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Acronyms Used

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT</td>
<td>Metric Tonne</td>
</tr>
<tr>
<td>MMT</td>
<td>Million Metric Tonne</td>
</tr>
<tr>
<td>MMSCMD</td>
<td>Million Standard Cubic Meter Per Day</td>
</tr>
<tr>
<td>NELP</td>
<td>New Exploration Licensing Policy</td>
</tr>
<tr>
<td>SKO</td>
<td>Straight Run Kerosene Oil</td>
</tr>
<tr>
<td>NG</td>
<td>Natural Gas</td>
</tr>
<tr>
<td>MoPNG</td>
<td>Ministry of Petroleum and Natural Gas</td>
</tr>
<tr>
<td>MNRES</td>
<td>Ministry of New and Renewable Energy</td>
</tr>
</tbody>
</table>
From a year back, India’s energy sector has seen notable progress on the policy and reforms front. While in some sectors the policy initiatives have moved forward, in others actual private participation has also made progress.

In the coal sector, the process for allocation of coal mines for captive use has already commenced and the bidding process for thirty-eight (38) coal fields with mineable reserves in excess of 2800 MMT has already been initiated. These are for consumers in the power, steel and cement sectors which are identified sectors for captive mine allocation. In the recently announced Union Budget in February 2007 captive mine allocation has been extended to underground coal gassification and coal liquefaction projects as well. These potentially represent a large opportunity since less than 20 percent of India’s estimated coal reserves of over 300 billion tons is considered extractable through current technology leaving the balance energy reserves to be extracted through alternative means such as in-situ coal gassification.

A lot of private sector interest is now seen in the coal sector and we have seen cases of investments by private equity players in coal value chain. Access to coal resources (either captive or through a contracted linkage) combined with presence in power generation such as in merchant power is a potentially lucrative combination.

On the oil & gas sector, a significant development has been the passage of the Petroleum and Natural Gas Regulatory Board (PNGRB) Bill in Parliament. An important feature of this bill is setting up of an independent regulatory for midstream and downstream activities and to promote competition in the oil and gas sector. Among the other events in the past year, bidding for oil & gas blocks under NELP – VI was successfully carried out and 65 blocks were awarded. Recognising that India could emerge as an export hub for refinery products and also to meet the emerging stringent environmental norms for petro-products, significant investments have been made by the oil majors to increase the complexity of the refineries.

On the Gas Sector, the Government appointed committee to decide on pricing for Production Sharing Contracts (PSC) has ruled that where prices have been determined through a transparent competitive bidding process, there is no need for the Government to intervene. The Government has also issued a pipeline policy that aims to promote open access and competitive bidding in construction of new pipelines.

On the Nuclear Energy front, significant progress has been made in the last year with the agreement between President Bush and Prime Minister Manmohan Singh on Indo-US nuclear co-operation. There are still some points which need to be sorted out and the agreement has to be ratified by the legislature, but once this goes through we expect to see rapid action on this front. The Atomic Energy Act is expected to be modified shortly allowing private participation and
anticipating this many large Indian and international players have started
discussions for possible tie-ups.

Renewable energy is another segment which has seen significant action. Wind
energy companies have shown robust growth and some alliances and
transactions have also emerged in this space between global and Indian
companies. Looking at the success of existing players, many new entrants are
waiting in the wings to enter and looking for technology partners for the same.
Solar energy is another area where interest has emerged. We have seen
technology transactions and alliances taking place in the last one year in this
space too. This is also an area where a lot of private equity interest in being seen.
Going forward, we expect this sector to see lot of action.

In the power sector, we have seen good progress in the last one year. The
Government has conducted the bidding process for two very large power
projects in generation each of 4000 MW size called Ultra Mega Power Project
(UMPP). One is a pit-head coal based plant at Sasan and this was allocated along
with a captive mine. The winning tariff was INR 1.19/kwh (2.7 c/kwh). The other
one was an imported coal based coastal plant at Mundra where the winning tariff
was INR 2.26/kwh (5.1 c/kwh). Both these are projected as landmark projects in
the history of the Indian power sector and will set the course for future
generation projects. We are also seeing increasing interest in Merchant Power
Plants (MPPs) encouraged by the emergence of a power market and rising short-
term power prices and a few of them have tied up the necessary financing.

