirement (MMT)	Area of Plantation (Million Hectare)
2006-07	5.00	2.62	2.19
2011-12	5.00	3.35	2.79
2011-12	20.00	13.38	11.19

**Source: Planning Commission Report*

Emission Reduction

According to the United States Environmental Protection Agency the use of biodiesel in a conventional diesel engine results in substantial reduction of unburned hydrocarbons, carbon monoxide, and particulate matter. Emissions of nitrogen oxides are either slightly reduced or slightly increased depending on the duty cycle of the engine and testing methods employed.

Table 4 Reduction of Emission Using Biodiesel

Emissions	B100	B10
Regulated emissions	-93%	30%
Total unburned Hydrocarbons	-50%	-20%
Carbon Monoxide		
Particulate Matter	-30%	-22%
NOx	+13%	+2%
Non-regulated Emissions	-100%	-20%*
Polycyclic Aromatic Hydrocarbons (PAH)**	-80%	-13%
NPAH (Nitrated PAH)**	-90%	-50%***
Ozone potential of special HC	-50%	-10%
Life cycle Emissions		
Carbon Dioxide (LCA)	-80%	-
Sulphur Dioxide (LCA)	-100%	-

**Estimated from B 100 results*
*** Average reduction across all compounds measured*
**** 2-nitroflourine results were within test method variability.*

The results for pure biodiesel (B100) and mixed biodiesel (B20% biodiesel and 80% petro-diesel) compared to conventional diesel are given in Table 4.

Biodiesel is nontoxic and poses little or no health risk to humans. Vehicles that run on biodiesel emit less sulfur dioxide (SO2), particulate matter (soot), carbon dioxide (CO2), with fewer heavy hydrocarbons (HC) and polycyclic aromatic hydrocarbons (PAH). Biodiesel does not contain sulfur so it will not contribute to sulfur dioxide emissions that result in acid rain.

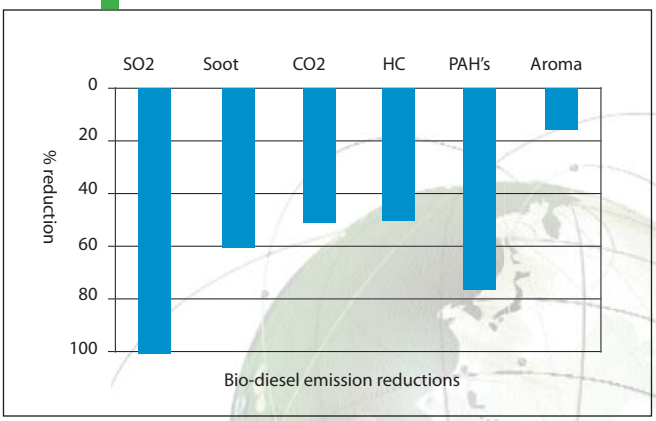
Economic Impact

According to a Planning Commission Report the cost of production of biodiesel is approximately around Rs. 16 per litre based on several assumptions. However, the actual cost of biodiesel presently is higher and may need subsidy in the form of duty concessions for sometime, as is the practice in most of the countries implementing bio-diesel programme. To meet the feedstock requirement large quantities of wasteland available in the country can be brought under Jatropha plantation. Further, the collection of seeds and extraction of oil will help to provide jobs in rural areas.

As per the demonstration project of Planning Commission of India, in the first phase, Jatropha would be cultivated on 4,00,000 hectares of wasteland at different places in the country. This will lead to create job opportunities for 4,00,000 people in rural areas for the cultivation and seed collection activities, if it is assumed that one hectare will be allotted to one person. According to the economics of this project, considering seed yield of 4 MT per hectare at the rate of Rs. 5/Kg could provide Rs. 20,000 per year to a family in rural areas. A large number of jobs would also be created in the related activities like expelling the seed and conversion of oil to biodiesel and distribution.

Planning Commission of India has further estimated that, if 5% blending is taken up at national level, approx. 2.62 MMTPA

Figure 5 Biodiesel Emission Reductions



(Source: www.wnbiodiesel.com/products.html)

biodiesel would be required. This requires plantation on 2.19 million hectares of land, which means jobs for more than two million people and livelihood for that many families. The concept of biodiesel production in India is totally based on the non-edible oilseeds like Jatropha and Karanjia, which are known to grow in Indian sub-continent. Hence, it will help the agriculture industry, chemical industry and petroleum industry etc. in terms of employment generation. Addition of biodiesel to petro-diesel will bring down the sulphur level and enhance the fuel quality in terms of low aromatics and higher lubricity. Petroleum industry will be able to market fuel which is safe, eco-friendly and which requires no extra infrastructure.

To encourage biodiesel production, Ministry of Petroleum & Natural gas has announced biodiesel purchase policy. Oil PSUs shall purchase biodiesel, meeting BIS specification, at Rs. 26.5/ litre from manufacturers. Accordingly twenty biodiesel purchase centres have been set-up by Oil PSUs at different locations all over the country.

Indian Initiatives

Though existence of non-edible oil in our country had been established long ago but there had been no systematic study, which could actually prove these to be the right candidates for bio-diesel production. IOC (R&D) Centre was the first in the country to undertake this programme [2,3,4] in a scientific and systematic manner. Thus, oil from Jatropha Curcas and Pongamia Pinnatta were evaluated and analyzed for various components as such. After hydrolysis the fatty acids present in these two oils were compared with those of soyabean, rapeseed, palm, etc. The overall resemblance of these fatty acids indicated the pre-feasibility of using these as feedstock for biodiesel production meeting IS 15607/ASTM D 6751 specifications. After optimization of process in the scale, the process has been scaled up to 60 kg in pilot plant. The developed technology was transferred to Venus Ethoxyethers, Goa and IKF Technologies Ltd. Kolkata on non-exclusive basis and on nominal technology fee and royalty sharing mechanism.

Indian railways which consumes about 2 MMT of diesel per year i.e. 5% of the total Indian production, became a willing partner in the biodiesel development programme. Indian Railways own very large expanses of land along the one lakh track kilometers. As an estimate, Railways could produce anywhere between 10-20% of their total requirement and replace that much amount of diesel. Railways also desire low sulphur and better lubricity being provided by biodiesel. The main interest of transport operators and Railways in biodiesel programme is derived from these properties of biodiesel, leading to lesser wear and tear. These are inherent advantages of replacing petro-diesel by biodiesel.

Realizing the need for an environmentally benign solution to the problem of energy, Indian Oil Corporation Ltd., the largest supplier of petroleum fuels and Indian Railways, largest consumer of diesel, joined hands and signed an MOU to undertake research on bio-diesel. It was planned to study the complete value chain in biodiesel as under.

- Plantation of Jatropha Saplings on Railway land
- Extraction of Oil from Seeds
- Trans-esterification of Jatropha Oil
- Blending of Biodiesel & Diesel
- Engine testing & Field Trials

As per the MOU with Indian Railways, plantation activities have been started at two sites of Surendernagar and Than Chotilla in Gujarat. In the first phase 62 hectares of land have been selected and after preparation of the sites, 1,50,000 saplings are being planted. Effect of spacing, irrigation and fertilizer on seed yield would be studied. Oil quality/quantity would also be examined. The project started in 2004. It is expected that from next year yield of fruits/seeds will start. Exhaustive emission testing was carried out at IOC, R&D Centre on diesel cars and with buses of Haryana Roadways. Using 10 to 20% blend of biodiesel in diesel there was 20% and 25% reduction in CO emission and 5% and 10% reduction in particulate matter respectively on a diesel car.

To establish the blending, supply and distribution of biodiesel, trials were started on Haryana Roadways buses at Gurgaon Depot during April 2004. The biodiesel was blended at the Rewari terminal of IOC. 20 buses each on 5% biodiesel-diesel blend and neat diesel were selected /identified for these trials. These trials are progressing satisfactorily and no operational problems have been reported by any of the bus drivers. Considerable reduction in smoke is observed in case of buses using 5% biodiesel blend. The average initial smoke of the buses running on biodiesel-diesel blend was 46.5 Hatridge Smoke Unit (HSU). The average reduction of smoke was 10.29%, 12.84%, 15.12% and 16% after completion of first, second, third and fourth month respectively. The average reduction of smoke in 4 months is 13.56%. Indian Railways also studied the emissions on 16 cylinder Alco engine test bed. B10, B20, B50 and B100 were tested for CO, CO2, NOx, residual HC and oxygen levels. All these testing were carried against petro-diesel. As per results, significant reduction in hydro-carbon and CO emissions was observed [5]. Indian Oil is now planning to become self sufficient in this biodiesel venture. It is being planned to start from the root, i.e., Jatropha plantation in commercial way in the wasteland available in different states. Interaction with State Governments have been initiated and it is expected that within a year Indian Oil will be able to start Jatropha plantation in few lakh hectares of land.

Conclusion

Biodiesel, the green fuel, has established itself as an alternative liquid fuel to petroleum diesel and has been successfully introduced in several countries in the world. Biodiesel has no sulphur, no nitrogen and no aromatics and hence has proven low emission fuel, which is accepted world over by engine manufacturers. It is safer to handle and requires no separate infrastructure for its distribution and marketing. It also fulfils strategic needs of energy of a country like India, which has large dependence on imported crude. A national program in this context will have a very positive impact on the Indian economy. It has also very large employment generation potential. Therefore biodiesel, an ecofriendly fuel, made from the renewable local resources has the potential to largely replace petro-diesel.

