Chapter III

Commodity Balance of Petroleum Products in India

Availability of petroleum products is of significant economic consequence for any country. Crude oil is a natural resource. To the extent, indigenous availability does not support the country's consumption requirement, Oil is imported.

The material balance essentially consists of the alignment of domestic demand for petroleum products with aggregate final supply in physical terms. Imports are defined as the gap between domestic demand and final supply. This gap manifests itself at two levels. First, given the utilization of refinery capacity, the shortfall between domestic crude production and refinery capacity is bridged by imports of crude petroleum. Gross availability of crude, net of wastage, forms refining output of light and medium distillates and heavy ends. The gap between this refinery production and domestic consumption is met by direct imports of petroleum products. Application of relevant import prices to the two gaps, yield an estimate of the value of the economy's import of POL. The symmetry in material balance that is achieved in the *post facto* sense derives from several functional relationships underlying the behavior of the components.

The hydrocarbon sector in India has undergone a massive transformation in terms of indigenous production of Crude Oil, import and export of petroleum products.

Table 3.1: Commodity Balance of Petroleum Products

Figures in Million Tonnes

	50-51	60-61	70-71	80-81	90-91	95-96	00-01	02-03	03-04	04-05	05-06
Crude Oil											
Refinery Throughput	0.3	6.6	18.4	25.8	51.8	58.7	103.4	112.6	121.8	127.4	130.1
Domestic Production	0.3	0.5	6.8	10.5	33.0	35.2	32.4	33.0	33.4	34.0	32.2
a) On- Shore	0.3	0.5	6.8	5.5	11.8	11.9	11.8	11.5	11.5	11.6	11.4
b) Off- Shore	-	-	-	5.0	21.2	23.3	20.6	21.5	21.9	22.4	20.8
Imports	Na	6.0	11.7	16.2	20.7	27.3	74.1	82.0	90.4	95.9	99.4
Petroleum Products											
Domestic Consumption, of which	3.3	7.7	17.9	30.9	55.0	74.7	99.6	104.1	107.8	111.6	113.2
a) Naphtha	-	-	0.9	2.3	3.4	3.7	8.1	11.9	11.9	14.0	12.2
b) Kerosene	0.9	2.0	3.3	4.2	8.4	9.3	10.7	10.4	10.2	9.4	9.5
c) High Speed Diesel	0.2	1.2	3.8	10.3	21.1	32.3	37.9	36.6	37.1	39.6	40.2
d) Fuel Oil	0.9	1.7	4.7	7.5	9.0	10.7	11.4	12.7	12.9	13.5	12.8
Domestic Production, of which	0.2	5.7	17.1	24.1	48.6	55.1	95.6	104.1	113.5	118.4	119.9
a) Naphtha	Na	-	1.2	2.1	4.9	6.0	9.9	9.7	11.3	15.8	16.0
b) Kerosene	Na	0.9	2.9	2.4	5.5	5.3	8.7	10.0	10.2	9.2	9.0
c) High Speed Diesel	Na	1.1	3.8	7.4	17.2	20.7	39.0	40.2	43.3	46.1	47.7
d) Fuel Oil	Na	1.6	4.1	6.1	9.4	9.6	11.4	12.2	13.4	14.7	14.1
Imports	3.1	2.5	1.1	7.3	8.7	20.3	4.2	6.7	7.9	8.8	13.4
Exports	Na	Na	0.3	neg	2.7	3.4	1.0	10.3	14.6	18.2	23.5

Source - Economic Survey, Govt. of India – successive issues

From the commodity balance point of view, Indian Oil Industry has passed through the following two landmark years, which have ushered in new phases and brought in different challenges:

a) 1976-77 to 1982-83 – Discovery and commercial production of offshore Bombay High Oil fields.

b) 1999-2000 – Enhancement of additional refining capacity in the country

This Chapter is organized in terms of the following sections:

1. Discovery of commercial production in off-shore Bombay High Oil fields
2. Enhancement of additional refining capacity in the country
3. Managing surplus (export of petroleum products)
4. Import of petroleum products
5. Oil security for India

Section 3.1 - Discovery and commercial Production in offshore Bombay High Oil fields

Country's self sufficiency in Oil is determined by its Crude Oil production. In India, till 1975-76 total Crude Oil production was 8.4 million tonnes, against the country's requirement of 22 million tonnes. Balance requirement of 13.6 million tones of Crude was imported, costing the country Rs 1052 Crores. Till then, the entire indigenous Crude Oil production was coming from two onshore Oil fields, namely, Assam Oil fields and Gujarat Oil fields in the ratio of 50%. Offshore production of Crude Oil commenced in 1976-77 and then every year the production increased gradually and touched 13 million tones by 1982-93 and 20 million by 1984-85. Supported by the increase in consumption and increased refining capacity, import of Crude Oil also grew every year in a consistent manner.

Import of Crude Oil took a quantum jump in 1999-2000, from 40 million tonne in 1998-99 to 57.8 million in 1999-2000 and further to 74 million in 2000-01, as Reliance refinery at Jamnagar came on steam in 1999.

Rs 40,000 crores was spent in crude oil import in 1999-2000 against Rs 15,000 crores in 1998-99, which was further heightened to Rs 66,000 crores in 2000-01.

Crude oil production by private and Joint Venture Companies commenced in 1995-96 in a modest volume, which picked up by the turn of the century, constituting 13% of total indigenous production now (2003-04). Production by private and Joint Venture Companies got a fillip by New Exploration Licensing Policy (NELP), which was approved in 1997 and became effective in February 1999. The fifth round of NELP was launched on January 4, 2005.

Table 3.2: Indigenous Production and Import of Crude Oil

Figures in thousand tonnes

	Onshore production	Offshore production	Private / JVC	Total indigenous production	Import	Import value in Rs Crores
1970-71	6822	-	-	6822	11683	107
1975-76	8448	-	-	8448	13624	1052
1976-77 *	8492	406	-	8898	14048	1176
1980-81	5522	4985	-	10507	13624	3349
1985-86	9345	20823	-	30168	15144	3687
1990-91	11830	21191	-	33021	20699	6118
1995-96 **	11852	22665	650	35167	27342	11517
2000-01	11714	16629	4083	32426	74097	65932
2001-02	11818	16073	4141	32032	78706	60397
2002-03	11397	17560	4088	33044	81989	76195
2003-04	11386	17677	4314	33373	90434	83528
2004-05	11517	18165	4300	33981	95861	117003
2005-06	11329	16309	4552	32190	99409	171702

* - Bombay High off Shore Production commenced

** - Production by Private and Joint Venture producers was commenced in 1995-96. NELP I was formulated in 1997 and was awarded in 1999

Source : Energy, Center for Monitoring Indian Economy, February 2007

The country's crude oil output in 2006-07 was up 5.6 per cent to 33.98 million tonne (MMT) compared with 32.19 MMT in the previous fiscal. However, the gas output in 2006-07 fell by 2 per cent due to lower off-take by consumers, environmental reasons, less than anticipated gain from new exploratory wells and miscreant activities in various operational areas. In 2006-07, the country produced 31.55 billion cubic meters (BCM) of natural gas, down from 32.20 BCM a year earlier.

Section 3.2 - Enhancement of Refining Capacity in the Country

Till 1998-99, India was importing both Crude Oil and refined petroleum products, as there was deficit in both refining capacity and indigenous crude production. Refining capacity (therefore availability of refined petroleum products) was less than the consumption of petroleum products and indigenous production of Crude Oil was less than the refining capacity to process Crude. With the commissioning of a 27 million tonne capacity refinery in 1999-2000 at Jamnagar, India's Crude import got increased and correspondingly refined product import got reduced, as the Table 3.3 below shows:

Table 3.3: Import of Petroleum Products: Crude and Refined Products

Figures in thousand tones

Year	1996-97	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
Total Crude Import	33,906	34,493	39,808	57,805	74,097	78,706	81,989	90,434	95,861	99,409	111,502
Total Product Import	20,265	22,970	23,772	16,608	9,267	7,009	7,228	8,001	8,828	13,441	16,967

Today (2006) Reliance' Jamnagar Refinery is the third largest refinery in the world with 33 million tonne capacity. The largest one is Paraguana Refining Centre in Venezuela and the second largest is of SK Corporation in South Korea. Indian Oil Corporation occupies 25th position in the largest refiners rank with 38 million tones capacity. World's total refining capacity in 2006 increased by 52 thousand barrels per day to 85.2 million barrels per day in 658 refineries. (Nakamura, 2006)

During 2006-07, Indian refineries processed 146.55 million tonnes (2.94 million bpd) of crude, up from 130.1 million tonnes (2.61 million bpd) in the previous year. In the 2006-07, Essar Oil commissioned its 210,000 bpd refinery, while Indian Oil Corporation doubled capacity at its Panipat unit to 240,000 bpd, part of India's plans to emerge as a global refining hub.