On the transmission front too, we saw a large project of approximately 1500 km
length of transmission line being awarded to the private sector through the
competitive bidding route and this process has got further encouraged by the
successes of the UMPP in generation. On the power distribution sector, private
participation through franchising has seen some action. An urban area adjacent to
Mumbai has been awarded to a private player under a franchising model and
more urban areas in Maharashtra and some other states are being planned for
private participation through franchising.

To summarise, the general theme of private participation and competition has
advanced in the past one year with some concrete examples on the ground to
substantiate it. Going forward, we expect these themes to manifest on a wider
scale.

Arvind Mahajan
National Industry Director - Infrastructure & Government
In order to fuel a rapidly growing economy, the Indian energy sector requires investments to the tune of USD 120 - 150 billion over the next five years. The imperative for private sector investment is strong in order to complement the public sector in meeting this investment requirement and to bring in the required capabilities and technologies to enhance energy resource extraction.

The Government of India has recognized the need for private participation and policies to promote private investment are being implemented. Private participation in coal mining for captive use, in oil & gas exploration and in the power sector is already seeing significant progress. It is also expected that private participation in nuclear energy would be allowed as and when the Indo-US Nuclear deal goes through.

Along with private participation, there is a move to bring in market mechanisms in the energy sector under an independent regulatory oversight. Progress has been made in sectors such as power and oil & gas where private participation is already significant. A gradual approach is important till the supply side position improves and more players enter the sector so that markets can work effectively.

In parallel, the Government is making efforts to broaden the supply base both internally and externally. It is intended to diversify the fuel basket by increasing shares of Natural Gas, Hydro and even Nuclear energy. At the same time, both Government and private sector companies are looking to acquire equity in energy assets abroad and we have seen recent examples in the oil & gas and coal sectors.

Energy transport infrastructure such as ports, railways, pipelines and power transmission networks need significant investment. The policy now allows private participation in all these areas and some private sector activity is already under way.

Tariff reform in the energy sector and distribution reform in the power sector are two important steps that need to be successfully carried out. Tariff reform to phase out subsidies or to target them effectively and distribution reforms to bring efficiency in the power sector are vital. Steps have been taken in these directions with mixed results. Going forward, this is an important area to manage.

The following sections highlight key opportunities in the different sectors:

### 2.1 Coal

India has vast reserves of coal and participation of the private sector in captive mining, across different user industries, is an immediate opportunity for investment. Thirty eight coal fields with mineable coal reserves in excess of 2,800 million tonnes\(^1\) have been identified and are in the process of being allocated for captive mining. This may imply a total capital requirement of around USD 1.5-2 billion. Investment activity in other parts of the coal value chain such as in coal washeries has also been seen in recent times.

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\(^1\) Ministry of Coal & Mines
2.2 Oil
The Government’s policy of allowing full private participation in upstream exploration and production has already attracted a number of private investors. Six rounds of competitive bidding under the Government policy, named New Exploration Licensing Policy (NELP), have already been done, around 185 blocks were awarded and reserves estimated at 700 MMT\(^2\) of oil and gas have been discovered. The sixth round of bidding (NELP-VI) for 65 blocks was successfully completed last year. In addition, India presents a lot of potential in the refining sector due to the strategic advantages of low cost and location; and is already a net exporter of products. The downstream marketing sector is also now open to private participation.

2.3 Gas
Discoveries of gas to the tune of 700 bcm\(^2\) in the last decade have meant that gas reserves hold promise in India. The potential for Coal Bed Methane appears to be very promising and will probably exceed the free natural gas reserves. While in the near term, potential for LNG may be limited due to inability of key sectors such as power to absorb high international prices, in the longer term there would be place for LNG as the share of Natural Gas in India’s energy mix increases.

On the demand side, an emerging area is auto-CNG and piped gas which have together accounted for about 7 percent of the total gas demand in the last five years. In the next few years, at least 30 cities have been identified for city-wide gas coverage by private and public sector players.

The draft gas pipeline policy gives support to the development of a national gas grid meant to create a common gas market across the country.

2.4 Nuclear
The envisaged growth of nuclear power in India is possible provided robust technologies are developed for both the front-end and the back-end of the fuel cycle. India has one of the largest reserves of the nuclear fuel - thorium. However, the nuclear energy programme will continue to be uranium based until commercial production based on thorium becomes feasible. There is a persisting need for developing techniques for economic and efficient extraction of uranium from lean sources e.g. sea water. If the Indo-US nuclear deal goes through, there will be a boost to nuclear energy and private participation in this sector would be expected.