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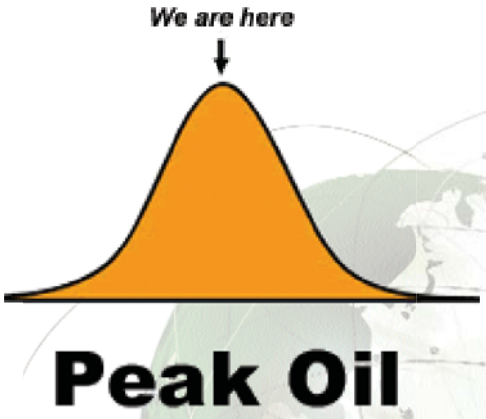

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The Genesis of Numaligarh Refinery

Madhuchanda A Choudhury
Deputy Manager (Corporate Communications)
Numaligarh Refinery Limited

Introduction

A technological marvel in its own right, the Numaligarh Refinery was conceived to act as a nucleus of growth in the North East and to provide a impetus to the industrial growth of Assam. The refinery was set up as a grass root Refinery at Numaligarh in the District of Golaghat, Assam, in fulfilment of the commitment made by the Govt. of India in the historic Assam Accord signed on August 15, 1985. This ambitious project began to take shape when after a brief hiatus, IBP Company was appointed as its implementing agency with 51% stake in the project in the year 1989. Major milestones like obtaining environmental clearances, appointment of EIL as project consultant and most importantly the CCEA approval followed in quick succession and finally Numaligarh Refinery Limited was incorporated as a Company on 22nd April, 1993. Shortly afterwards in the year 1995, Bharat Petroleum Corporation Limited (BPCL) was inducted as a major promoter with 32% stake, while IBP's stake was reduced to 19%, while the Govt. of Assam continued to hold 10 % stake in the Company. Construction works picked up full swing thereafter and the refinery was commissioned in April 1999 with commencement of commercial production from 1st October 2000.

Location

Located in Numaligarh, in the District of Golaghat in Upper Assam, the Refinery is about a 270 kms drive from the capital city of Guwahati. It covers a sprawling 750 acres of land, once known to be the grazing ground of wild elephants. Legend says that 'Numaligarh' is named after the fortress ('garh' in Assamese) of princess 'Numali' who ruled over the land in this part of the country some 500 years ago. Set amidst verdant hills and hillocks, undulating slopes and lush green tea gardens on the banks of the river Dhansiri, the Refinery has the world famous Kaziranga National park, the abode of the world famous one-horned Rhino as its neighbour. In total harmony with nature, it emanates a perfect balance between industry and environment.

First steps

Land acquisition for the Refinery and its 270 acres township involved rehabilitation of about 90 families to the nearby hamlets. Being a sensitive issue, it was handled with utmost care which resulted in smooth transfer of land without much hullabaloo. Other than alternative land, the rehabilitation package for the displaced families included amenities such as a primary school for the children, drinking water facilities, sanitation and sewerage facilities, village lighting etc.

Meeting the challenge

The adage goes that behind every adversity, there lies an opportunity. And the commissioning of this state of the art Refinery within the approved cost and time, logistic bottlenecks and turbulent environment notwithstanding has proven just that. For the people of Assam, it was like a dream come true.

Though the Refinery is relatively small, its inherent strengths more than offsets the disadvantage of not enjoying the benefit of economy of scale. It is almost a well head refinery which processes sweet low sulphur wax rich north east crude from the oil fields of upper Assam. Oil India Limited and ONGC are the crude suppliers.

Technology at its best

With a refining capacity of 3 MMTPA, the Refinery configuration was designed and process technologies adopted so as to maximise the production of middle distillates. Therefore, it is not a matter of surprise that the net distillate yield of the Refinery is one of the highest amongst oil sector PSUs. With the commissioning of the Refinery the deficit of Kerosene and HSD in the North East no longer exists.

The original Refinery configuration included the Crude Distillation Unit (CDU), Vacuum Distillation Unit (VDU), Delayed Coker Unit (DCU), Hydrocracker Unit (HCU), Hydrogen Unit (H2U), Coke Calcination Unit (CCU) and a Sulphur Recovery Block (SRB). With the above major plant units, the refinery was designed to have LPG, Naphtha, High Speed Diesel (HSD), Aviation Turbine Fuel (ATF), Superior Kerosene Oil (SKO), Raw petroleum coke (RPC) and Calcined Petroleum Coke (CPC) and sulphur as its main products

The refinery is one of the first few refineries in the country to install secondary processing facilities like the state of the art Hydrocracker Unit. The quality of products of Numaligarh Refinery is of very high order due to incorporation of Hydrocracker technology as well as processing of low sulphur Assam crude.

Atmospheric column being brought from Jetty.

Atmospheric column reaches Dhansiripar jetty by river route

Other special features that set the Refinery apart are production of 93% light and middle distillates, Zero fuel oil production, Ground level flare, Captive power plant, DCS/microprocessor based instrumentation systems et al.

The refinery adopted the best technology available in the Refining sector, with Engineers India Limited as the prime consultants for the Project. Process licensors for various technologies include Chevron, USA, Haldar Topsoe, Denmark and Svedala, USA. The Co-generation power plant installed by Daelim Engineering Co., Korea with Gas Turbine Generators supplied by Nouvo Pignone, Italy, was by far the largest single order placed during the construction stage worth Rs. 161 crores in Indian currency.

Major contracts and procurement orders were lined by our Commercial team for major Civil, Structural, Mechanical and Instrumentation jobs with contractors such as L&T, Stewarts & Lloyds, Bells Controls Ltd., PFCC, BHPV, BHEL, Paharpur Cooling Towers, Nicco Corporation, Punj Lloyd, Lloyd Insulations to name a few. Local contractors with the required expertise were also hauled in to put the Refinery in place. With the Refinery turning into a beehive of activities, business opportunities for the unemployed local youth also opened up who were gainfully employed either directly or indirectly as suppliers , contractors or contract labourers.

Fully automated systems and business systems driven by Enterprise Resource Planning (ERP) were put in place for running the Refinery and the Marketing terminal. In fact, NRL was the first public sector refinery in India to adopt ERP to integrate and support its business processes.

Utilisation of waterways

The skyline of Numaligarh Refinery underwent a vast change with the erection of the massive atmospheric column weighing 168 MT in the refinery. The very transportation of the 5.75 m diameter column to the project site was an achievement. Unlike

Panoramic view of the Numaligarh Refinery Plant, Assam

other projects of the region, huge 54 metres columns had to be transported, the height of which was equivalent to an 18 storey building in one piece from Vishakhapatnam to the project site through sea and river routes. It was the first time that waterways were utilized for transporting Over Weight Components (OWC) and Over Dimensional Components (ODC) as an environmental impact measure for protecting the Kaziranga National Park. First, it was brought to Kolkata from Vishakhapatnam by sea, in the Kolkata port it was reloaded into a barge and transported via Bangladesh through the Padma and Brahmaputra rivers and finally by Dhansiri to a specially built jetty at Dhansirimukh. From here to the project site at Numaligarh, it was transported by road with innovative methods using two structural platforms and hydraulic trailers with 24 axles . One 600- tonne crane from Demag, Germany and two 100- tonnes cranes were accurately used by a specialised band of crews for its synchronous erection at the site. The Vacuum column in 5 pieces (Weighing 300 MT), 3 Hydrocracker Reactors (Weighing 272 MT, 371 MT and 383 MT respectively), 2 gas turbo generators (Weighing 102 MT each), The DCU fractionator column and some other critical ODC/OWC equipment were transported like wise through waterways to the project site, which is the first ever of its kind in this part of the country.

Not only was the challenge met successfully, it worked to our advantage since transporting huge equipment and machineries in single piece avoided the need for welding, stress relieving, testing etc at the construction site. In the course of getting this colossal job done, NRL invested in flagging the river and dredging it at places, thereby opening options for future evacuation of products by river ways .

Linked projects

With the Refinery construction progressing full swing, its two linked projects viz the crude oil pipeline and the marketing terminal too progressed simultaneously. The crude oil pipeline was implemented by OIL connecting the the Refinery with the Naharkatia-Barauni Pipeline at Badulipar at a distance of about 14 kms from the Refinery. For implementation of the Numaligarh Refinery Terminal located adjacent to the Refinery in 250 acres of land was planned with a fully automated dispatch system with its own BG railway siding to ensure prompt evacuation of its products by railways. The rail loading was based on 'engine on load' concept with total automation of its systems. The marketing and all other infrastructure requirements were completed in synchronisation with the Refinery commissioning.

Environment Management Systems

At every step of building this refinery, environment friendly measures were is one aspect that was never overlooked and was taken special care of. NRL was conceptualised as one of the most environment friendly refineries in the country. Right from its inception, conscious efforts were made at every stage to preserve the environment complying with statutory norms prescribed by concerned authorities. Environment clearances were obtained for both the Refinery and Marketing Terminal from the Ministry of Environment and Forests and State pollution Control Board, Assam. Adequate measures for abatement of pollution were taken in the formative years with almost Rs. 100 crores set aside for environment management. The environment friendliness of the Refinery is manifest from the fact that in spite of processing low sulphur crude, a sulphur recovery block was established which is the first among refineries processing Assam crude. Environment impact assessment studies through National Environmental Engineering Research Institute (NEERI), Nagpur, for the Refinery, Marketing terminal and the adjacent Kaziranga National Park were carried out which clearly indicated that there would be no adverse environmental impact due to setting up of the refinery and marketing terminal project. A 'no development zone' was notified within a radius of 15 kms all around the refinery extending upto the eastern boundary of Kaziranga. To minimize the levels of pollution, low NOx burners were installed. All stacks were installed with a minimum 60 metres height so that pollutants are dissipated over a large area. Besides normal pollution control measures, specific steps were taken to ensure that there was no adverse impact on the adjacent Kaziranga National park. Air quality monitoring stations were installed in 5 locations, one at the boundary of Kaziranga and the other four within 2-5 kms of the Refinery for continuous monitoring of hydrocarbons., sulphur, carbon monoxide and suspended particles. The effluent treatment plant with tertiary treatment facilities is considered one of the most modern with latest technology. A modern sewage treatment plant in the township and an incinerator in the hospital are provided to take care of hygiene in the locality. Installation

of the unique non-illuminating ground flare in the refinery is one amongst the firsts in the country. In addition, a 100 metres green belt around the Refinery and 25 metres around the Marketing terminal was created.