Indian refinery processing will get a fillip in next few years as Asia's third-largest oil consumer plans to add 2.14 million bpd by 2012 to its existing 2.98 million-bpd capacity. It expects domestic demand to grow at a compounded annual growth rate of 2.9 percent to 132 million tonnes (967.56 million barrels) in 2012. In 2006-07 capacity utilization was 107.7 percent, up from 100.2 percent in the previous year.

Throughput of Indian refineries has been growing as firms expand to tap global markets where they can sell at prices higher than India's state-regulated retail rates. They have continued running at near full throttle despite a downturn in international profit margins for simple Asian refiners. Indian oil product exports surged 45 percent in 2006-07.

3.2.1 Stylized facts on the Material Balance In Oil Sector in India

The formation of the material balance is presented in Table 3.1. By the seventies, domestic crude production rose to account for close to 40% of domestic consumption and domestic refining capacity met the entire domestic requirement of petroleum products. Since then, the behavior of import demand has been the outcome of the internal dynamics of the material balance, interrupted by exogenous supply shocks. The speed of adjustment to the shocks has been influenced by the response of the principal components of material balance, i.e., domestic consumption, domestic production and refinery capacity. The oil shocks have induced macro economic effects in term of slow down / decline in overall and sectoral activities, flare of inflation, hardening of interest rates, overvaluation of the exchange rate, widening of the external imbalance and loss of reserves. In the period leading up to first oil shock, i.e., 1970-74, domestic consumption rose faster than the real growth rate of the economy, causing a doubling of product imports in every successive year. Domestic production of crude, on the other hand, rose moderately with a decline in the crisis year 1973-74. Crude import volume went up sharply in 1973-74 mainly to meet the enhancement of refinery capacity and to some extent, to meet the shortfall in production. Thus, on the eve of the first oil shock, a structural imbalance was building, as reflected in (i) the rising share of imports in the volume of domestic consumption (IC) and (ii) declining share of domestic production in domestic consumption (DPC). The vulnerability of the economy to the shock signaled by these indicators was soon to be reflected in the balance of payments. Between September 1973 and April 1974, international crude oil prices shot four folds (from US $ 2.70 per barrel in 1973-74 to US $ 9.76 per barrel in 1974-75). Oil imports doubled the share in total imports to 20%, jumping from US $ 266 million in 1972-73 to US $ 1457 million in 1974-75. Second round of impact through non-oil commodity prices worsened the balance of payments.

Macro economic adjustment to the first oil shock was relatively painless. This has been commonly attributed to the easy availability of balance of payment support from financial flows in the form of remittances, aid and IMF facilities. While these factors eased the pressure on balance of payments, it was the structural shifts within the material petroleum balance which enabled the real sector adjustment. Between 1974-75 and 1978-79, concerted efforts towards exploration and utilization of onshore oil basins resulted in an average annual increase of a little

above 10 percent in domestic production. The DCP index began climbing upwards from its trough in 1973-74 for a prolonged period up to 1977-78, dipping thereafter to signal the onset of the second crisis. Austerity measures contained domestic consumption in 1974-76 until the recovery of economic activity began to drive up consumption at around 8 percent per annum in the subsequent years up to 1980-81 when the full blown impact of the second oil shock impacted on the Indian economy. Installation of refinery capacity grew modestly in comparison at around 5.5 percent. The import volumes mirrored the behavior of domestic consumption. The compressed, post shock level of imports was maintained until the burgeoning growth of domestic consumption spilt over in to imports. The expansion was spread over both crude and products. The IC index declined steadily from 1973-74 to 1978-79. It began to rise only coincidentally in 1979-80, the year of second oil shock.

The second OPEC price hike resulted in the trebling of crude prices in 1979-1980. Imports of POL, which was averaging a fourth of total imports, soared to account for over 40% of the total import payments. During the period of the crisis, domestic production stagnated and actually declined in 1980-81 in the wake of troubled internal developments. Although the growth of domestic consumption slowed down by the imposition of policy brakes, this could not check a surge in import volumes. Import of crude went through a one-step increase in 1979-80 to accommodate the momentum of consumption growth gathered in the pre-crisis years, and stabilized thereafter. The entire impact of the shortfall in domestic production, slow down in building of refinery capacity and an annual growth of 5 percent in consumption were reflected in an increase of 86 percent in imports of products. In the period 1979-81, the DPC index declined drastically, indicative of the extreme fragility of the economy. The IC index rose to the first oil shock level in 1980-81, the year in which the full effects of the second oil shock were felt. With the increase in oil prices, import prices and soaring import bills fed these shocks into the domestic economy through a worsening of the balance of payment situation, a hemorrhage of the foreign exchange reserves and double digit inflation. The adjustment to the second oil shock was entirely shifted on to the balance of payments without any compensating variation in the elements of material balance. India borrowed from the IMF Rs 274 crores under the Compensatory Financing Facility (CFF) and Rs 545 crores from the IMF Trust Fund in 1980-81. Negotiations were made for Extended Fund Facility (EFF) of SDR 5 billion from the IMF in November 1981 out of which SDR 3.9 billion was finally drawn and SDR 1.1 billion ultimately surrendered.

In 1981, the discovery of Bombay High impacted in the form of a positive shock on the material balance. For a prolonged period up to 1989-90, domestic production surged at an annual compound rate of 12.5 percent, the maximum increase occurring during 1981-85. The leading indicator, i.e., the DPC index improved continuously up to 1985-86; from 1986-87 onwards, however, there was a steady deterioration in DPC index as domestic consumption growth, driven by an acceleration of overall growth, increased from around 4 percent in the first

half of the eighties to over 7 percent in the second half. The declining trend in the DPC index in the second half of the eighties went unheeded in the unbridled pursuit of growth. To contain the dependence on imports, there was a continuous expansion of refining capacity which grew at an annual compound rate of 7.8 percent over the period 1980-90. The emphasis on installation of additional refining capacity emerged from the surplus conditions which set in after 1981 when, in view of lack of refining capacity, exports of crude oil were affected between 1982 and 1985. Furthermore, in the eighties, on stream capacity ensured a modest volume of exports of intermediate and finished products from India. Imports of crude and products followed a similar pattern: decline / stagnation in the first half of the eighties and a sharp increase in the second half. The IC index, the coincident indicator, fell all through the first half of the eighties up to 1986-87 after which there was one step increase. The balance of payment weathered the increase in imports through the expansion of exports and the saving on account of soft international crude oil prices. The share of POL imports (OM / TM) declined from over 40 percent in 1980-81 to 15 percent in 1989-90. As a consequence, the signals from the leading and coincidental indicators were obscured; moreover, internal imbalances were increasingly reflected in a widening and persistent current account deficit. External financing became the overriding consideration as the current account deficit was employed as an accelerator in the growth process.

In 1990-91, when the Gulf crisis impacted upon the economy, the DPC index was falling and an upward trend in the IC index was getting entrenched. Thus, while the discovery of Bombay High stabilized the economy in the wake of second oil shock, fundamental adjustments in the material balance were held back in the quest for higher growth. As the deterioration in the balance of payment became pronounced, the rigidities in the material balance increased the vulnerability of the economy to external shocks.

In the nineties, the adjustment to the Gulf crisis has followed a pattern similar to that in the post second oil shock period. Structural adjustment in the material balance was not immediately undertaken. Instead, the entire adjustment initially got shifted to the balance of payment. Unlike in the early eighties, the fortuitous discovery of Bombay High has been absent in the nineties. Domestic production has remained stagnant with a decline in the early nineties. Stagnation has also set in upon the growth of refinery capacity. After slowing down up to 1993-94, domestic consumption has risen at an annual average growth rate of 10.5 percent. The combined burden of production shortfall, stagnation in refining and a surge in domestic consumption has fallen on imports. The increase in imports has been concentrated in products, although since 1996-97, crude imports have also been stepped up. The signs of growing vulnerability of the economy to POL shocks are being increasingly reflected by the leading and coincident indicators. The DPC index has fallen steadily through the nineties to pre second oil shocks levels. The IC index has climbed to a level that it had reached during the first oil shock and again in 1980-81, during the second oil shock. The capability to

withstand sustained increases in international prices / supply shocks is getting undermined by the near absence of compensating variations in the material balance. As seen in the adjustment of the first oil shock and painfully absent in the second oil shock, adjustments in the material balance operate in the manner of an automatic stabilizer in the face of POL shocks.

An attempt has been made here to estimate POL imports for India emerging as the gap in the consistency between domestic consumption, domestic production and refinery capacity. (Basu *et al*, 1999) The material balance identity is taken as the constraints, i.e., DD = DOMCR + ICR + IPOL, where DD is final domestic consumption (net of exports), DOMCR is the domestic production of crude, ICR is the import of crude and IPOL is the import of finished products. The total import bill can then be defined as O = PCR X ICR + PPOL X IPOL, where O is the total oil import value, PCR the international crude oil price, PPOL the international price of finished POL products. This identity states that the total import bill is the sum of the value of crude oil import and finished product import.