2.5 Hydro
India is endowed with a hydroelectric potential of about 150,000 MW\(^3\). However, only 17 percent of the hydroelectric potential has been harnessed so far; with another 5 percent under various stages of development. Private participation in the hydro sector will be important to meet the target of an additional 45,000 MW of hydro capacity within the next ten years. Various policy measures are being
contemplated to encourage private participation which seek to address issues such as mitigating geological risks, resettlement and rehabilitation of project affected persons through Public Private Partnership initiatives and incentives for performance. The revised hydro policy is currently under discussion by the Government of India.

2.6 Renewable Energy
India has a vast potential for renewable energy sources, especially in areas such as solar power, biomass and wind power. The current installed capacity of renewable energy is around 9220 MW, constituting about 73 percent of India’s total installed generation capacity. India is already the fourth largest in the world in terms of wind energy installations and we are seeing significant investment activity in this area. Technological breakthroughs for cost-effective photovoltaic technology could generate a quantum leap in the renewable energy sector since India is well endowed with solar insolation (average of 6 kwh/ sq.mt./day).

2.7 Electricity

2.7.1 Generation
The government has envisaged a capacity addition of around 107,000 MW by 2012, out of which 22,900 MW is earmarked for the private sector. The opportunities in generation are now very encouraging on account of - the emerging power trading environment, the policy of open access on transmission and distribution networks and reforms in the power sector. Recent developments in this area include award of two Ultra Mega Power Projects (UMPPs) each of size 4000 MW on basis of competitive bidding. Four more UMPPs are expected to be awarded by end of 2007. We are also beginning to see activity in relation to merchant power plants and the Government policy now encourages this by assistance in providing fuel linkages and other clearances.

2.7.2 Transmission
Private investment in the transmission sector can be done either through an Independent Power Transmission Company (IPTC) or through a Joint Venture Company (JVC). These participations are envisaged largely for creation of the National Grid along with the state owned transmission utilities. The private sector participation is expected to be in projects requiring a capital outlay of around USD 4.5 billion. In the last year, transmission projects in the western region covering approximately 1500 km were awarded to the private sector on a Build, Own, Operate (BOO) basis in a competitive bidding process.

2.7.3 Distribution
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4 Ministry of New and Renewable Energy , Government of India
5 Blue Print for Power Development, Ministry of Power
6 Formation of the National Grid is a plan for strengthening of the inter-state and inter-regional transmission network that will enable unrestricted flow of electricity across regions and enable development of a deep electricity market
7 Source: Ministry of Power, Government of India
sector participation is expected to be in projects requiring a capital outlay of around USD 4.5 billion. In the last year, transmission projects in the western region covering approximately 1500 km were awarded to the private sector on a Build, Own, Operate (BOO) basis in a competitive bidding process.

2.7.4 Trading
Power trading, as an activity, is evolving rapidly in India. Currently, around 15 GWh of electricity is traded every year and there are four or five large trading players. Merchant power plants, open access and the move to set up a Power Exchange will all give a fillip to power trading.

2.7.5 Energy savings and Demand Side Management
A study conducted for the Asian Development Bank estimated an immediate energy saving potential of 54,500 million kWh and peak saving of 9,240 MW. This has an investment potential of USD 3 billion.

In spite of the above opportunities, a lot remains to be done in terms of strengthening and building the regulatory institutions that will allow Government to distance itself from operational decision making and make the reform process more transparent and sustainable. For example, the electricity regulatory commissions would need to be provided more independence to deal with tariff design, market structure development, etc. and given an environment to operate without political interference.