The Township

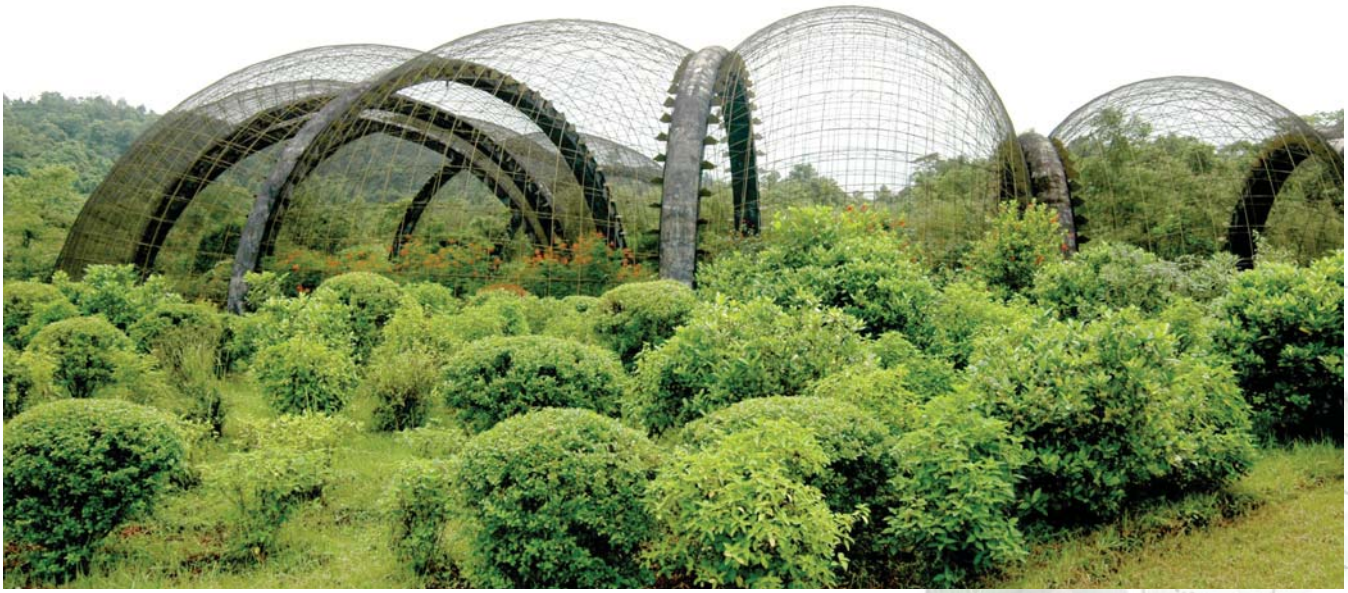
Along with the Refinery, an aesthetically pleasing and functionally convenient Township also came into being to supplement and compliment the refinery in harnessing its most valuable human resources. The modern township designed and landscaped by the reputed School of Planning and Architecture was built on the banks of the Kaliyani river on a sprawling luxuriant green undulated plot of 270 acres with sprinkling of tea garden. Other than residential quarters for housing its employees, guest houses, a hospital, a school and a shopping centre were constructed. Plenty of open spaces with parks and gardens along with recreational facilities like a community centre and a club gradually came up. The township was planned on flat grounds and plateaus without disturbing hill slopes and terrains, thereby keeping the natural landscape intact with a strong boundary wall to ensure the safety and security of its inmates. One unique addition to the township was the creation of the beautiful butterfly park for breeding and rearing of butterflies – which other than adding colour was a discreet step towards environmental conservation.

Key success factors

Able team leaders, the committed team values of honesty and integrity with the highest standards of ethics in all business dealings, trust and respect, effective communication, team spirit, sincerity, dedication, professionalism and missionary zeal are the key factors which have made this ambitious refinery project a grand success. The project team adopted various project management practices like kick off meetings within 2 weeks of placement of any major order, development of project infrastructure for uninterrupted work, periodic review of progress with contractors, vendors and consultants for micro/macro planning, approval of drawing across the table, benchmarking for critical units, rigorous follow up with all concerned at all levels, maintenance of hindrances register, construction of working sheds to facilitate working during long rainy seasons, stringent quality control by way of inspection of works and highest safety standards and basic amenities for contractor's workmen which saw the refinery through.

Conclusion

This is in a nutshell the story of how this mega project called Numaligarh Refinery came into being. While execution of the project, there were many challenges and hurdles, both internal and external, which were surmounted with considerable ease. The mantra behind the success story was undoubtedly the selfless dedication of all the people involved in the project and their ability to work as a team. In the process of building the refinery, an organisation of dedicated, dynamic and energetic employees was created with its own unique value system, for it is rightly said that it is the values that make or break an enterprise. Ever since, the company has marched forward with determination and unrelenting vigour, crossed many a milestone in its pursuit for excellence and continues to remain a frontrunner with its pool of knowledgeable and motivated employees who are ever ready to face the challenges that the future holds in store.



The Butterfly Park, Numaligarh, Assam

Oil Price and Strategy of Upstream Companies

Rajiv Kumar
Sr. Staff Officer to CMD,
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Rajeev Kumar, B.Tech, MBA – has over two decades of experience in Oil India Limited. He is presently working as Sr. Staff Officer to CMD. He has exposure to both Indian & International hydrocarbon scenario.

Background & Literature Survey

The article tries to examine the strategy of the upstream Exploration & Production (E&P) companies with regard to acquisition of new reserves and capital investment in exploration and production in relation to oil price. It has been observed that about 40% reserves of the upstream companies come through merger or acquisition. In the year 2000, about US$53 billion out of the total capital investment of 124 billion world over were for acquisition of unproved or proved properties. In the period 1998-2000 number of mergers and acquisitions activities took place for consolidation particularly keeping in view the low price, which was cutting the margins of the Company. Merger of Exxon Mobil was an example of such merger for consolidation. Further growth in the petroleum companies in the recent years have not been the mega companies but by the petropreneurs. Over the past five years, the revenues of the majors have grown by only 2 percent per year on average. But the petropreneurs can boast an average annual growth rate of more than 20 percent, and the creation of almost $40 billion in new revenues. Cairn Energy is a good example of this. These diverging fortunes hint at the way in which the petroleum industry is "atomizing," or breaking up into niches where focused competitors can gain competitive advantage. This is a story of how skills have become more important than scale or scope, and strategic insight and foresight more important than structural position. It is also a cautionary tale for players in any business who imagine that legacy assets, vertical integration, or the sheer size of their balance sheet will insulate them from industry changes and new forms of competition.

This brings us to the question of strategies of upstream oil companies. Question arises when to invest more on Exploration for new reserves and what is the right opportunity for Companies to acquire property. Is it during the period when prices are low or during the period when oil prices are high? Majors are looking for high margins & consolidation and hence ready to wait for right opportunity. On the other hand, petropreneurs who are basically niche players may go for acquisition at much lower margin compared to majors as long as the property is giving them marginal return.

Further, according to most oil companies, alliances will play an important role in reshaping the industry over the next five years. Alliances are often preferred to acquisitions and divestitures because they bypass or reduce the valuation, tax, and regulatory issues associated with outright changes

in control, and allow both parent companies to retain oil reserves as a hedge against price increases. For some participants, alliances are away to build strengths, shore up weaknesses, extract latent value from assets, and make preemptive moves to retain or regain leading market positions. For others, they offer an opportunity to improve performance when the scope for cutting internal costs and reengineering business processes has been exhausted.

Article will dwell upon the strategies of upstream companies on capital investment and acquisition with relation to the price. Is crude oil price an important driver for capital investment/ acquisition or some other parameters are the key drivers.