The critical elements of the estimation exercise are, thus, ICR and IPOL. The level of domestic refinery throughput (RTH) sets the upper limit of crude oil that can be processed into finished goods in the country itself. Domestic crude oil production (DOMCR) is the availability of raw crude domestically. Any difference between the two, after accounting for a given proportion of wastage, is met by importing crude oil (ICR) from abroad. In a functional form,

ICR = ICR (RTH, DOMCR) (1)

Refinery throughput (RTH) enters domestic consumption (DD) after due processes of refinement and distillation as refinery production (REF). The shortfall in REF in relation to DD (adjusted for distribution losses) is met by imports of finished products (IPOL). Accordingly an estimate of IPOL requires contemporaneous estimates of DD and REF, i.e,

IPOL = IPOL (DD, REF) (2)

DD = DD (AG, TR, OTH, Co, PRCR) (3)

REF = REF (RTH) (4)

Equation (3) states that the final domestic consumption is a function of agricultural output (AG), transportation sector output (TR), other industry and service sector (OTH), inter fuel substitution (CO) and crude oil price domestic currency (PRCR). The model is complete with the estimation of a functional form for the international prices of products. The data suggest a stable relationship between product prices and crude oil prices in the international markets. Accordingly,

PPOL = PPOL (PCR) (5)

Data for the period 1970-71 to 1997-98 are used in the model. The model consists of the following exogenous, endogenous and pre-determined variables:

Endogenous variable

1. PPOL = international prices of petroleum products
2. REF = refinery production
3. DD = total demand for petroleum products
4. IPOL = import of petroleum products
5. ICR = import of crude petroleum

Pre-determined variables

Exogenous variables:

1. AG = agriculture
2. TR = Transport
3. OTH = industry and other services (excluding mining)
4. CO = coal
5. RTH = refinery throughput
6. DOMCR = domestic crude production
7. EXRT = exchange rate
8. PCR = international crude prices in UD dollar; the domestic equivalent, i.e., PRCR is obtained by applying Rs / US $ exchange rate to PCR
9. DUM73 = dummy for the first oil shock
10. DUM80 = dummy for the second oil shock
11. DUM90 = dummy for the third oil shock
12. DUMBH = dummy for the Bombay High Recovery

Lagged endogenous:

13. PPOL (-1) = product prices with a one period lag

Figures in the parentheses indicate t-value; * indicates 10% level of significance; ** indicates 5% level of significance; *** indicates 1% level of significance

dICR = 4.04 + 0.59 dRTH – 0.84 dDOMCR + 22.84 DUMBH (1)
(1.80)* (5.29) *** (8.69) *** (3.00) ***

R-Bar-Square: 0.77 DW-Statistics: 1.86

The volume of crude petroleum imports is positively influenced by changes in refinery throughput level, i.e., as capacity increases, given domestic production, the demand for crude import rises to match the feed-stock requirements of refineries to ensure that idle capacity does not impute costs into the output. As expected, domestic production has a strong economizing influence on imports which tends to outweigh the demand spurring impact of capacity expansion.

A dummy for the discovery of Bombay High (DUMBH) has a surprisingly strong positive effect on crude import demand. This can be explained by the constraints on domestic refinery capacity to accommodate the initial impact of positive supply shocks, the subsequent and sympathetic expansion of refining capacity to cut down the need for crude exports, which in turn, creates additional demand for crude imports.

$$dIPOL = 2.0 + 0.69\ dDD - 0.76\ dREF \qquad (2)$$
$$(1.03)\ (7.48)^{***}\quad (6.14)^{***}$$

R-Bar-Square: 0.66 DW-Statistics: 2.14

Equation (2) bears out the dynamics of the demand for petroleum products in India. While these imports are essentially driven by the behavior of domestic consumption, which is attested to by the sign of DD, the expansion in domestic refinery capacity and therefore, in refinery output (REF) progressively substitutes for imports, effecting economy from the point of view of the balance of payments as product imports are relatively more expensive than crude import equivalents.

$$dDD = 4.47 + 0.002\ dTR + 0.002\ dOTH + 0.0007\ dAG\ (-1) - 0.15\ dCO$$
$$(2.24)^{**}\ (7.39)^{***}\quad (2.56)^{**}\quad (11.66)^{***}\quad (5.25)^{***}$$

$$- 0.04\ dPRCR\ (-2) - 10.57\ DUM73 + 5.86\ DUM79 - 14.27\ DUM90 \qquad (3)$$
$$(2.37)^{**}\quad (2.62)^{**}\quad (1.79)^{*}\quad (3.54)^{***}$$

R-Bar-Square: 0.92 DW-Statistics: 2.17

Equation (3) captures the process of formation of consumption demand in India. Transportation and industrial sector activity are the main source of domestic consumption of petroleum products. Agricultural activity has a positive influence on consumption demand, albeit with a one-period lag, indicating the role of stable, adaptive expectations (contemporaneous influence was statistically insignificant and hence is not reported). The possibilities of inter-fuel substitution are evident in the negative sign of the variable CO which is a summary proxy for coal and other sources of energy that can replace the demand for POL consumption. The argument for domestic prices (PRCR) has the expected negative sign, showing that consumption is rationed, to some extent, by changes in administered prices. PRCR is employed with a two-period lag since in the Indian context, the impact of changes in international prices are first cushioned by the fiscal regime and passed on to consumer after a lag.

All the dummies, representing the oil shocks, turnout to be significant; while the dummies for the 1973 and the 1990 shocks have a negative sign, indicating that the policy responses tended to curb domestic demand in the face of exogenous shocks, the dummy for 1979 has a positive sign, pointing to the absence of

compensating policy changes and the passive absorption of the shock through the balance of payments.

dREF = 0.52 + 0.91 dRTH (4)
(1.52) (37.20) ***

R Bar Square : 0.99 DW statistics: 2.75

Equation (4) sets out the process of conversion of refinery feedstock into final production after the various process of refinement.

dPPOL = 0.29 + 1.39 dPCR - 0.28 dPPOL (-1) (5)
(0.53) (7.91) *** (2.75) **

R Bar Square: 0.77 Durbin's h: - 1.13

Equation (5) estimates the relationship between international product prices and raw crude oil prices. The statistically significant coefficient of the lagged dependent variable indicates that there is an adjustment process at work which spills over the span of one year.

The application of a material balance framework for analyzing the dynamics of POL imports has considerable practical utility for country like India. It allows for specific supply side influences. This is important from the point of view of the Indian context, where domestic demand is constrained by policy interventions to the level of aggregate availability of POL. Although the material balance 'balances' in an *ex-post* sense, it evolves through functional relationships which need to be scrutinized empirically to gain an understanding of import behavior.

Section 3.3 - Managing Surplus

For last 50 years till the turn of the century, Indian oil Industry was living with a net deficit from the supply side. Potential demand was considered to be 'given' and supply side was managed to meet the demand. In 1999-2000, India's refining capacity increased from 69 million tones to 112 million tones and is proposed to be enhanced further. On the consumption side, 2000 - 2002 seemed to be depressed year. Therefore, a glut like situation in the domestic market was being managed by Indian Oil companies. Surplus product is being exported.

Table 3.4: Refinery Crude Throughput

Figures in Thousand tones

	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
IOC, Guwahati	856	836	914	707	656	458	891	1004	864	839
IOC, Barauni	2181	2204	3411	3122	2876	2994	4304	5082	5553	5469
IOC, Koyali	10694	10935	11109	12006	11697	12434	12758	11698	11543	12953
IOC, Haldia	4706	4714	4105	3873	4026	4513	4518	5418	5502	5836
IOC, Mathura	8565	8909	8125	7133	8031	8207	8248	6387	7938	8883
IOC, Digboi	502	553	603	678	653	581	602	651	615	586
IOC, Panipat	0	2208	4153	5707	5822	6101	6338	6387	6507	9435
BPC, Mumbai	7996	8878	8907	8663	8744	8711	8703	9143	10298	12041
HPC, Mumbai	6378	5203	6007	5575	5641	6078	6108	6118	6249	7420
HPC, Vishakha	2467	3861	4555	6405	6706	6851	7591	7822	7569	9232
BPC, Kochi	7729	7770	7830	7520	6797	7580	7854	7925	6939	7743
CPCL, Chennai	6965	6101	6377	6046	6123	6176	6387	8181	9680	9784
CPCL, Narimanam	556	644	636	579	566	643	653	743	682	617
BRPL, Bogaingaon	1718	1653	1905	1488	1475	1463	2126	2311	2356	2067
BPC, Numaligarh	0	0	215	1451	2307	1879	2200	2042	2132	2496
MRPL, Mangalore	3853	4069	5200	6438	5487	7253	10069	11809	12014	12536
RPL, Jamnagar	0	0	11912	26033	29654	30544	32345	31490	34471	31670
ONGC, Tatipaka					13	85	83	93	93	94
EOL, Jamnagar										1762
Total	**65166**	**68538**	**85709**	**103110**	**106540**	**110580**	**118680**	**124302**	**126986**	**141463**

Source: Indian Petroleum & Natural Gas Statistics, successive issues

Traditionally India has been a net deficit country and has been exporting a small volume of those products for which there is no domestic market. During 1970s, the export volume was 135 thousand tonnes per annum only, which was 1600 and 2700 thousand tonnes per annum during 1980s and 1990s. The products were mainly those for which there was no demand in the country; these were Naphtha and Furnace Oil.