In the following chapters, starting with an overview, each energy segment has been discussed in greater detail; highlighting key issues, the policy and regulatory framework in these segments and the emerging areas for investment in these segments.
By world standards, India’s current level of energy consumption is very low. For the year 2004-05, the total annual energy consumption for India is estimated at 572 Mtoe (million tons oil equivalent) and the per capita consumption at 531 kgoe (kilograms oil equivalent). (Exhibit 2.1)

Exhibit 2.1: India’s per capita energy consumption compared to other countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Per Capita TPES consumption (Kgoe)</th>
<th>Per Capita Electricity consumption (Kwh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA (2006)</td>
<td>4,732</td>
<td>531</td>
</tr>
<tr>
<td>China (2006)</td>
<td>1,767</td>
<td>2,516</td>
</tr>
<tr>
<td>Japan (2006)</td>
<td>1,476</td>
<td>8,076</td>
</tr>
<tr>
<td>South Korea (2004)</td>
<td>4,431</td>
<td>1,391</td>
</tr>
<tr>
<td>World Avg (2006)</td>
<td>1,242</td>
<td>7,913</td>
</tr>
<tr>
<td>OECD (2004)</td>
<td>3,216</td>
<td>13,338</td>
</tr>
<tr>
<td>India (2004)</td>
<td>4,732</td>
<td>531</td>
</tr>
</tbody>
</table>


However, with a targeted GDP growth rate of 7 to 8 percent, and an estimated energy elasticity of 0.80, the energy requirements of the country are expected to grow at 5.6-6.4 percent per annum over the next few years. This implies a four-fold increase in India’s energy requirement over the next 25 years and hence, the country faces significant challenges in meeting this.

3.1 India’s Current Energy Basket

India is well endowed with coal. However, it is poorly endowed with oil assets and has to depend on crude imports to meet a major share of its needs (around 71 percent).

Exhibit 2.2: India’s composition of energy sources and usage

Source: Planning Commission of India, 2006
Exhibit 2.2 reflects only primary energy sources that are commercially exploited. A large population of India in the rural areas still depends on traditional sources of energy such as firewood, animal dung and biomass. The usage of such sources of energy is estimated at around 143 Mtoe per annum or approximately 44 percent of total primary energy use (Source: Planning Commission of India).

3.2 Future Energy Requirements and Supply Options
Coal is expected to continue to be the dominant energy source. However India would have to actively develop non-coal sources given that at a growth rate of 5 percent in coal production, India’s extractable coal reserves would get exhausted in 458 years. Therefore, from a long-term perspective and in view of growing environmental concerns from use of coal, the country needs to look at developing alternate sources such as nuclear energy. India has vast reserves of the nuclear fuel thorium but the technology is not yet developed for its commercial use. India’s oil assets are meager but recent discoveries hold promise for India’s gas reserves and coal bed methane. Renewable energy currently contributes a small fraction and it is expected to grow very rapidly especially in areas like wind and solar power. In the short-term, renewable energy would play an important role of supplementing the total energy requirement. Over the longer term, its importance would be more strategic so that the country can build a certain level of self-reliance in renewable technologies of the future.

The following exhibit depicts the estimated reserves for various energy sources:

**Exhibit 2.3: Estimated energy reserves**

<table>
<thead>
<tr>
<th>Resource</th>
<th>Unit</th>
<th>Reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal - Extractable</td>
<td>Mtoe</td>
<td>13,489</td>
</tr>
<tr>
<td>Oil</td>
<td>Mtoe</td>
<td>786</td>
</tr>
<tr>
<td>Gas – including coal bed methane</td>
<td>Mtoe</td>
<td>1,866</td>
</tr>
<tr>
<td>Uranium – metal</td>
<td>Tonnes</td>
<td>61,000</td>
</tr>
<tr>
<td>Thorium – metal</td>
<td>Tonnes</td>
<td>225,000</td>
</tr>
<tr>
<td>Hydel</td>
<td>MW</td>
<td>150,000</td>
</tr>
</tbody>
</table>

Source: Planning Commission of India, 2006

Different demand-side and supply-side scenarios have been developed by India’s Planning Commission to meet the future energy requirements. These scenarios look at energy efficiency as well as supply side options. The energy efficiency options include:

- **Energy efficiency in end-use**: Efficient use of energy in industry, lighting, household appliances etc. can lower India’s energy needs by 142 Mtoe in 2031-32 (or 75 percent of the total energy requirement).
• **Increase in rail road share of freight:** Currently, the road transport carries a major portion of freight traffic. If the share of railways in freight increases from the current level of 32 percent to 50 percent by 2031-32, it would contribute towards an energy saving of 34 Mtoe in 2031-32 (or 1.8 percent of the total energy requirement).

• **Increase in transportation efficiency:** Use of mass transport system in cities, better utilization of motor vehicles (such as vehicle pooling) and increase in fuel efficiency of motor vehicles (possible to the extent of 50 percent with current technology) can save about 81 Mtoe of energy in 2031-32 (or 4.3 percent of the total energy requirement).