Trends in upstream

International trends analysis has proven that companies all over the world – both big and small use a balanced mix of acquisition and exploration and development to accrete resources. A survey carried out by Andersen of 155 companies came out with following conclusions:-

- Over 48% of the companies have invested more than 20% of their total capital expenditure (includes exploration, development, unproven property deals and proven property deals) on acquisition of Proven properties. Totally 79% of all companies have gone for some level of acquisition.
- Over 43% of the companies have acquired 20% or more of the reserve accretion through acquisitions. Totally 73% of the companies have acquired some producing property or the other.
- Approximately 35% of all reserves were added through acquisitions, while 33% came from exploration and 32% came from reserve revisions, enhanced recovery, etc.
- There has been no connection between size of the company and the trend towards or away from acquisition.
- Of the Big 6 oil companies, 2 have gone in for over 50% of reserve accretion from acquisition, 2 have not acquired at all and 2 more have acquired reserves which are between 15 to 20% of the reserve accretion.
- Some of the largest acquirers in % age terms have been mid size companies, which have gone for a combination of farm ins, purchase of proven properties and acquisition / merger of companies to build up reserves and production capacities

Many literatures have reported spurt of mergers and acquisitions during the 1980s and late 1990s when the oil prices were down. Similarly, between 1980 to 1985 there were number of acquisitions in the oil sector. Some of which are:

Year	Acquirer	Acquired	Value (billion US$)
1979	Shell Oil Co.	Belridge Oil Co.	3.60
1981	Dupont	Conoco	7.80
1982	US Steel	Marathon Oil	5.90
1982	Occidental	Citi Services Co.	4.10
1983	Texaco	Getty	10.0
1984	Chevron	Gulf Oil	13.2
1984	Mobil	Superior Oil	5.7
1985	Exxon	Hunt Oil	0.50
1985	Occidental	Midcon Corp	
1987	BP	Sohio	7.90

Further, these mergers and acquisitions were very active during 1990s. In fact year 1998 when oil prices were at their lowest, there were number of mega mergers like Exxon Mobil, Total and Petrofina, and BP and Amoco. The making of these mergers are summarised below:-

- Exxon Mobil
  - Exxon
  - Mobil (1998)
- Royal Dutch Shell Group
  - Royal Dutch
  - Shell T&T
  - Equilon (2001)
  - Fletcher Challenge NZ (2000)
  - Woodside (35% - 2001)
  - Enterprise Oil (2002)
- TOTALFinaElf
  - TOTAL
  - Petrofina (1998)
  - Elf Aquitaine (1999)
- BP
  - BP
  - Amoco (1998)
  - Arco (less Alaska - 1999)
  - Vastar (1999)
  - Burma Castrol (2000)
- Chevron Texaco
  - Chevron
  - Texaco (2001)
  - Caltex (2001)

- Conoco Philips

  Philips

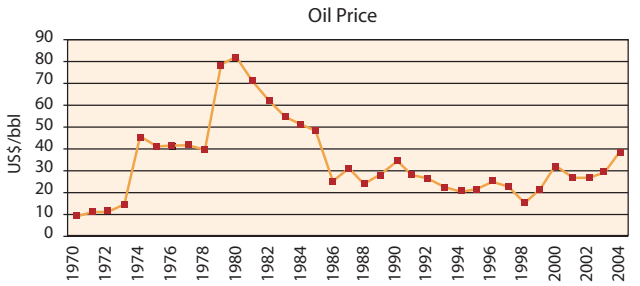
  Arco (Alaska – 2000)

  TOSCO (2001)

  Conoco (2002)

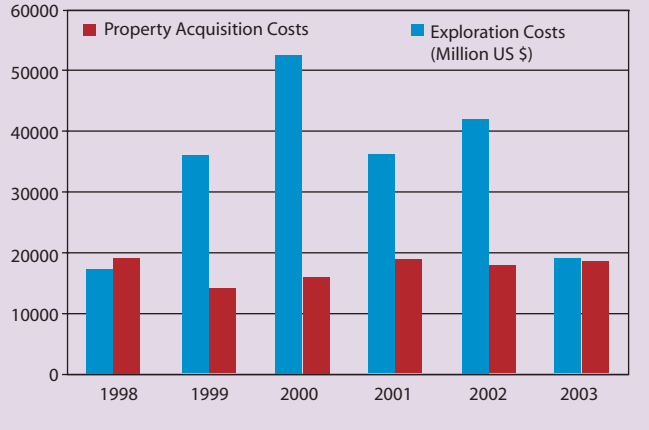
  Gulf Canada (2001)

If we look at the above mergers and acquisitions and the crude oil price, it is observed that most of these mergers and acquisitions took place when prices were relatively low.



Further, the figure below gives the scenario of acquisition of reserves vis-à-vis establishment of same through own efforts, during the period of low oil price:-

Acquisition vs Exploration



The above brings to the focus whether these mergers and acquisitions are related to oil price. Do these take place when the oil prices are low and hence, industries want to consolidate and bring down the cost at the same time the smaller companies with reserves in pockets want to farm out in order to share the risk in view of low oil prices.

Why Mergers & Acquisitions and Global Trend of Mergers and Acquisitions

Mergers and Acquisitions have a unique potential to transform firms and to contribute to corporate renewal, to gain strategic and operational advantages that neither firm can achieve on its own. Corporations merge to obtain better positions in turbulent and dynamic working environments as well as creating competitive advantages against other market actors. They can provide an ability to gain all the benefits from combining assets and sharing capabilities in a way not obtainable through partnership. However, M&A's can bring into a company, capabilities that the organisation finds hard to develop organically. They can also provide the opportunity to leverage existing capabilities into much more significant positions such as combining market shares and technical know-how. The primary reasons for M&As is to achieve synergy by integrating two business units in a combination that will increase competitive advantage. However, financial success and competitiveness depend directly on the ability to identify and capture the synergies or cost savings available through integration.

There are a multitude of different reasons why M&As are undertaken, the potential benefits vary accordingly. According to four different main categories of M&A benefits can be distinguished are:

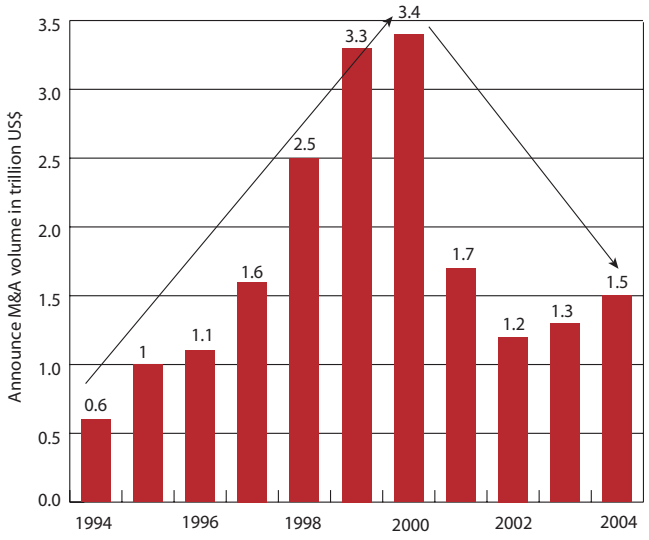
(a) Operational resource sharing can create economies of scale and scope. A typical example is the use of common distribution channels or a common sales organisation.

(b) The transfer of functional skills can improve the competitive position of one or both of the partners in an M&A process. Thus, if one firm possesses superior capabilities in, for example, manufacturing or R&D, the associated skills may be transferred to the other.

(c) Transfer of general management skills within M&A can be used in order to increase the competitiveness of the new organisation.

(d) M&As can also create advantages without capability transfer. Combination benefits occur, for example, through increased market power, enhanced reputation, or greater financial leverage. According to a well-known and often quoted definition, transferring technical capacity involves the capacity to develop new technology and the transfer of scientific knowledge. It entails "the ability to modify and further develop imported technology--it involves learning how to learn as well as to use what others have learned".

With this background, let us look at the volume of mergers and acquisitions between 1994 to 2004:



Literature suggest that the increased volume of Mergers and acquisitions from 1994 to 2000 have been fueled by following factors

- Robust economic and profit growth
- Strong Equity Market Performance particularly in technology, media and telecom
- Accommodating regulatory environment
- Globalisation of certain industries
- Technological Convergence
- Desire for scale and scope
- Quest for earning growth

However, subsequently due to economic slow down, dramatic decline in equity values, corporate scandals and regulatory scrutiny, large "failed" deals, increased focus on return on capital, and tight credit environment played a spoil sport which resulted in decline in mergers and acquisitions activities.

The point here is the M&A decisions are based on both the internal and external environment. There may be strong internal compelling reasons to go for M&A but external environment with regard to global economy, Government policy, credit environment etc. may force the companies against such move.

What drives M&A activity in Oil & Gas sector

The M&A activities in the Oil & Gas sector have been in the range of 10 to 15%. The figure below gives the share of M&A in E&P during 1996, 2000 and 2003:-

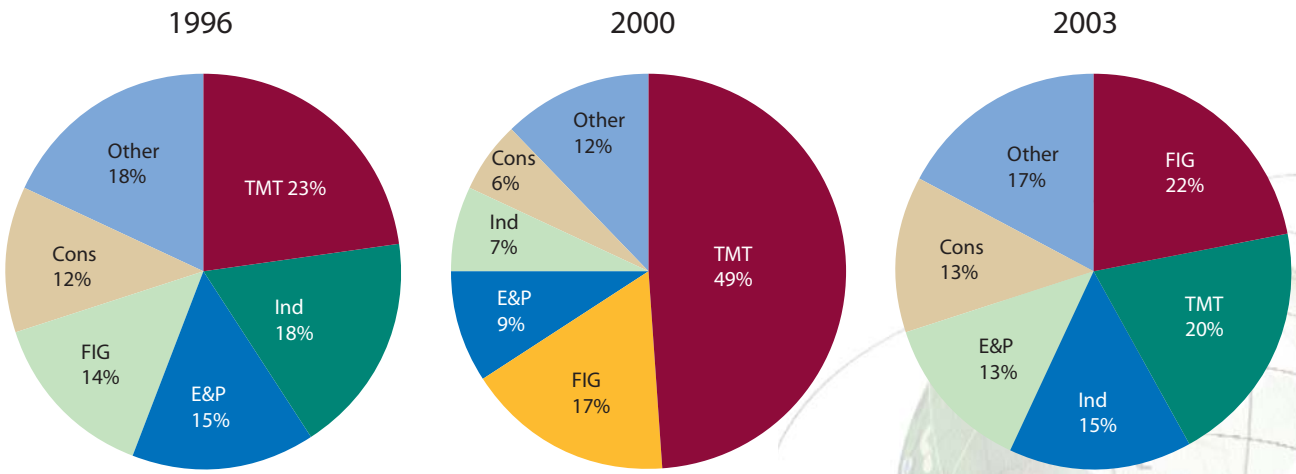
As can be seen from above, share of M&A in E&P constitute a major component of mergers and acquisitions in the world. There are various factors which has impact on the mergers & acquisitions in oil & gas sectors particularly in E&P sector. These are:-

a) Sharing of risk both political and operational and hence, to build portfolio of properties.

b) With most of the easy area being already discovered for hydrocarbon, the opportunities for E&P Companies are mainly two - acquisition of reserves through farm-in and through intensification of exploration which has become technologically challenging and geologically complex.

c) Opportunity for cost saving due to consolidation and economy of scale. Exxon Mobil claims it has saved over US$ 8 billion due to its merger. Oil major BP claims to have saved US$ 6 billion due to merger.

d) Pressures from investors to set and meet aggressive growth target – target that may be very stiff and ordinarily not possible to meet through organic growth. It has been observed that reserves and production growth via acquisition remains less exp ensive than through exploration and production. However, prices of these acquisitions are linked to the price of crude oil.