2000-01 was a landmark year in the export history of Indian Petroleum products, in which above 8 million tonnes of product was exported. All types of refined petroleum products were exported, as is given in the Table 3.5 below:

Table 3.5: Export of Petroleum products in 2000-01

	Quantity exported	Export Value realized	
	000 tonnes	Rs Crores	Million US Dollar
Petrol	1202	1442	315
Naphtha / NGL	2882	3273	715
Aviation Fuel	160	174	33
Diesel	1597	1872	409
FO / LSHS	508	320	70
Others	2016	591	129
Total	**8365**	**7672**	**1676**

Source: Indian Petroleum & Natural Gas Statistics, successive issues

Table 3.6: Export of Petroleum products (2001-02 to 2006-07)

(Quantity : 000 Tonnes; Value: Rs Crores)

	2001-02		2002-03		2003-04		2004-05	
	Volume	Value	Volume	Value	Volume	Value	Volume	Value
LPG	0	0	0	0	0	0	145	307
MS	2406	2570	2336	3011	2979	4021	2897	5625
Naphtha	2515	2234	2067	2325	2176	2653	2925	5030
TAME	87	123	90	139	83	117	0	0
Reformate	0	0	0	0	210	309	321	551
Light Distaillates	**5008**	**4927**	**4493**	**5475**	**5448**	**7100**	**6288**	**11513**
SKO	0	0	0	0	0	0	207	460
HSD / LDO	2890	2571	3178	3547	6181	6763	7286	11782
ATF	194	176	697	790	1660	1950	2480	4447
Middle Distillates	**3084**	**2747**	**3875**	**4337**	**7841**	**8713**	**9973**	**16689**
FO / LSHS	482	255	1120	902	1310	928	1792	1517
VGO / Lubes	272	211	101	109	17	36	102	137
Coke / Bitumen / White Oil / Paraffin	1219	79	700	45	4	4	56	71
Heavy Ends	**1973**	**545**	**1921**	**1056**	**1331**	**968**	**1950**	**1726**
Total	**10,065**	**8,219**	**10,289**	**10,868**	**14,620**	**16,781**	**18,211**	**29,928**

Source: Indian Petroleum & Natural Gas Statistics

....Contd

Table 3.6: Export of Petroleum products (2001-02 to 2006-07)

(Quantity : 000 Tonnes; Value: Rs Crores)

	2005-06		2006-07	
	Volume	Value	Volume	Value
LPG	53	164	87	287
MS	2417	5843	3696	10538
Naphtha	5066	10787	8337	21292
SKO	121	371	150	542
ATF	2828	7077	3749	10512
HSD	8504	18654	11778	30295
FO	1815	2268	3759	4988
LDO	0.2	0.5	0.1	0.3
LUBES	291	355	37	153
BITUMEN	33	25	66	77
COKE	306	277	223	266
OTHERS	2028	4152	854	1947
Total Exports	**23,460**	**49,974**	**32,737**	**80,898**

Source: Indian Petroleum & Natural Gas Statistics

During last 5 years, (2000-01 to 2004-05), India earned Rs 14,300 crore per year on average from export of petroleum products, constituting 5% of India's export earnings. In 2004-05, the export realization was in fact Rs 28,386 crores, constituting 7.8% of India's total export earnings.

India's surplus refined oil products are, in a way, a boon to the country's external trade balance. This emerging factor goes a long way to defy the notion that oil industry in India is a drain on country's balance of payment. If India's oil companies can create value for their products in neighboring countries in the Asia Pacific and Far East region, then oil industry will no longer be a hole in the external pocket of India. The challenges are many, as Indian refineries have to compete with refineries in countries like Singapore, Malaysia, Thailand, and Korea.

Section 3.4 - Import of Petroleum Products

Material Balance Approach to estimate demand for POL imports for India

In India, efforts to indigenize the dependence on POL were intensified in the aftermath of the first oil shock. Thereafter, domestic production has accounted for around 30 to 50% of final consumption except in the eighties, when the self sufficiency ratio (domestic production as a proportion of final consumption) rose to 60 to 70%.

From early fifties onwards, a geographically dispersed domestic refinery base has been built up with a view to economizing on the higher foreign exchange outgo associated with imports of finished products relative to crude. Consequently, an assessment of the economy's requirements of imports needs to take into account the interaction between final consumption, domestic production and refinery throughput.

Domestic Consumption

Domestic demand is primarily driven by domestic activity that is usually product and user specific. Accurate estimates of the responsiveness domestic demand to aggregate activity are not readily available in Indian context primarily due to lack of information on domestic demand. In the face of foreign exchange constraints, behavior of international prices, policies for inter fuel substitution etc., domestic demand is subjected to rationing, so that consumption is kept lower than demand. In view of this shortcoming, consumption data is generally used as a proxy for domestic demand, running the risk of obtaining an identity. In general, domestic consumption moves closely with or higher than activity levels in spite of rationing. Most studies of oil demand suggests that demand for oil is income elastic; with stable prices the demand for oil will grow faster than income. Price elasticity is either low or insignificant.

Domestic Crude Production

The magnitude and timing of imports of POL is determined on the one hand, by the behavior of domestic consumption, smoothed as it were by the policy regime, and on the other, by the performance of domestic production.

Efforts to achieve self sufficiency in POL by augmenting domestic output of crude oil have witnessed alternative phases of growth and stagnation. The first phase of growth that came in the wake of the first oil shock and extended up to the end

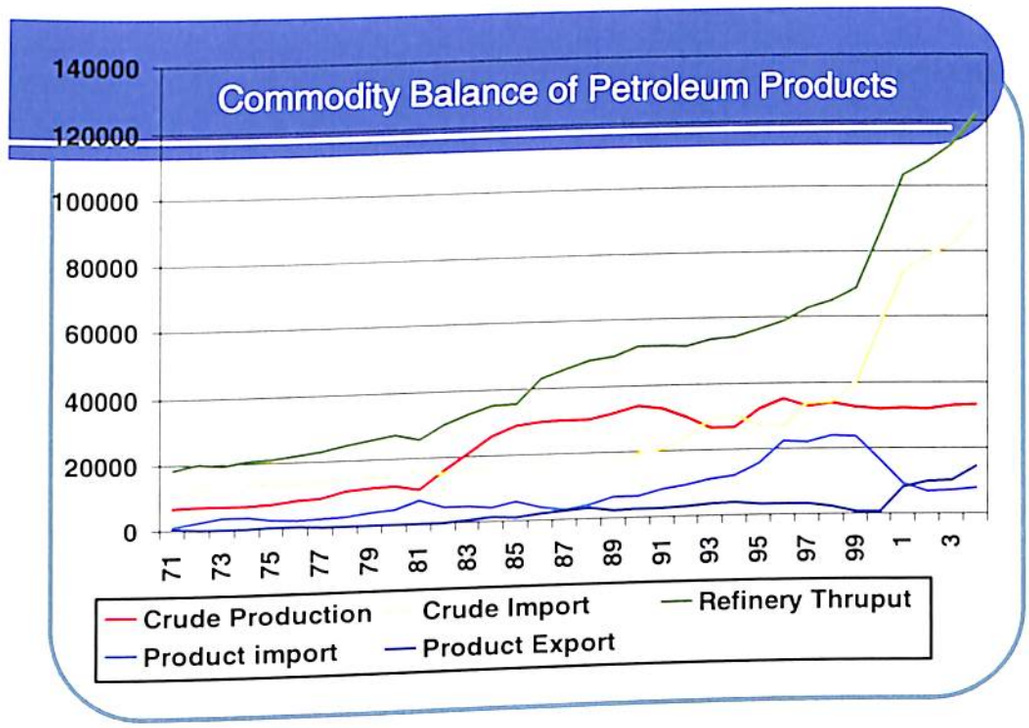
of the seventies was driven by successes of onshore exploration program. The second phase beginning in the early eighties up to the end of the decade was mainly due to the discovery of Bombay High supported by improvement in utilization of other wells. In the nineties, there has been a prolonged period of plateau of domestic production with absolute decline in certain years.

Refinery Production

Refinery activity plays a critical role in the material balance matrix and affects the composition of imports as between crude and products. Cost considerations associated with self reliance in this strategic material and the foreign exchange constraints together determine the policy choice for the scale of refining operations in India. The size of indigenous refining capacity sets the limit on the volume of imports of crude for the country, given the level of domestic production. Since the eighties, refinery capacity has been fully utilized up to situation of over utilization in the nineties. Refining capacity also influences the volume of imports of products that essentially falls out of the material balance calculus as a residual after refinery production has been matched against the domestic consumption requirement. Refinery production involves processing and consequently, refining production varies between 93 – 94% of the refinery throughput, i.e., the input crude fed in to refinery industry.

Figures of import of crude oil and petroleum product are presented in Table 3.1 and 3.3 above in this chapter.