• **Efficiencies in thermal power generation:** Currently, the efficiencies of thermal generation in India stand at 30.5 percent. An increase to 38-40 percent through use of super critical boiler technologies could lead to a savings of 111 Mtoe in 2031-32 (or 5.8 percent of the total energy requirement).

Together the energy efficiency measures can save 351 Mtoe of energy or around 19 percent of India’s energy requirements by 2031-32.

The supply side options include:

• Fully exploiting India’s hydro potential of 150,000 MW from current level of 32,326 MW

• Scaling up nuclear generation by successfully developing the Fast Breeder Reactor (FBR) technology (which uses uranium as fuel) and developing Advance Heavy Water Reactor for utilizing thorium (of which India has abundant reserves).

• Development of natural gas sources and using it for electricity generation - either through indigenous exploration or through pipeline import and LNG

• Development of renewable energy sources, including solar power through cost effective photovoltaic technology, fuel wood, bio-diesel and wind energy
The range of utilization of different fuels in 2031-32 as compared to current levels is shown below:

**Exhibit 2.4: Comparison of energy utilization in 2031-32 with present**

<table>
<thead>
<tr>
<th>Resource</th>
<th>Utilisation in 2031-32 (Mtoe)</th>
<th>Current utilisation (Mtoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>350-486</td>
<td>119</td>
</tr>
<tr>
<td>Natural Gas (including CBM)</td>
<td>104-150</td>
<td>29</td>
</tr>
<tr>
<td>Coal</td>
<td>632-1022</td>
<td>167</td>
</tr>
<tr>
<td>Hydro</td>
<td>13-35</td>
<td>7</td>
</tr>
<tr>
<td>Nuclear</td>
<td>76-98</td>
<td>5</td>
</tr>
<tr>
<td>Solar</td>
<td>1200</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Wind</td>
<td>10</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Fuel wood</td>
<td>620</td>
<td>140</td>
</tr>
<tr>
<td>Ethanol</td>
<td>10</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Bio diesel</td>
<td>20</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

*Source: Planning Commission of India, 2006*

### 3.3 Key Imperatives for India

To meet its large and growing energy needs, there are certain key imperatives for the Indian energy sector:

#### 3.3.1 Private sector investment needs to complement public sector

Reliability of energy supply and its cost will be key determinants of both, economic growth and social upliftment. Achieving this will require significant investment – of capital as well as of capabilities. Private sector will necessarily need to complement the public sector in both areas. The Government policies continue to lay emphasis on enabling a higher level of private sector participation. Sector reforms are aimed at attracting private investment and efficiency, through different forms of competitive markets. A large part of the power sector, for example, will become contestable by 2008, opening up a USD 5 bn market. Overall, the investment needed in the Indian energy sector is to the tune of USD 120 to 150 bn over the next five years.

To encourage private investment, clarity and stability in policy framework is essential. For example, clarity in matters related to pricing of energy products, the market structure and Government incentives and subsidy administration are important to minimize the risks of investment. Some clarity has emerged, for
example, in areas such as oil & gas pricing where the price determination process has been set out.

3.3.2 Encourage market mechanisms with a credible and independent regulatory oversight

The benefits of market mechanisms in bringing in production and resource allocation efficiencies are needed. Market mechanisms will also encourage investments as it will tend to minimize the regulatory risks. However, the market mechanisms have to be introduced gradually as supply side situation improves. Currently, with the huge deficit in energy products, market mechanisms are likely to get abused if not managed to some degree by an independent regulatory oversight.

For example, the regulator for the power sector has been in place for a while. While tight regulation was adopted in the initial years, now we are seeing market mechanisms being used. For example, the case of long-term generation tariffs being determined through a competitive bidding process and the development of a short-term market for power.

3.3.3 Reduce vulnerability to price and supply shocks

The Indian energy basket is weighted towards coal (51%) and oil (36%). From a long term energy security perspective, it is necessary to diversify the energy basket. For example, if the known coal reserves are expected to exhaust in about 40 years, it would be a challenge to replace 51 percent of the energy basket. Diversification would mean increasing the share of Natural Gas, Nuclear and Hydro energy apart from a strategic thrust towards renewable energy.