(Source: Goldman Sachs presentation)

e) Attractive mid and long term demand fundamentals. The demand is expected to grow and prices particularly of natural gas which is presently undervalued in most of the areas expected to go up.

f) Disciplined capital spending, burgeoning cash flows and improved balance sheet.

g) Renewed focus on strategic efficiency of the asset and not just the size.

h) Smaller, successful but growth constraint players see consolidation as cure for market invisibility.

i) Technology namely drilling, survey, well servicing, emission reduction etc. is another key driver for mergers and acquisitions in the upstream companies.

Many researches have indicated that the M&A activities in 1980s and late 1990s can be viewed as a response to price instability. Oil firms sought to invest in new technologies to reduce costs. Oil price declined as low as to $9 per barrel in late 1998 and thus the overriding objective for mergers beginning in 1998 was to further increase efficiencies to lower breakeven levels towards the $11 to $12 per barrel range.

Mergers & Acquisitions during 1980s

The oil industry was marked with change during the decade of the 1980s. The profitability of oil sector was greatly depressed by the fall in oil prices beginning in 1981. Significant cuts in investment and drilling followed. Three important trends developed during the period:-

- Industry concentration increased because of mergers & acquisitions;
- Large oil companies increased their reserves to production ratio;
- Major oil companies sold number of their refinery asset and concentrated on exploration and production area. However, this may be due to the fact that some of the OPEC countries moved downstream, into refining, marketing and petrochemicals.

There were 12 major mergers and acquisitions in oil sector each costing $ 1 billion and above. As literature reports, motivations for such mergers were:-

- To consolidate
- Believe that it was less expensive to purchase companies than to make sizeable, more risky investments elsewhere,
- Large number of bankruptcies of small-scale domestic producer when prices fail to unprofitable level. Major Companies took advantage of low asset value of such small producer in the hope of ripping profit when oil prices are high.

Merger of Exxon and Mobil

The strong motivation between Exxon and Mobil which was completed on 30th November, 1998 seems to be consolidation.

The motives seems to be two:

- By combining two complementary assets, Exxon Mobil would have stronger presence in the various regions of the world with highest potential for oil & gas discoveries.
- Combined Company would be in a stronger position to invest in programmes involving large outlays with high prospective risks and returns.

Some of the examples of complementary assets are:-

a) Combination of Exxon experience of deep water in West Africa with Mobil expertise of production and exploration acreage in Nigeria and Equatorial Guinea.

b) In the Caspian region, Combination of Exxon strong presence in Azerbaijan with Mobil's similar presence in Kazakhstan including its interest in Turkmenistan.

c) Similarly, complementary exploration and production operation in South America, Russia and Eastern Canada.

Merger estimated operational synergy of US$ 2.8 billion two third of which was expected to come from eliminating duplicate facilities and excess capacity. Further, synergy benefit was expected to come from applying each company's best practices across worldwide exploration.

The basic characteristics of the deal was:

	Exxon	Mobil
Market Value (Billion) as on 20/11/98	$175.00	$58.7
Book Value (Billion) as on 30/9/98	$ 43.70	$19.0
Market Value/ Book value	4.0	3.1
PE Ratio	23.6	17.9
Total Paid (billion)	$74.2	
Premium overmarket (biilion)	$15.5	
Premium over book value	$55.2	

The deal terms were as under:

Pre-Merger

	Amounts			Percentage	
	Exxon	Mobil	Total	Exxon	Mobil
Share Price	$72.00	$75.25			
Shares outstanding (Million)	2431	780			
Total Market Value (billion)	$175.00	$58.70	$233.70	74.9	25.1
Exchange terms 1.32 for 1					
Post Merger No. of shares (million)	2431	1030	3461	70.2	29.8

(Source Weston – 2004)

The deal was based on the discounted cash flow NPV calculation which was strongly linked to the oil price as both the cost of acquisition in terms of property valuation as well as the return expected were linked to the crude oil price.

Panel A Premerger		
	Market Caps	Ownership Proportions
Exxon	$ 175.0	74.9%
Mobil	58.7	25.1%
Total	**233.7**	**100%**
Panel B Postmerger		
Combined Value	$283.3	
Paid to Mobil	74.2	
Remainder	209.1	
Exxon Premerger	175.0	
Gain from Merger		$34.1
Portion to Exxon 70%		23.9
Portion to Mobil 30%		10.2
Plus Premium to Mobil		15.5
Mobil Total Gain		**25.7**

(Source Weston – 2004)

As can be seen from above, the merger of Exxon Mobil resulted in gain due to consolidation which resulted in increase in value. Literature leads to the theory that the consolidation was mainly due to decrease in oil price and hence, achieving cost efficiency through better synergy.

Other Major Mergers in 1990s

The major reasons cited for such mergers are the need for increased efficiency and cost savings. Economic literature also suggests that firms sometimes merge to enhance their ability to control prices. Most of these mergers during the low oil price period led to increase in value of the company which can be seen from the table given below:

As can be seen from the table below, except for the case of Total Petrofina, there has been value addition in all the mergers.

The companies Chevron Texaco brought to the table certain practices many of which were in Supply Chain Management which resulted in reduction in cost. The merger gave Chevron Texaco the resources and global reach to compete against such huge rivals as Exxon Mobil and the British company BP, analysts say. As one of the oil analysts Mark Uptigrove puts it "This was sort of a merger of necessity. In order for Chevron and Texaco not to get left in the dust, they had to come together." The move made Chevron Texaco the largest producer in some of the world's most important oil fields, including Kazakhstan, Indonesia and the Gulf of Mexico. The merger also gave the new company a size comparable to the industry's global giants.

Oil Price and Reserve Acquisition

As mentioned earlier, the upstream companies built reserves both through acquisition as well as exploration & production efforts. Acquisition of reserves can be through mergers and acquisitions which has been discussed earlier as well as through farm-in which is again acquisition of certain % participating interest in the producing properties. From the buyer point of view, following are looked into:-

- Prospectivity of the properties
- Future Production Potential of the existing reserves
- Upside Potential – Chances of finding more oil in future
- Input required for producing the field in terms of IOR/EOR measures/ Infrastructure
- Fiscal policy of the local Government
- Calculation of NPV on the basis of weighted average cost of capital and return expected based on risk premium
- Analysis of Risk and Reward
- Policy about Risk Spread

Target	Acquirer	Announcement Date	Market Cap - 10 Days			Value Changes (-10, +10)		
			Target	Acquirer	Combined	Target	Acquirer	Combined
Amoco	BP	8/11/1998	38.7	79.7	118.4	10.6	1.9	12.5
PetroFina	Total	12/01/1998	8.1	29.6	37.7	2.5	(4.7)	(2.2)
Mobil	Exxon	12/01/1998	56.7	173.7	230.3	11.7	5.4	17.1
Arco	BP	4/01/1999	20.8	161.5	182.3	4.7	7.9	12.6
Elf Acquitaine	TotalFina	7/05/1999	41.6	46.2	87.8	5.9	(3.2)	2.7
Texaco	Chevron	10/16/2000	29.4	56.6	86.0	3.8	(1.1)	2.7
Tosco	Phillips	2/04/2001	5.0	14.0	19.1	1.2	(0.2)	1.0
Gulf Canada	Conoco	5/29/2001	3.0	19.2	22.2	1.1	(0.3)	0.7
Conoco	Phillips	11/18/2001	15.5	20.6	36.1	2.3	2.1	4.5
Totals			**218.8**	**601.1**	**819.9**	**43.8**	**7.8**	**51.6**

(Source Weston – 2004)

The ultimate decision is generally based on the cost benefit analysis. The expenditure likely to be incurred including the capital investment, and the projected income are linked to the crude oil price. Valuation of reserves is basically compromise between the cost of finding the reserves and total valuation of the reserves discounting for the development charges. Buyers look at the conservative oil price in the coming future whereas Sellers look at the optimistic price scenario in future to get the best deal. Motivations of sale of properties are account of following reasons:-

- Core Competence of Seller is in exploration and wants to get best out of the deal from the exploration discovery;
- Seller is a small Company whose profitability is effected when the oil prices are low and hence, find it difficult to survive;
- There is strategic shift in Seller's areas of interest and sharing of risk
- Political compulsion