Exhibit - 4



***1999** – Refining capacity jumped from 68 to 86 MMT, creeping augmentation thereafter.*
***2001**- Export of POL products soared from 0.7 to 8.3 MMT, increasing thereafter on a sustained basis.*

Section 3.5 - Oil Security for India

3.5.1 The Deficit Context of Oil Security

Uninterrupted supply of fuel is a cause for concern for all countries. More so for a country like India, whose import dependence is 75% of total consumption! Security measure is basically to insulate the country from shock arising from sudden and unanticipated disruption in supply. By definition, security measure is a defense mechanism, requiring perpetual preparedness. Security is a balancing act; it is a rational choice amongst multiple options; short term and long term. Security has a cost implication. Therefore very high degree of security measure may be cost prohibitive.

Oil security in Indian context would mean:

- uninterrupted availability of petroleum products to meet unrestricted demand
  Exposure: 116 MMT demand – 33 MMT indigenous crude productions
- uninterrupted availability of Crude oil for refineries to run up to full capacity
  Exposure: 127 MMT refining capacity – 33 MMT indigenous crude production

Measures to ensure security in oil has two sides:

Demand side security measures

1. Conservation in use of oil,
2. Commercial exploitation of non-fossil renewable energy,
3. Availability and rational use of alternate form of energy like power and coal

Supply side security measures: 3's

1. Source
2. Shipping
3. Storage

India's geo-stationary position is endowed with following favorable features from the point of view of source of crude oil and refined products:

- India is positioned in close proximity to Middle East on the one hand and Asia Pacific on the other. The world's largest reserve of oil and gas lies in Middle East Region. It is here that the production cost of crude oil is the lowest. Sailing time of a loaded vessel from Middle East and Asia Pacific to India is 4 to 6 days. While Middle East produces High Sulfur Crude, the Asia Pacific produces Crude with low sulfur.

- Second strategically alternative source for India is West Africa (Nigeria, Libya, Sudan, and Egypt).

- Third source, which is of latest development, is oil from Russia and Caspian basin.

The Gulf Region has unfortunately been in the vortex of considerable instability and insecurity for more than 25 years, witnessing the eight year long Iran – Iraq war in 1980s; the first Gulf war in 1991; prolonged period of sanctions, no-fly zones and inspection against Iraq all through the 1990s; and finally the fall out of September 11 and the US led war on Iraq in 2003.

Despite this environment of instability and violence, the region has generally been able to maintain the oil and gas supplies required by India. However, from a

geo-political perspective, India cannot ignore the possibility of large scale violence which could seriously disrupt supplies. Hence prudent oil security policy requires that sources are diversified.

As strategy, India need to have diplomatic and commercial dealings with all the above sources, so that in case one source becomes inaccessible for any reason, the other sources can be tapped without much interruption.

3.5.2 External Dimension of Oil Security

'An important component of this effort is the external dimension which is made up of the following: (i) acquisition of assets abroad. This consists of two approaches: (a) acquiring equity participation in developed fields, and (b) obtaining exploration and production contracts in different parts of the world; (ii) entering into long term LNG supply contracts; (iii) pursuing transnational gas pipeline proposals; and (iv) promoting partnership with foreign entities in the downstream sector; both in India and abroad.' (Ahmad, 2005)

'India's external hydrocarbon strategy is being implemented in a highly competitive international environment which is made up of international and national oil majors contending vigorously for assets in the few new areas in which they are available, i.e., in the Caspian, in Western and Central Africa, and in some parts of Latin America, while consolidating their presence in the Gulf. This effort is currently being mounted in an oil market that has seen prices reach new heights, in turn generating a frenzied environment, with international companies offering billions of dollars for assets that have acquired even undue value because of the high oil prices.' (Ahmad, 2005)

3.5.3 Asian Premium

Oil diplomacy is being used to address the issue of 'Asian Premium'. The 'Asian Premium' is the observed difference between the price of crude oil sold into Asia, compared to the other two main consuming areas – the United States and Europe. Since 1997, the formula prices of Arabian Light into Asia have averaged a premium of $ 1 -1.50 per barrel, while formula prices to Europe and the USA have remained roughly similar.

The premium owes its origin to the aftermath of the 1986 price collapse. The Saudi formula prices (at least notionally) were determined in the market place and were based on various spot prices. Three pricing areas were introduced: deliveries to the USA based upon Western Texas Intermediate (WTI); deliveries to Europe based upon Brent; and deliveries to Asia based upon an average of Dubai and Omani crude. However for each formula price, 'adjustment factors' were applied, the details of which were not published and not generally known.

The Asian Premium is understood by reference to 'discriminating monopoly' and 'limiting pricing'. As part of the introduction of formula pricing, Saudi Aramco imposed destination clauses on crude sales and refused to allow spot sales. This was the key mechanism to keep markets physically separate. Without destination clauses, the Asian 'limit price' would be the European price plus any additional transportation costs. Most of the other Middle East crude suppliers have limited ability to sell more crude into Asia. They are limited by the amount of crude they can shift from Europe to Asia in response to price differentials. By contrast, Saudi Arabia with its very large excess capacity can easily meet additional demand from Asia, albeit within the context of OPEC quota. Thus again, this inability to switch between markets strengthens the ability of Saudi Arabia to keep the markets physically separate.

However, the real key is the difference in demand elasticity between the Asian and the US and European markets. The USA and Europe face a variety of crude suppliers willing and able to supply crude oil, compared to Asia. Asia is obsessed by the issue of supply security and will pay a premium for what it sees as secure supplies of crude oil. Specifically, the bulk of the crude purchased is done on the basis of term contracts rather than spot contracts. Asian buyers are unwilling to risk the vagaries of the spot market and fear that they will be unable to secure refinery input.

Also there is much more scope for 'limit pricing' in Asia than in the USA or Europe. Whenever Saudi Arabia sets its formula price for Asia, it is risking that it can set it at a level which will not drive away buyers or attract competition from other sources. Asia demands term contracts. Because alternative suppliers are very few, the 'limit price' is higher than in the USA or Europe, where attempts at over pricing will produce a rapid and effective competitive response from buyers and other suppliers. The difference is the Asian Premium.

Policy solutions have been advanced to Asian buyers (India is one amongst them) to avoid paying premium by means of competition. (Stevens, 2005) Asian buyers could develop strategic stocks to get confidence to move away from dependence on term contracts. They could also encourage crude oil from other suppliers to enter the region; most obviously encourage pipeline supplies from Russia. Improving the competitive nature of crude and product markets in Asia would further assist the process. Many national oil markets in Asia retain strong elements of regulation and government interference. Regionally, Singapore is the only spot market in Asia and compared to its US and European counterparts, the volume of trading is small. Greater entry into world oil markets would further undermine the ability of the Middle East exporters to impose the Asian Premium. As for the Saudi policy dimension, the key is its willingness and ability to impose destination clauses in its sales contracts. It is not clear why they would be willing to undermine a system which is worth a very large amount of revenue. However, a key will be Saudi's entry to the World Trade Organization (WTO), since it

seems very likely that the WTO would have serious problems with such destination clauses.

3.5.4 Global & Neighborhood Concern for Oil Security

India's quest for oil security has to be seen in the context of global concern for energy security and the impact of China's energy policy.

Structural Imbalance in Global Oil Market

World oil consumption has increased dramatically in the past few decades, nearly doubling between 1970 and 2002. This trend is expected to continue, with growth projections of an increase in demand from 78 million barrels per day in 2002 to 119 million barrels per day in 2025. This increase in oil demand will undoubtedly place an increasing strain in global supplies, requiring large increases in oil production (approximately 42 million barrels per day over the 2002 levels).

World's total oil and gas reserves and production, as presented in Table 3.7 below, shows that there is only a marginal increase in both.

Table 3.7: Worldwide Oil and Gas Reserves and Production

Estimated Proved Reserves				Oil Production			
January 1, 2006		January 1, 2007		Producing oil wells	Estimated 2006 (1,000 b/d)	Change from 2005 (%)	Actual 2005 (1,000 b/d)
Oil (1,000 bbl)	Gas (bcf)	Oil (1,000 bbl)	Gas (bcf)				
1,317,447,415	6,182,692	1,292,549,534	6,112,144	807,172	72,486.5	0.2	72,361.6

Source: Radler (2007)

Furthermore, oil supply sources have become increasingly concentrated in the hands of few exporters, primarily led by the members of Organization of Petroleum Exporting Countries (OPEC). The world's oil reserves are concentrated in the sedimentary basins of the Middle East such as Gulf States, (65% according to OPEC 2003 data or 70% according to USGS, 2000). Gulf States producers accounted for 24.7% of the world oil supply in 2005 and are expected to provide 51.8% of world oil production in 2030. Therefore, oil from the Gulf States is very important to USA, European Union and Asia Pacific in energy supply strategies. Global oil demand will rise from 84 million barrels per day (mbd) today to 121 mbd in 2030. North America will import 75% of total oil in 2020, EU will import 90% of total oil in 2030 and Asia Pacific oil dependence will rise to 78% in 2020.