The other issue is vulnerability to price shocks. Vulnerability to price shocks are addressed by diversifying the fuel basket, enhancing domestic production of energy and in initiatives such as taking equity positions in energy resources abroad. We are seeing a positive trend in all these areas. Nuclear, natural gas and hydro power are getting the required impetus. Domestic production is being enhanced with initiatives on private participation and Indian companies have begun to take equity positions in international energy resources including oil & gas and coal.

3.3.4 Bringing in efficiency and enhancing capacity in energy transport infrastructure

In India, there is a high degree of inter-regional disparity in terms of energy sources and the growth centers. Significant initiatives are underway to enable investment in ports and railway infrastructure to move coal, pipelines and storage network for oil and gas, and transmission network for electricity. Enhanced transmission capacity will also enable exploitation of the Himalayan hydro resources in Himachal Pradesh, Uttarakhand and the North Eastern states, as also in Nepal and Bhutan.
For this purpose, private participation in energy transport sector is actively being promoted. Private investment in ports, dedicated freight corridors, pipelines and power transmission has already begun to take place.

3.3.5 Tariff reform and power sector reform
This is one of the most difficult and important area as far as the energy sector is concerned. Prices of electricity and some of the other energy products are highly distorted thereby promoting inefficient end-use and sometimes even inefficient energy choices. For example, power, kerosene and domestic gas are highly subsidized. There have been various policy measures to address this and to some degree of success. However, the challenge is in implementation and bringing in the required political will to address this issue.

Power sector reform on the distribution front is another key area where progress has been slow. High network losses largely due to theft and pilferage have left the power sector cash strapped. While some states have done well on the distribution reform front, in others private sector participation in the form of franchising is being now tried as a potential solution.

3.3.6 Provide Government Support for Energy Efficiency
The Government needs to create a policy framework that provides incentives for energy efficiency. This could, for example, mean providing incentives in urban areas for mass transport systems and promoting R&D in energy efficiency. The environment should encourage energy efficiency companies to come up and operate profitably.

In parallel, India is also emerging as a significantly active market in terms of Clean Development Mechanism (CDM) projects being conceptualized and registered with the Executive Board (EB).

The growing awareness of the CDM benefits would make this an important area for investments in the Indian energy sector. CDM should also give the necessary fillip for energy efficiency measures in India.

The Government of India is recognizing the importance of private sector participation, and independent regulation in the energy sector. The future holds a lot of opportunities for international and domestic private participation. KPMG’s Energy and Natural Resources practice presents an analysis on each of the fuel sectors in the following chapters.
4 Coal Sector

The majority of India’s energy requirement is met by coal; which is largely mined in the Eastern and the Central regions of the country. In 2005-06, the total coal production in the country was around 405.2 MMT (advanced estimates) and majority of it catered to the core sectors of power, steel and cement.

Exhibit 3.1: Comparison profile

Inspite of various policy initiatives to diversify the fuel mix, it is becoming increasingly evident that coal will continue to play a major role in sustaining the growth momentum of India. Based on estimates, the consumption of coal is projected to rise by nearly 40 percent over the next five years and set to almost double by 2019-20.

However, in the recent past, the country’s coal sector has come under pressure due to its inability to meet demand, both planned and unplanned, of the user industries.

Exhibit 3.2: Coal requirement vs availability

As per the government’s own estimates, production will lag behind demand by about 100 MMT as of 2011-12 and by 250 MMT by 2019-20.
4.1 Key Issues Facing the Sector
The critical issues facing the coal sector are highlighted below:

- Typically washed coal is used for power generation in western countries, whereas in India only a miniscule percentage of steam coal is washed.

- Coal mining in India has been associated with poor employee productivity\(^9\). The ‘output per miner per annum’ in India varies from 150 to 2,650 tonnes compared to an average productivity of around 12,000 tonnes in the U.S. and Australia\(^10\).

- No comprehensive solution to deal with the fly ash generated at coal power stations\(^11\) has been developed in India. Clean coal technologies (such as Integrated Gasification Combined Cycle where the coal is converted to gas) are available, but these are expensive and they need modification to suit Indian specifications.

- There is a lack of an independent regulatory body to govern investments and operations in the sector. Amongst the regulatory body’s core activities should include coal block allocation, mine approval and introduce competition in price determination.