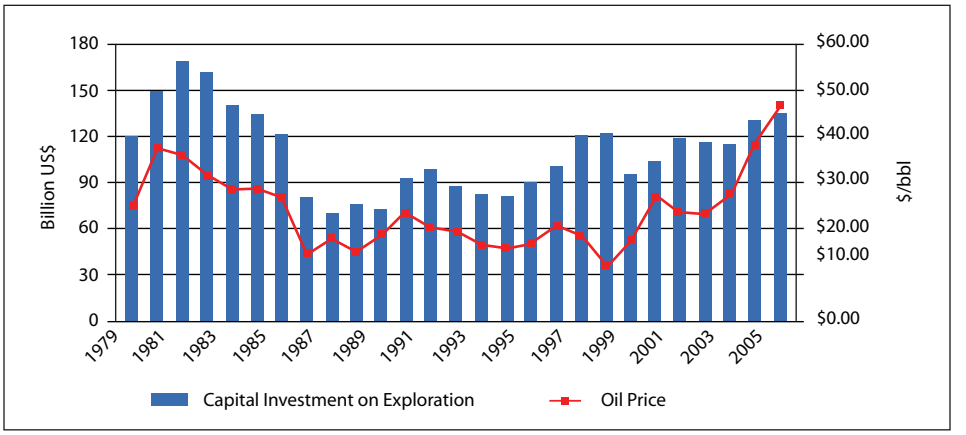
Hence, Crude Oil price is an important determinant both for the seller as well as the buyer for the producing property.

Reserves are also accrued through Company's own effort of exploration and development. Exploration consists of Seismic work & other geoscientific work followed by wild cat drilling based on the prospectivity of the area. The wild cat drilling may or may not lead to discovery of commercial hydrocarbons. Both for Seismic Work and for drilling, there is need for outsourcing of man, material, equipment, technology etc. Exploration efforts are dependent on the retained profit of the company as well as cost of the inputs mentioned above. In case high oil price, the retained profit goes up but at the same time cost of outsourcing also goes up whereas in oil prices are low, retained profit comes down as well as the cost of outsourcing.

Both the above require capital investment. Hence, it will necessary to understand the relationship between capital investment for exploration and oil price.

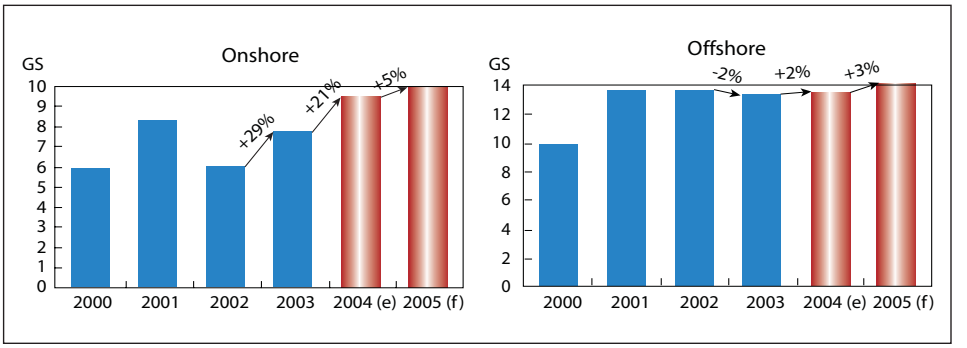
Econometric Model - Relationship between oil price and Capital Investment for reserves accretion/ acquisition

Figure below plot of oil prices vis-à-vis capital investment on exploration which includes expenditure on both acquisition and accretion of reserves.



It emerges from the plot the increase in oil price results increase in investment in the exploration activities and similarly the decrease in price results in decline in investment. Various literatures suggest that the effect is mainly one year later.

Further it may be noted that there has been apparently increase in the drilling activities compared to previous year which seems to be fueled by recent increase in oil price. The chart below clearly shows the trend.



(Source IFP/Economic Studies - 2004)

It may be noted that prices increased in 2001 and then declined in 2002 which was followed by continuous increase since 2003. Similar, trend can be seen in number of wells drilled also. As against 56,651 wells drilled in 2001, it came down to 43,809 during 2002 and then increased by 25% to 54,586 in 2003 followed by increase of 11% to 60,681 during 2004.

Considering above, we start with the hypothesis that **"Oil Price effect capital investment"**

We consider log linear econometric model

$$\ln K_t = b_0 + b_1 \ln O_t + b_2 \ln O_{(t-1)} + u_t$$

Where

Kt	=	Capital Investment
Ot	=	Nominal Oil price in US$
O(t-1)	=	Nominal Oil price in US$

The result of the regression model is as under:-

Coefficient Estimates

	Coefficients	*Standard Error*	*t Stat*	*p-value*
const	2.36	0.33	7.18	0.00
Ln Ot	0.34	0.12	2.70	0.01
Ln O(t-1)	0.41	0.13	3.12	0.01

OLS estimate is

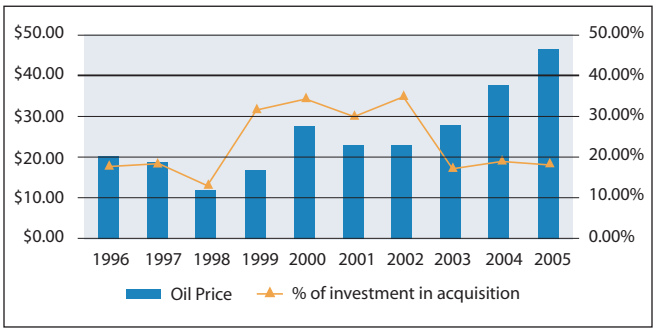
$\ln Kt = 2.36 + 0.34 * \ln Ot + 0.41 * \ln O(t-1)$

Hence, as it emerges from above, the increase in oil price increases the capital investment on exploration. The impact is more for the previous year.

10% increase in price in the previous year leads to around 4.1% increase in capital investment in the current year. This also seems to be logical as increase in oil price leads to increase in retained earning which helps in pumping more money for the exploration work.

Acquisition Vis-à-vis Accretion of Reserves

The plot below gives trend of %acquisition cost of total investment in E&P vis-à-vis price.



As appears from above, the general trend of acquisition is more in the low oil price scenario. However, the % share of acquisition cost seems to go up one year after the oil price increase.

Economic regression model of the linear log type which gives the highest R square was run. The explanatory variable were log of oil price for the current year and one year earlier and dependent variable was share of acquisition cost out of total capital investment on exploration. Econometric Model is

$$At = b_0 + b_1 \ln O_t + b_2 \ln O_{(t-1)} + u_t$$

Where

At	=	% of acquisition investment of total capital investment on exploration
Ot	=	Nominal Oil price in US$
O(t-1)	=	Nominal Oil price in US$

The result obtain is

	Coefficients	*Standard Error*	*t Stat*	*p-value*
Constant	0.48	0.29	1.67	0.15
$\ln O_t$	0.10	0.10	0.95	0.38
$\ln O_{(t-1)}$	-0.18	0.13	-1.38	0.22

R square value is 0.24.

As the R square value is very low as well as the p–value is above 0.10. It can not be conclusively said that %acquisition investment of total capital investment is dependent on oil price. However, (-) coefficient of earlier oil price (one year back) with p-value of 0.22, does indicate that increase in price in the previous brings down the acquisition investment of the total capital investment on the exploration.

It, however, can be noted that our earlier model on capital investment vis-à-vis oil price clearly proved that increase in oil price leads to increase in capital investment on exploration.

Conclusion

Article looked at the relationship between oil price and strategy of the oil & gas companies with regard to mergers and acquisitions. It briefly covered the motive of mergers and acquisitions which can be summed up as:-

- Economies of Scale
- Increased Revenue/ Increased Market Share
- Cross Selling
- Synergy
- Geographical or other diversification

If we see the world scenario, the merger & acquisition were at its peak during 2000 when the total volume of mergers and acquisition were around 3.4 trillion US$ which subsequently declined due to economy slow down and other reason mentioned before.

History indicates that during the low oil price regime number of mega merger took place particularly during 1980-1986 and 1998-2002. In 1998, when the real oil price was at its lowest, three mega mergers took place namely Exxon Mobil, BP Amoco, & TotalFina and process started for merger of Chevron Texaco.

There were12 major mergers in oil & gas industry from 1980 to 1985 mainly in E&P each costing over 1 billion US$.

Acquisition of reserves can be either through merger or acquiring participating interest through farm-in. Buyer as well as the seller both looks at the expected future oil price to get best out of the deal. The exploration requires outsourcing in terms of man, material, equipment and technology. The price of these properties goes up when the oil prices are high. Hence, it emerges that capital investment for acquisition and exploration are linked to the oil price. Considering above, a quantative estimate was also made to see the elasticity of capital investment on exploration vis-à-vis oil price. Log linear relationship best describes the relationship between oil price and capital investment with effect more shown after one year of increase. The elasticity of capital investment on price increase is around 0.42 i.e. 10% price increase results in increase in capital investment of 4.2% one year later.

Due to lack of data not much work could be done to find out an empirical relationship between share of acquisition as percentage of total capital investment vis-à-vis oil price. However, plot indicates that decrease in price leads to increased acquisition activity compared to actual exploration. As only 10 years data was available, hence, econometric had indicated very low value of R square but the OLS estimate definitely indicate negative relationship between one year lagged price increase vis-à-vis share of acquisition cost in the total capital cost.