This concentration will likely continue in the coming decades, increasing the dependence on imports for many countries, such as US, China and India. OPEC members are expected to be the major suppliers of increased oil demand, though substantial increases are also expected to come from the Caspian, Western Africa and Latin America. Thus, increased concentration of exports, combined with limited global excess capacity will make all importing countries more vulnerable to price shocks and increase the overall sense of global energy security.

There are several security elements affecting the continuous flow of oil from the Gulf region. International competition, wars and conflicts, mistakes made in security enhancement and radicalism leading to terrorist acts in the Middle East are affecting the oil supply. Some possible long term solutions have been advanced by Sen, 2007.

It is very significant to note that United States has taken a task upon itself to play a leading role in addressing the world's energy challenges and ensuring adequate and reliable supplies of affordable and market priced energy. (USDE, 2006)

Steps taken by China for Oil Security

Over two decades of market oriented reforms in China have resulted in large increases in per capita incomes, significant poverty reduction, a substantial rise in private sector activity and growing integration into the global economy. Since 1978, China's economy has grown about 9 percent a year, fueled by freeing market forces, opening to outside investment and exports. In 2004, China's GDP grew at 9.1 percent. China is now world's seventh largest economy, the world's third largest trading nation and a major destination for foreign direct investment (FDI). To sustain that growth, China is increasingly engaged with the rest of the world to secure oil. China is the world's second largest oil consumer after the United States (India's position is sixth). China became a net importer of oil in 1993, after years of growth in consumption and stagnant production. Ever since then, its import dependence is growing each year. For example, in 1993, China only imported 1% of its total oil consumption. By 2004, approximately 48% of China's oil consumption was imported, leaving China with an import dependency of approximately 3 million barrels per day. China's oil consumption is estimated to reach 14.2 million barrels per day in 2025, out of which 10.7 million will be imported.

As China became more dependent on imported oil, it has sought to acquire interests in overseas exploration and production. Chinese oil companies have invested in Kazakhstan, Venezuela, Sudan, Iraq, Iran, Peru and Azerbaijan. This raises concern for other oil importing countries in Asian region that actions by

Chinese companies to acquire energy assets will segregate energy resources from the competitive market, which might restrict supply and thereby raise prices.

There are striking examples of China undertaking aggressive diplomatic initiatives; some recent examples of which are given below:

In February 2004, President Hu Jintao visited Egypt, Gabon and Algeria. Following the visit, PetroChina signed petroleum investment agreements with Egypt and Algeria while Sinopec started importing oil from Gabon for the first time.

Also in 2004, President Hu Jintao visited Kazakhstan and established a strategic partnership between the two countries through a joint communiqué. Hu's visit directly helped the two countries reach the agreement to build the Kazakhstan-China oil pipeline.

During the visit of Premier Wen Jiabao to Russia in 2004, a key agenda item was Russia's Far East oil pipeline.

In January 2005, China and Canada issued a 'Statement of Energy Cooperation in the 21st Century', which said, "China and Canada have decided to work together to promote cooperation in the oil and gas sector, including Canada's oil sands, as well as the uranium resources sector." The two nations will encourage their respective enterprises to expand upon their commercial partnerships.

In April 2005, China and India pledged to cooperate on upstream development in foreign countries, the first such agreement between these two neighbors to be reached in decades.

In December 2005, OPEC President Sheikh Ahmad Fahd al-Sabah visited China to engage in talks regarding world energy markets and meeting China's future energy needs.

In addition to state visits and high level diplomacy, the Chinese government is also promoting bilateral ties by making soft loans and other types of assistance in countries where China has been promoting energy and other investments through state companies. In 2004, China provided a 17 year, $ 2 billion oil backed loan to the Angolan government that will be used to rebuild national infrastructure ravaged by years of civil war. The agreement provides China with crude in return for credit and also opens the door to possible future exploration prospects.

China has also launched closer relations with Cuba. A few months after President Hu's visit to Havana in November 2004, where China signed a memorandum of understanding that essentially committed over $ 500 million

investment in Cuba, Sinopec signed an agreement with Cuba's state run Cubapetroleo (Cupet) to jointly produce oil in Cuba.

China has also supplied direct infrastructure development to many producer countries, undertaking such projects as port facilities in Gabon, railways in Nigeria and a metro system in Iran.

With Sudan, which is among the top five oil exporters to China, Chinese state oil companies have concluded a few exploration and production contracts in recent years.

Even a country like US is 'working internationally to create expanded energy partnership with major consuming and producing countries. These partnerships are designed to improve energy security globally through domestic energy resource development, increasing the use of clean fuels, improved legal and regulatory regimes, increasing private investment, diversifying resources to include alternative and renewable energy sources and helping the developing countries and growing economies to be more efficient producers and consumers of energy.' (Pumphrey, 2006)

India's latest follow up on oil diplomacy

Taking a leaf out of Chinese oil diplomacy, Mr. Murli Deora, the Union Minister for Petroleum and Natural Gas, visited Saudi Arabia in May 2007 to lobby for Indian public sector oil companies in their quest for deals in West Asia. The minister was in West Asia to drum up support during the second Asian Ministerial Energy Roundtable and specifically for leveraging the Indian government's diplomatic influence for ONGC Videsh Ltd's (OVL) interests in Iraq, the bid by the consortium of Indian Oil Corporation (IOC), OVL and BP for development of Kuwaiti oil fields, investment by Kuwait in the grass root refinery projects at Paradip (Orissa), Bathinda (Punjab) and Bina (Madhya Pradesh), and the participation of GAIL (India) Ltd and Engineers India Ltd in projects in Qatar. West Asia holds the key to energy security for India, the world's fifth largest oil importer.

Energy supply deficits in East Asia are a cause of concern for the growing economies of China, India, Japan and South Korea. In 2006, the Asia-Pacific demand was 15.6 million barrels per day (BPD) compared with local crude and gas production of 6.85 million BPD. India's consumption of petroleum products is around 112 million tonnes per annum. Minister's visit holds a lot of importance as West Asia supplies around 70% of the Asian oil consumption. This calls for cross-investments in energy markets to promote shared interest of energy producers and consumers and in such a situation, India's long-standing good relationship with the Emirates could be leveraged in its favor. OVL had signed an exploration and development contract for 100% participating interest in exploration of Block 8 in the western desert of Iraq with the Oil Exploration

Company of Iraq. However, the seismic survey could not be carried out due to the volatile political situation in Iraq that led to war with the US. The Indian government now wants the validity of the contract to be maintained and ratified by the new US-installed Iraqi government. In Kuwait, two public sector firms—IOC (with a 10% stake) and OVL (5% stake)—have in a consortium along with BP (lead promoter with a 65% stake) and Occidental (25% stake) jointly bid for the development of four northern Kuwaiti oil fields of Raudhatain, Sabriyah, Ratqa and Abdali. However, the consortium faces stiff competition from Chevron Texaco and Exxon Mobil. In such a situation, the Indian government wants to use the diplomatic lever to swing the deal in the consortium's favour. The Indian government is also seeking Saudi Arabia's participation for the grass-roots refinery projects that are coming up in India. India also wants the Oman government to allow IOC to import 0.5 mt of crude oil from the Emirates. Earlier, IOC had been rebuffed when it approached the Oman government to supply crude oil—the former claiming that it had prior commitments.

Government of India is embarking upon an energy diplomacy program to deal with all areas of energy by setting up a dedicated cell in the external affairs ministry. The cell will identify ways to enhance diplomatic relationships with other oil consuming and producing countries as India tries to win multi-billion contracts in Russia's Sakhalin and hydrocarbon blocks in Africa. It will also look to resolve contentious transnational gas pipeline issues among other things.

The move comes close on the heels of India having lost prestigious projects to China in Kazakhstan, Nigeria, Angola and Myanmar. The cell, to be headed by an additional secretary-level official, will also act as a coordinator of technical issues that are being pursued by other ministries, such as petroleum and natural gas, coal, power and the department of atomic energy. It will also push the agenda on an integrated energy policy for the country. Energy security is a key to sustaining 8%-plus economic growth. India is leveraging its long-standing relationship with Russia to acquire a stake in Sakhalin-III. India already has a 20% stake in Sakhalin-I through ONGC Videsh Ltd, and is studying options to bring its share of gas to India through a swap deal with Japan.

Another project India is pursuing is the Turkmenistan-Afghanistan-Pakistan-India pipeline. The main issue here is of security as the pipeline passes through Afghanistan and Baluchistan (Pakistan), both routinely unstable areas. The deals that India has recently lost to China include the H1 and H3 offshore hydrocarbon blocks in Myanmar. India also failed to acquire a stake in Petro Kazakh, Kazakhstan's national oil firm, which went to China's National Petroleum Corp. Chinese companies also beat Indian firms in Angola and Nigeria. Indian firms lost in Angola because they couldn't match the Chinese' offer of a $2 billion soft loan. In order to sweeten hydrocarbon deals, China has used its permanent membership at UN Security Council where it has a veto power. Some experts attribute its recent win in the Myanmar deal to this clout. India is now following the Chinese model of going beyond commercial considerations, although it is

taking a different path. For instance, NTPC Ltd offered to build power-generation projects in Nigeria in lieu of a gas block there. India has also offered to develop infrastructure networks like railways in Angola. With Indian firms starting to acquire coal mines abroad for importing coal, the cell could help with the negotiations. Coal India wants to buy mines in Australia and Africa, and Tata Power recently bought a stake in Indonesia to import coal for its Mundra project.