Given the size of investment requirements and the level of political interference, the task of transforming the coal sector becomes formidable. In view of this, the following efforts can become the cornerstones of reform in the sector.

4.1.1 Improvement in operational efficiency of the coal companies
The public sector company, Coal India Limited (CIL), is in need of an organizational transformation in order to gradually align its operating costs to international standards. Mining costs of CIL are at least 35 percent higher than those of leading coal-exporting countries such as Australia, Indonesia, and South Africa. To match international productivity levels, Coal India will need to invest in new technologies, improve processes for planning and execution of projects, and institutionalize a comprehensive risk management framework\(^12\).

4.1.2 Strengthening of logistics in coal distribution
The logistics infrastructure of India, such as ports and railways are congested. In order to increase freight capacity from the coal-producing regions to the demand centers in the northern and central parts of the country, it is necessary that the Indian Railways augments capacity. At present delays are created and inefficiency promoted because freight trains get a lower priority than passenger trains. Special freight corridors are required to raise speeds, cut costs, and increase the system’s reliability. The Dedicated Freight Corridor (DFC), linking the ports to the hinterland costing about INR 220 Billion, is the single largest project in this direction.

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\(^9\) Coal from Coal India Limited (and it subsidiaries), account for around 85 percent of the annual production of coal in India. Coal India Limited is also the second biggest employer in the world with around 500,000 employees.

\(^10\) Source: Tata Energy Research Institute, India.

\(^11\) Around 90-100 MT of ash is generated at power stations in each year. India has been able to absorb only 11 percent of this ash compared to 25 percent by China.

\(^12\) A first step, providing a catalyst for improvement, would be to allow competition among mining subsidiaries of CIL. Another would be to encourage joint ventures with world leaders in coal mining.
### 4.1.3 Focusing on technology for future

Even though India’s numerous technology research institutes are working on energy-related R&D, there is a possibility that they are operating in a fragmented fashion. The Government may get improved recoveries on its investment by concentrating on only a few important technology areas. To start with, focus may be applied towards tighter emission standards and development of inexpensive clean-coal technologies - viz. extraction of methane from coal deposits.

There has been an increased focus on Coal Bed Methane (CBM) exploration as a source of natural gas. India holds significant opportunities on commercial exploration of CBM. Till date 26 CBM blocks, with a potential of covering 13,600 sq Kms, have been allotted under CBM exploration policy.

### 4.2 Policy and Regulatory Framework

Currently, the allocation of coal mining blocks to non-CIL companies by the Ministry of Coal, is done either under government dispensation or through the captive dispensation route. Under the government dispensation route, the block is allocated to a government company and the company has the right to sell coal on a merchant basis; unless specified otherwise in the letter of allotment. Under the captive route, blocks are allotted only to those companies which have specified end-use projects, such as power, cement and steel. All non-government companies apply for allocation of coal mining blocks under the captive dispensation route.

The sector has traditionally been characterized by - state monopoly, lack of independent regulation and lack of transparency in tariff determination. The government has now realized that a high growth rate in domestic production cannot be sustained without carrying out structural reforms and introducing competition through private participation. Hence, the Government has taken the following measures:

- Distancing of the government from price determination of all grades of coal
- Opening of captive coal mining for power, iron and steel, and cement for private investment. Foreign investments are now permitted in Indian companies taking up coal mining for captive use. The allocation of coal blocks are proposed to be done on the basis of competitive bidding
- Allowing State Government companies and undertakings to carry out mining of coal and lignite reserves anywhere in the country - either by the opencast or by the underground method
- Allowing coal mining companies who have long term contracts with specified end users (viz power, cement and steel) to apply for a captive coal block under the captive dispensation route
- Exempting customs duty on coking coal
- Inclusion of coal gasification and coal liquefaction as specified end user for application of coal mining block:
In addition to the above, the following measures have been accepted in principle and are awaiting implementation:

- Freeing the sector from distribution controls
- Establishment of a regulatory authority to resolve price disputes between the producers and the consumers of coal
- Allowing public sector enterprises to undertake joint venture projects with the private sector.

In order to de-bottleneck the logistics chain, the government has taken the following key initiatives:

- 100 percent income tax exemption on port development projects
- 100 percent FDI for port development projects under the automatic route
- Allowing private players to invest in minor and intermediate ports
- Allowing private investments and ownerships in rail track, rolling stock and container depot

4.3 The India Opportunity

The recognition of private investment requirements and acknowledgement for the need to improve operational efficiency provides immense investment opportunities in coal and related sectors.