Summing up, it appears that there are more mergers and acquisitions when the oil prices hit the bottom mainly for consolidation and price cut. There are absolutely no doubt both through historical records of last 25 years, logically as well as through econometric analysis that the capital investment goes up with the increase in crude oil price. However, it can not be conclusively said that the acquisition share of total capital investment goes up when the prices are low in spite of the fact that past ten years indicates towards the same.

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From Shores of Tripoli

R. Ravindra
First Secretary, Embassy of India, Libya

In its efforts to acquire exploration and producing properties abroad, OIL won its first block as an operator in Libya. As a result it established its 1st office on foreign soil in Tripoli. During the entire process, the Hon'ble Ambassador of India in Libya and the staff of the embassy helped OIL in establising themselves in Libya. This article on Tripoli is contributed by the First Secretary (Commercial) Shri R. Ravindra, who is also an avid reader of Synergy.

Editorial Team

Shri R. Ravindra, is from 1999 batch of Indian Foreign Service-currently serving as First Secretary (Commercial) at Embassy of India, Tripoli, Libya. He can be reached at raguttahalli@hotmail.com

1. The name "Tripoli" throws up few inquisitive questions in the minds of persons-especially first timers, who have no exposure to Libya. I am sure it is less the case among "Oil Indians" who through this in house magazine already know few things about Tripoli and Libya. Some of them are frequent visitors to Tripoli and few have made Tripoli-their temporary home.
2. Tripoli is one of the most beautiful cities in the Mediterranean. The pristine and unpolluted environs, stunning coastline, out of the world ancient cities (Sabratha, Leptis Magna, Shahat and Ghadames-to name a few) and several unexplored places makes it worth considering a visit to Libya. Libya has in its history many interesting tales and amazing sites all over the country which are less known to outer world. I assure that you will not be disappointed.
3. The name "Tripoli" is derived from Greek meaning "three cities" and the Arabic pronunciation is Tarabulus. The Phoenicians founded their colony of Carthage in about the 10th century BC. The Phoenician traders who were active in the region built three cities in Libya-Oea (now Tripoli), Sabratha and Leptis Magna. Tripoli and the surrounding area were called Tripolitania. Phoenicians used to trade in gold, silver, raw metals, ivory, apes and peacocks. Subsequent to Punic wars, Tarabulus came under Roman rule during 1st Century BC.
4. The rich and fertile lands of eastern region of Libya made Greek seafarers during the 7th century BC to settle in the city of Cyrene-the present Shahhat. Over the next 200 years, four more important Greek cities were founded in the surrounding area by the Greek. They are: Barce (Al Marj); Euhesperides (later called Berenice and presently called Benghazi); Teuchira (later Arsnio and presently Tukrah); and Apollonia (Susah). All together these cities were called the Five Cities or Pentapolis. Cyrene was the capital and the name Cyrenaica was derived from Cyrene as it is known even now. The significance of North Africa for Greeks was so much that they divided the world into Asia, Europe and Libya. By 1st century AD Cyrenaica and Tripolitana were united by the Romans under one administration.
5. The subsequent period is said to be one of the finest-if not the best, in the Libyan history with most of the coastal towns-particularly Sabrata and Leptis achieving peak of prosperity. One could see the remnants of civilization which these cities achieved even now.

Sabrata

6. Sabrata which was built (limestone) in 4th century derives its name from Libyan Berber word meaning "grain market". The theatre built in 2nd century AD is a masterpiece overlooking the sea with a 95 meter diameter auditorium-one of the largest in Africa. Sabrata is one hour journey towards west of Tripoli.

Leptis Magna

7. Compared to Sabrata, Leptis Magna is still a living city. One can easily visualize the glorious past while walking in the site. Though initial settlement was built (of hard sand stone) in 7th Century BC, the status of the city was elevated during the reign of Lucius Septimius Severus in the 2nd Century. He granted a tax free status to the city and it matched the grandeur of imperial Rome. Arch of Septimus Severus (triumphal arch in occasion of Emperor Septimus's return to Leptis in 203), impressive amphitheater, temples, forum, hadrianic baths, basilica, the macellium, or outdoor

Leptis Magna

market are must see. According to legend, Carthaginian general Hannibal is reputed to have bought the elephants for his march on Rome in this very market. Leptis Magna's baths- an early version of the leisure centre and circus are among the largest outside Rome. And, as at Sabratah, the mosaics and sculptures abound in extraordinary detail. Leptis is 1 ½ journey from Tripoli towards east. Another nearby place (15 Kms from Leptis) worth a visit is Villa Silin, a 2nd Century Roman villa with 20 rooms of exquisite mosaics and frescoes. Both Leptis and Sabrata were inscribed as UNESCO World Heritage Sites in 1982.

Triumphal Arch of Septimus Severus

Tripoli

8. Tripoli has several interesting places. The museum has very good collection of Libyan heritage from BC to the present day. The museum is housed in one part of Red Castle which was the seat of power of various rulers till 20th century. Adjoining Madina-(see Marcus Aurelius arch-Marcus was the famous Roman emperor who appointed Septemus Severus in 172 AD as a Senator. Septemus Severus, a native of Leptis Magna went on to become emperor later), Green Square, magnificent Corniche along Mediterranean, coffee and pastry shops are worth spending time. Other places which are getting popular among expat community here are Taleel beach, Tajoura beach and the one and only magnetic point at a place 100 kms enroute of Nalut after Aziziyah (Incidentally the highest recorded temperature in the world comes from Aziziyah. On September 13, 1922, the highest shade temperature on earth, 136°F (57.8°C), was recorded here). Many of those who have visited the place argue that it is not an optical illusion. See it to believe it.

Sahara, Akakus Mountains and Ubari Lake

9. The desert in Libya is home to some of the spectacular desert sceneries in this part of the world. Dunes, deep valleys, palm fringed lakes, volcanic mountains with breath taking rock formations will leave the visitor spellbound. Libya except for the coast, is mostly desert. The great Sahara desert covering entire North Africa runs in Libya from Ghadames in the west to Kufra-a cluster of oases in the east bordering Egypt. The important places to see lie in the southwest region between Sebha and Ghat. The lakes of Ubari near Sebha- i.e., Gebroun, Umm Al Maa, Mavo and Mandara are a must. Of the four, Gebroun is the largest measuring 250 mts by 300 mts. You may try dune skiing as well as swimming in the buoyant waters of the lake. The journey from Sebha to Ghat takes you through Germa-capital of ancient Garamatarian Empire of Fezzan. Ghat in the foot hills of Akakus Mountains is the place of prehistoric paintings and carvings dating back to 12000 years. The paintings show fertile countryside with elephants, crocodiles, giraffe, hunting scenes, and domestic animals such as horses and cattle-a reflection of Libya during those years.

Ghadames

10. Ghadames is the "jewel of the Sahara" is a fascinating mud-brick oasis settlement. A visit to Libya would not be complete without visiting Ghadames.. Ghadames is an OASIS town on ancient caravan routes of North Africa believed to have come up around 3000 BC. Ghadames later became one of the busiest trading towns of the northern Sahara, with caravans organized by local merchants sent across North Africa, from the Atlantic to the Red Sea. The old city is in UNESCO list of heritage sites Families used to live in old city as recent as 1984.

Fortified Granaries of Kabaw near Nalut

Ghadames abandoned old medina

Temple of Zeus - 5th Century BC

Cyrene-ancient sprawling city

Lady be Good in Tubruk

Green Mountains and Eastern Part

11. Perhaps this part of Libya is the most beautiful-with literally lush green mountains (Beginning from Benghazi to Wadi al Kuf and upto Derna), picturesque valleys and agricultural fields make you feel that you are in a different world. With calm and tranquil Mediterranean Sea under clear blue sky on the one side and serpentine roads with steep gradient passing through Wadi al Kuf will take you slowly and steadily to the top of the hill range-Cyrene. I would advice you to take few breaks along the journey to look out for

the magnificent still Mediterranean flocking the sky-thereby making a natural blue canvas backdrop in which one could see real ships moving at snails pace amidst green trees and a vast agricultural terrain on the land side. A scene even a million barrel oil discovery cannot buy! Very few Oilindians would disagree-after the visit.

Cyrene

12. Once you reach the plateau passing green mountains will find Cyrene-the oldest and most important of the five Greek cities. According to myth it was named after Cyrene-a brave princess who was abducted and brought to this place by Apollo. Cyrene was found by Greek settlers of island of Thera (present Santorini in Greece) in early 7th century BC. The Greeks built their city not around a port, but around a holy spring in the cliff that still flows from its dark tunnel in the mountain. It was expanded in the later years with more settlers coming in from Greece. It subsequently became important city of the Greek world. Several Greek kings including Alexander and Ptolemy reigned over the city. Snow fall also takes place in February every year in Cyrene-at least for few days. Far below, on the coast, stands Soussa (Apollonia) famous for Byzantine churches.




Indians troops in 2nd world war

13. During Second World War, the battles of Alamein and Tobruk changed the course of War in favor of allied forces. Winston Churchill famously summed up after the success in these battles as "now this is not the end, it is not even the beginning of the end. But it is, perhaps, the end of the beginning". The war in the desert was the most difficult for both allied and axis forces for ensuring uninterrupted supply for the front including oil. Perhaps at that time none of sides knew that they are fighting a war at place which would soon become a major oil supplier to the world.