3.5.5 Associated Measures for Oil Security

Shipping

Shipping is by far the weakest link in meeting the emergency situation in a cost-effective manner. India is ill equipped to handle ships of larger size, largely due to inadequate port facilities and low tankage.

'Sakhalin I' is India's largest overseas investment, done by OVL. It has had its commercial production just for last one year and the first consignment of equity oil, 90 TMT from 'Sakhalin I' has reached MRPL. Shipping Sakhalin crude to India directly is a complicated logistics issue. The shipment will have to pass through the congested Malacca Straits, clogged with tankers ferrying energy to Japan, China and South Korea from the Persian Gulf and other parts of the world.

Port facilities have to be created to handle VLCC. May be off-shore floating storage like LOOP (Louisiana Off-shore Oil Platform) in the US Gulf coast or Fujairah in Persian Gulf are to be developed.

Storage

Strategic storage for both Crude and Products has to be created to enhance emergency response mechanism. This can be shared with regional blacks like SAARC and ASEAN countries like SRP among countries of IEA.

Other measures

A strong financial strength of the country is the best security to meet any disruption. Specially, foreign exchange reserve of India, India's export earning and India's trading share in the international market are important parameters to shield India against any kind of disruption.

Investment environment in the country and fiscal system attracting foreign capital for exploration and extraction of Crude in deep sea area are also important factors contributing to India's self reliance on oil consumption.

Indian companies should be encouraged to acquire equity in overseas oil fields, either independently or in collaboration with local NOCs. Domestic companies should also be encouraged to have trading both in physical and paper market, which would provide easy access to oil, when required in emergency.

3.5.6 Energy Efficiency & Management

In the backdrop of high energy demand and import dependence, energy efficiency and management has a critical role to play. The aim of energy management is to achieve organizational objectives at minimum energy consumption.

Three key principles of energy management are:

- purchase energy at the lowest available price
- manage energy consumption at peak efficiency
- utilize the most appropriate technology

Within these principles lies a complex matrix of knowledge and skill requirements. For example, managing energy consumption at peak efficiency can involve activities ranging from auditing, to specifying retrofit measures and analyzing the resulting return on investment, to monitoring and targeting, to conducting employee and tenant awareness educational programs, and more.

The skill set for energy management includes technical knowledge of contemporary energy systems and energy rate structures, analytical techniques for assessing energy use, financial management methods for evaluating energy efficiency investments, and social marketing skills for building organizational commitment.

The primary aim of energy management is to gain control of consumption and costs by assessing current use, and by taking steps to incorporate energy efficiency into the corporate culture. This often involves:

- Identifying, and quantifying organization's major users of energy
- Reviewing energy purchasing strategies - the fuel and billing rate structure choices - to make sure that the most appropriate energy sources are being exploited and that they are being bought at the right prices
- Assessing operating practices; namely heating plant, lighting and ventilation control strategies to ensure that existing plant and equipments are operated at maximum efficiency
- Motivating and training practices - energy awareness - raising campaigns and training programs for all individuals and groups whose actions can affect consumption

Energy management can be described by five distinctive steps - each containing a number of smaller steps. The five steps are reiterated during the lifetime of the system.

(i) Energy Policy:
The energy policy defines the overall guidelines for the efforts to achieve greater energy efficiency. It is established and maintained by the top management of the company.

(ii) Planning:
The company reviews all energy aspects to form an overview of the significant energy consumption i.e. the machinery, equipment and activities which account for the highest energy consumption or which offer the most considerable potential for energy savings. The review forms the basis for determining the order of priority of the energy saving efforts. Concrete energy targets are set complying with the overall energy policy.

(iii) Implementation and Operation:
The company involves the employees in the implementation of the objectives and makes sure better use of energy becomes a part of their daily routines. This includes introducing procedures for energy conscious purchasing, operation and maintenance of equipment with significant energy consumption, energy efficient design activities etc.

(iv) Checking and Corrective Actions:
The company monitors and measures the significant energy consumption and all activities with a significant impact on energy aspects. Corrective and preventive actions are taken in case of non-conformance.

(iv) Management Review:
The top management periodically evaluates how the implementation of plan, objectives and operational control is proceeding to ensure its continuing suitability. The management review must address the possible need for changes of the elements of the energy management system, in the light of the commitment to continual improvement.

Two organizations in our country are carrying out pioneering works in improving energy efficiency in industries.

- Bureau of Energy Efficiency (BEE), which is a statutory body under Ministry of Power, set up in 2002, under Energy Conservation Act 2001

- Petroleum Conservation Research Association (PCRA), which is a registered society under Ministry of Petroleum & Natural Gas, set up in 1978

Bureau of Energy Efficiency (BEE)

Energy Conservation Act provides the necessary legal and institutional framework to enable the government to rapidly promote efficient use of energy and its conservation in different sectors of the economy. BEE is enjoined with the responsibility to implement the Act.

The mission of BEE is to institutionalize energy efficiency services, enable delivery mechanism in the country and provide leadership in energy efficiency in all sectors of the country. The broad objectives of BEE are to:

- Exert leadership and provide a policy framework and direction to national energy conservation activities and efficiency programs;
- Coordinate policies and programs on efficient use of energy with stakeholders;
- Establish systems and procedures to measure, monitor and verify energy efficiency results in individual sectors as well as at the macro level;
- Leverage multilateral, bilateral and private sector support in implementation of the Energy Conservation Act;
- Demonstrate delivery of energy efficiency services as mandated in Energy Conservation Act through public private partnership; and
- Interpret, plan and manage energy conservation programs as envisaged in Energy Conservation Act.

On the basis of the above objectives, BEE has developed action plan consisting of ten thrust areas. Among those ten thrust areas are: Industry Program for Energy Conservation, Demand Side Management, Energy Efficiency in Buildings and Establishments; Energy Conservation Building Code and Labeling Program.

Energy Conservation Building Code (ECBC) 2006, developed by BEE with support from International Institute for Energy Conservation (IIEC) was launched in 2007. ECBC has provision for:

- Building envelopes, except for unconditioned storage spaces or warehouses;
- Mechanical systems and equipment, including heating, ventilating and air conditioning;
- Service hot water heating;
- Interior and exterior lighting; and
- Electrical power and motors

Further, for the above systems, various options for energy conservation have been identified as 'compliance options'. There are some mandatory provisions for each of the building systems and there are prescriptive options. The compliance options which are of prescriptive type, project implementer

can analyze feasibility of different options in terms of cost and energy saving and opt for feasible options.

BEE's another major assignment as per the Act is 'Standards and Labeling'. The powers and functions regarding standards and Labeling of BEE are:

- Notifying specified equipment and appliances;
- Directing mandatory display of label on notified equipment and appliances
- Specifying energy consumption standards for notified equipment and appliances not conforming to standards
- Prohibiting manufacture, sale, purchase and import of notified equipment and appliance; and
- Developing, testing and certification procedures and promote testing facilities for certification and testing of energy consumption of equipment and appliances

Enforcement of rules and regulations for energy efficiency framed by BEE, including those related to standards and labeling, rests with the Central Government through issuance of notifications and other means. However, BEE is empowered to make regulations on matters specified in the Act, including the particulars to be displayed on label and the manner of display.

BEE has identified energy intensive industries and is seriously engaged in conducting R&D and audit activities for those industries. In a path breaking work, BEE has documented process, equipment design and tips for those industries like: Aluminum, Chemicals, Drugs and Pharmaceuticals, Glass, Mining, Power, Tea, Automobiles, Fertilizers, Railways, Paint, Port Trust, Textiles, Buildings, Dairy, Forging, Iron & Steel, Petrochemicals, Pulp & Paper, Tyre, Cement, Distillery & Brewery, Jute, Plastic and Sugar.

BEE identified equipment and appliances to be covered by the Standard and Labeling program based on the set of criteria. Those criteria include energy intensity, contribution of electricity usage in the specified category and the potential for savings, in terms of energy consumption and against total peak energy demand. On this basis, BEE prepared a list of equipment and appliances, ranging from pure consumer appliances like refrigerators, single unit room air conditioners, electric water heaters to agriculture pumps set up to 15 kw, industrial fans and blowers and air compressors up to 100 kw and electric light sources, control gears and luminaries.

BEE conducts National Energy Conservation Awards to various industries and energy users under several categories. The best practices followed in the awarded company set a kind of benchmark in that industry and applications, which have been documented for others to follow. These awards are highly publicized and over a period of time have become very popular.