14. Of the thirteen infantry divisions which fought the war for Allied forces in the desert of Libya and Egypt during 1940-42, three were Indian i.e., 4th, 5th and 8th. Indian soldiers were recruited from martial races like Sikh, Rajput, Dogras, Pathans and Jats. While British shuffled Indian infantry divisions continuously during the war from Iraq to Sudan to Ethiopia to Egypt to Libya, it was 4th Infantry Division which played a major role in the battle of Sidi Barrani in Egypt bordering Libya in December 1940, Operation Battleaxe (June 15-17, 1941) to relieve the Axis Siege of Tobruk and 2nd battle of Alamein in October 1942. 8th Infantry division also played a role in halting Rommel's advance towards Egypt in 1st battle of Alamein in July 1942. Obviously many Indian soldiers died during these battles. The graves of Indian soldiers in Libya can be found in Tripoli, Benghazi and Tubruk.

Graves of Indian Soldiers in Benghazi

15. Before we end, I request OilIndians to try answering questions on Libya at "Mind Benders". Anyone who knows correct answers should ask Oil India Magazine editor a free ticket to Tripoli. I am just joking! I wish Oil India all the best in its quest for Oil in Libya-which I am sure, would happen by 2010/2011 before the end of EPSA contract-Insha'Allah.

- Year in which our former PM Smt. Indira Gandhi visited Tripoli?
- Where lies the city of same name "Tripoli"?
- In which place the first Oil discovery was made in Libya?
- Name of the first Indian Ambassador to Libya?
- How many crew members did the ill fated B-25 bomber -"Lady be Good" that crashed in the Libyan Desert on April 3 1943 had?
- Which Country's Navy Band has ".....to the shores of Tripoli"?
- Name of the present Chairman of National Oil Corporation, Libya?

16. Let me close the article by guessing answer to the last question. Before the end of EPSA contact - i.e. year 2010/2011 - Insha'Alla. all the best to Oilindians.

THE MOTH

A man found a cocoon of an emperor moth. He took it home so that he could watch the moth come out of the cocoon. On that day a small opening appeared, he sat and watched the moth for several hours as the moth struggled to force the body through that little hole.

Then it seemed to stop making any progress. It appeared as if it had gotten as far as it could and it could go no farther. It just seemed to be stuck.

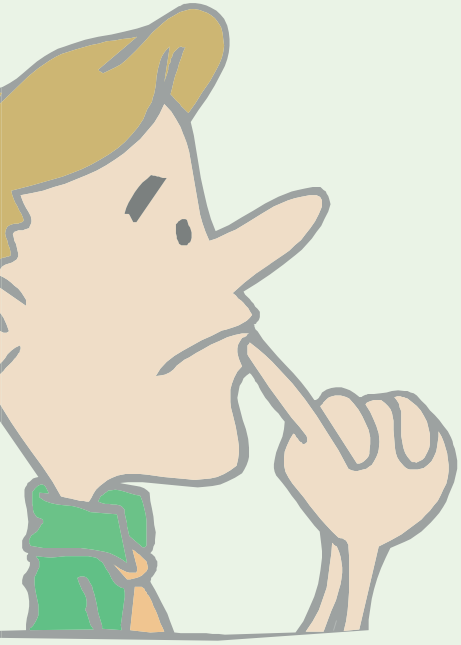
Then the man, in his kindness, decided to help the moth, so he took a pair of scissors and snipped off the remaining bit of the cocoon. The moth then emerged easily. But it had a swollen body and small, shriveled wings.

The man continued to watch the moth because he expected that, at any moment, the wings would enlarge and expand to be able to support the body, which would contract in time.

Neither happened! In fact, the little moth spent the rest of its life crawling around with a swollen body and shriveled body and shriveled wings. It never was able to fly.

What the man in his kindness and haste did not understand was that the restricting cocoon and the struggle required for the moth to get through the tiny opening was the way of forcing fluid from the body of the moth into its wings so that it would be ready for flight once it achieved its freedom from the cocoon. Freedom and flight would only come after the struggle.

By depriving the moth of a struggle, he deprived the moth of health. Sometimes struggles are exactly what we need in our life. If we were to go through our life without any obstacles, we would be crippled. We would not be as strong as what we could have been.



Mind Benders

Here is a quiz for our readers.
Send in your answers to the editor or e-mail them to: ajaini@oil.delhi.nic.in
3 winners will be given attractive prizes.

1. WHICH INDIA BORN ACTRESS GOT HER ONLY ACTING OSCAR IN 1951 , JOINING HER HUSBAND LAURENCE OLIVIER TO BECOME THE ONLY MARRIED COUPLE TO RECEIVE LEAD ACTING AWARDS?

2. WHO CAPTAINED THE AUSTRALIAN TEAM DURING THE 'BODYLINE' SERIES IN 1932?

3. IN THE SEVENTEENTH CENTURY WHAT WAS THE NAME GIVEN TO THE MUGHAL CUSTOM HOUSES ON THE WEST COAST OF INDIA

4. WHICH INDIAN BRAND NAME, SET UP BY THE TATAS, GETS ITS NAME FROM A LEON DELIBES OPERA ABOUT AN INDIAN MAIDEN CALLED LAKSHMI?

5. WHAT TRADE ORGANIZATION WAS FOUNDED BY A GROUP OF INDUSTRIALISTS LED BY G.D.BIRLA AND PUROSHOTTAM THAKUR DAS IN 1927?

6. WHEN THE PRINCE OF WALES MUSEUM STARTED IN 1922, THE ART COLLECTION OF MEMBERS OF WHICH BUSINESS HOUSE WAS THE FIRST MAJOR ACQUISITION OF THE MUSEUM?

7. WHICH INDIAN BUSINESSMAN ENTERED INTO A COLLABORATION WITH CARR GORDON AND PRINCEP TO FORM INDIA'S FIRST FOREIGN COLLABORATION IN 1833?

Winners of Synergy- Vol. 4 Issue 2 Quiz are:

1. **Mr. R.Ravindra**
   First secretary,
   Embassy of India, Libya
2. **Mr. Santanu Sharma**
   Executive Trainee,
   Well Logging Department
3. **Mrs. N.Ratna**
   Manager (P&A), Delhi
4. **Mr. Neeraj Bharadwaj**
5. **Mr. Sushanta Purkayastha**
   Asst Officer, T & D
6. **Indraneel Das Barua**
   ET, Personnel Dept.

Congratulations to all the Winners *- Editorial Team*

Answers of the Synergy - Volume 4 Issue 2 Quiz are

1. Found extensively in the forests of Assam, which is the only species of ape native to India?
   Hoolock or White Browed
   Gibbon
2. Which narcotic is named after the Greek God of sleep & dreams?
   Morphine
3. What is the name of the collection of speeches of JRD Tata edited by R.M.Lala S.A Sabavala in 1986
   Keynote
4. What is the motto of Asian Games
   Ever Onward
5. "I am the fountain from which no one can drink. For many I am considered a necessary link. Like gold to all I am sought for, but my continued death brings wealth for all, to want more. What am I?"
   Black Gold or Hydrocarbon
6. The name of which brand of whiskey means 'Short Shirt' and is also the name of a famous British ship?
   Cutty Sark
7. Which Sony product was originally sold in Britain under the name, Stowaway?
   Walkman

PRODUCT WISE DETAILS OF IMPORTS / EXPORTS

(Figures from PPAC, MOP & NG)

	APRIL-JAN 06			APRIL-JAN, 2007		
	QTY TMT	VALUE Rs. Crore	$ Million	QTY TMT	VALUE Rs. Crore	$ Million
IMPORTS	**25130**	**39178**	**8862**	**26626**	**48543**	**10668**
CRUDE IMPORTS	25130	39178	8862	90682	48543	10668
PRODUCT IMPORT						
LPG	2400	5668	1269	1871	4696	1039
PETROL	445	1176	268	409	1302	284
NAPHTHA/NGL	1924	4439	994	4686	13002	2849
SKO	812	2017	461	1048	3200	698
HSD	731	1721	393	826	2318	508
LOBS	1102	2722	611	573	2297	502
FUEL OIL/LSHS	664	903	210	748	1110	243
BITUMEN	15	19	4	6	8	2
OTHERS	2209	3442	877	2421	4632	1018
SUB-TOTAL	10317	22136	5094	12590	32566	7143
GROSS IMPORTS	**91640**	**160226**	**36312**	**103272**	**81109**	**17811**
EXPORTS						
LPG	45	133	30	97	288	64
MS	1758	4238	962	2933	8373	1839
NAPTHA/NGL	4109	8687	1938	7039	17919	3973
ATF	2276	5663	1277	3410	9843	2160
HSD	6779	14961	3376	10375	27316	5979
SKO	109	331	75	125	463	101
LDO	0.20	0.50	0.10	0.12	0.31	0.07
LOBS/LUBES	4	16	4	8	49	7
FO/LSHS	1537	1884	436	4725	36231	1391
BITUMEN	30	22	5	100	65	15
OTHERS	839	1535	342	533	1426	311
TOTAL EXPORTS	**17487**	**37470**	**8445**	**29345**	**71973**	**15841**
NET IMPORTS	**74153**	**122756**	**27867**	**73928**	**142376**	**31251**

CONSUMPTION OF PETROLEUM PRODUCTS

(All figures in TMT)

PRODUCT	APRIL-JAN, 06	APRIL-JAN, 07	% GROWTH
LPG	8707	8930	2.6
MS	7165	7662	6.9
NAPHTHA	10083	11670	15.7
ATF	2677	3287	22.8
SKO	7980	7884	-1.2
HSD	33183	35421	6.7
LDO	753	604	-19.8
LUBES	1716	1389	-19.1
FO/LSHS	10759	10384	-3.5
BITUMEN	2650	2924	10.3
OTHERS	7919	8382	5.8
TOTAL	93591	98536	5.3

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