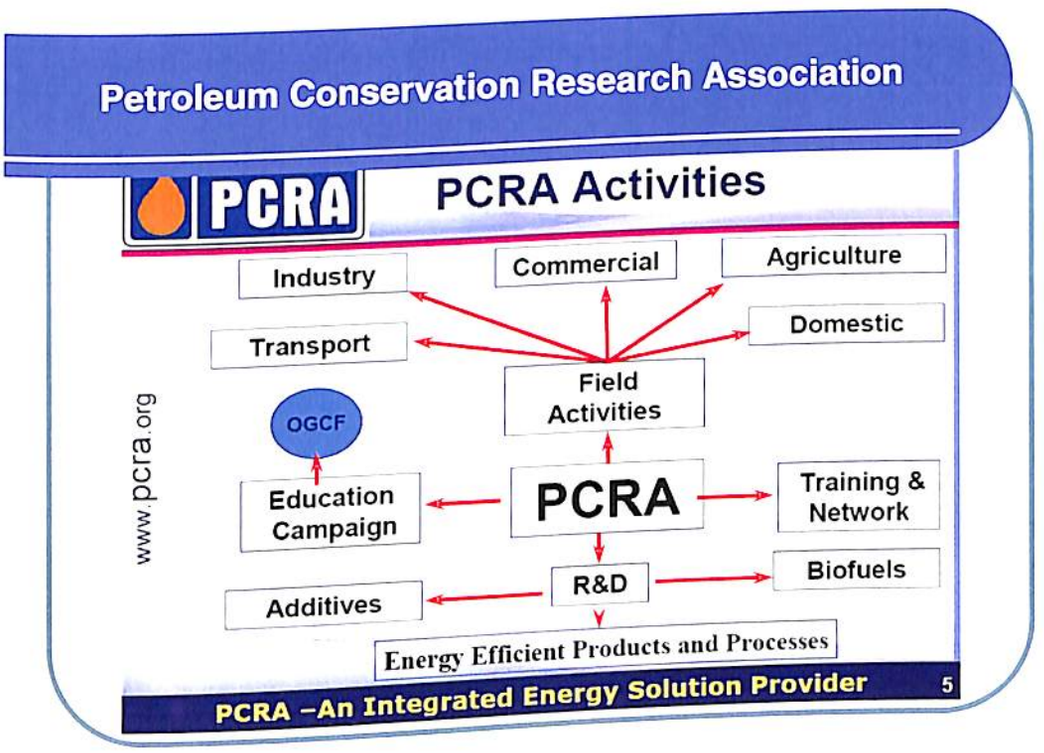
To create awareness in the public, BEE also conducts painting competition on energy conservation amongst school children on a national scale.

Petroleum Conservation Research Association (PCRA)

PCRA is engaged in promotion of energy conservation schemes in sectors like: industrial, transport, agriculture and domestic. Apart from conducting mass awareness programs, PCRA has sponsored R&D projects aimed at:

- Development of fuel efficient appliances
- Development of fuel efficient technologies and processes
- Energy efficient improvements by retrofitting and modifications
- Development of instruments for energy efficiency monitoring
- Testing of additives / devices / appliances for fuel economy and emission reduction
- Inter fuel substitution and promotion of renewable sources of energy

Exhibit - 5



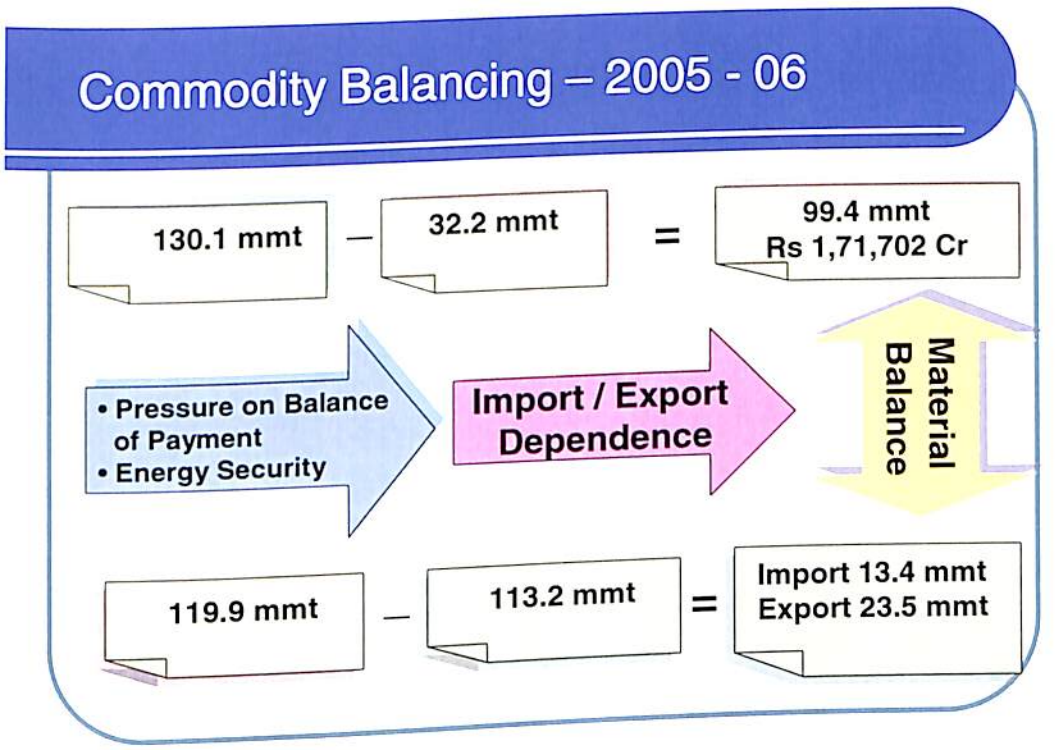
One of the significant jobs that PCRA has undertaken is promotion of bio fuels. PCRA is nominated as nodal coordinating outfit of Ministry of Petroleum and Natural Gas for conducting mass awareness program for dissemination of information on bio diesel.

PCRA has opened a national bio-fuel centre as a nodal information centre on bio diesel. PCRA has launched a dedicated website on bio diesel: www.pcra-biofuels.org. PCRA conducts seminar and other knowledge disseminating forums on bio-diesel.

PCRA has undertaken significant actions towards urban energy management. This has attempted to improve the urban living conditions by undertaking such initiatives which includes improvement in energy utilization efficiency, infrastructure planning, environmental quality and resource management.

Summary

Exhibit - 6



- Refining is 76% import dependent
- 20% refined product is exported
- Commodity balance in India is a dynamic phenomenon

To summarize, India is self sufficient in oil by 25%. Options to ensure energy security for high consuming countries like India are:

- A long term energy strategy based on assessment of the composition of energy consumption and energy balance
- Incentive to develop energy saving and substitute technologies, particularly renewable energy sources
- Upgrade the indigenous exploitation of oil and gas resources
- Acquire overseas energy sources and amplify the effects of energy diplomacy.
- Develop strategic infrastructure like storage and port facilities to handle large parcel size of crude oil and products.
- Use monetary and fiscal instruments to align oil economy with national economic agenda.

Oil security is a multifaceted issue. Oil Industry and the Government together are taking care of the oil requirement of the economy. Besides being an economic issue, this has strategic and diplomatic angles, which have been dealt in this Chapter.

Recap: Chapter III

Crude Oil import took a quantum jump in 1999-2000, from 40 MMT in 1998-99 to 57.8 MMT in 1999-2000 and further to 74 MMT in 2000-01, as Reliance refinery at Jamnagar came on steam in 1999.

Rs 40,000 crores was spent in crude oil import in 1999-2000 against Rs 15,000 crores in 1998-99, which was further heightened to Rs 66,000 crores in 2000-01.

During 2006-07, Indian refineries processed 146.55 million tonnes (2.94 million bpd) of crude, up from 130.1 million tonnes (2.61 million bpd) in the previous year.

During last 5 years, (2000-01 to 2004-05), India earned Rs 14,300 crore per year on average from export of petroleum products, constituting 5% of India's export earnings. In 2004-05, the export realization was in fact Rs 28,386 crores, constituting 7.8% of India's total export earnings.

The 'Asian Premium' is the observed difference between the price of crude oil sold into Asia, compared to the other two main consuming areas – the United States and Europe. Since 1997, the formula prices of Arabian Light into Asia have averaged a premium of $ 1 -1.50 per barrel, while formula prices to Europe and the USA have remained roughly similar.

The world's oil reserves are concentrated in the sedimentary basins of the Middle East such as Gulf States, (65% according to OPEC 2003 data or 70% according to USGS, 2000). Gulf States producers accounted for 24.7% of the world oil supply in 2005 and are expected to provide 51.8% of world oil production in 2030. Therefore, oil from the Gulf States is very important to USA, European Union and Asia Pacific in energy supply strategies. Global oil demand will rise from 84 million barrels per day (mbd) today to 121 mbd in 2030. North America will import 75% of total oil in 2020, EU will import 90% of total oil in 2030 and Asia Pacific oil dependence will rise to 78% in 2020.