Participation of the private sector in captive mining, across different user industries, is an immediate investment opportunity. Thirty eight coal fields with mineable coal reserves in excess of 2,800 million tonnes\textsuperscript{[15]} have been identified and are in the process of being allocated for captive mining. This may imply a total capital requirement of around USD 1.5-2 billion. However, it should be remembered that deposits, which are on the surface and are easily extractable, may have already been largely explored. In future agencies would need to address increasingly difficult terrain and search coal at greater depths using more sophisticated technology; thus requiring more capital investments and a larger scale of operations. Apart from coal production, there have also been investments in other parts of the value chain such as coal washeries.

There is a need to issue new regulations which support a free market, allow the formation of joint ventures or other alliances, and encourage the development of shared infrastructure such as dedicated rail lines and power transmission networks. To achieve these goals, the Government will have to overcome strong opposition from political and business interests within the sector.

Being a related sector, seaports that receive shipments of coal, railroads, etc would require USD 40-50 billion in investments for harmonious capacity expansion in capacity. The government’s plan to invest USD 2 billion to increase capacity and remove bottlenecks at existing major ports is much lower compared to an estimated actual requirement of USD 30 billion. Similarly, a total USD 15-20 billion is required towards creation of new freight corridors and integrating them with existing rail operations.

\textsuperscript{[13]} In view of lack of technical understanding, user industries are not expected to be directly involved in activity of coal mining. They will like to appoint a Mine Developer and Operator (‘MDO’) for the purpose. In this regard, the need of the hour is a framework that will allow for (a) free exchange of relevant information and (b) transparent evaluation of bids from prospective MDOs. The framework is expected to assist both parties in managing the risks that are involved in the activities of planning, development, exploration, etc in an effective manner.

\textsuperscript{[14]} Without the earlier restriction of isolated small pockets

\textsuperscript{[15]} Ministry of Coal & Mines
Oil comprises about 36 per cent of India’s primary energy consumption at present, and driven by India’s overall economic growth, it is expected to grow both in absolute and percentage terms. The growth in demand is projected to catapult the overall demand to 196 MMT in 2011-12 and 250 MMT in 2024-25.

The growing demand-supply gap has led the Indian government to open up exploration and production to private participants through NELP and develop a more holistic strategy for acquisition of equity oil abroad.

5.1 Key issues facing the Sector

The following are the major issues faced by the Oil sector:

- **Absence of statutory framework in the upstream industry**: India has significantly shied away from structural regulation; regulations in India being more focused towards use of standards in the areas of health, safety and environment, and certain critical aspects of operations and pricing. The scope of the proposed legislation, through the recently drafted Petroleum Regulatory Board Bill, is confined to the downstream industry. While the upstream industry is still governed under a policy framework by the Directorate General of Hydrocarbons. Notable is the absence of any statutory framework in the upstream sector.

- **Incidence of cross subsidy due to social obligations**: Till recently the subsidy burden on LPG, SKO and diesel were allocated to the national oil companies; but the incidence has been spread out across to the private sector. Although this phenomenon is likely to remain due to social obligations of the Government, a more transparent procedure for the allocation of subsidies would boost investor confidence further.
5.2 Policy and Regulatory Framework

The current upstream regulation is provided by Director General of Hydrocarbons (DGH) primarily on technical aspects than on pricing front. The midstream and downstream sectors are largely unregulated. However, downstream regulation is proposed to be introduced with the passing of the PNGRB bill.

Over the past five to six years, the trend has been towards opening up the sector for greater investment, setting up an independent regulator to monitor post production activities, and enabling a transition from an administered to a market driven mechanism. This also includes de-controlling of most of the petroleum products and allowing private sector companies to market them at the market-determined prices\textsuperscript{16}.

Another significant trend in oil and gas regulation in India, and one which is likely to continue, is the opening up of the sector to private and foreign participation. A 100 percent Foreign Direct Investment is allowed in exploration, creation of pipeline infrastructure, refining and in downstream retailing. 100 percent FDI in retailing is allowed subject to minimum investment of USD 445 million in midstream or upstream sector. Combined with the attractiveness of the Indian market in the oil sector, this is likely to bring forth significant investments in the future.

On the pricing front, the government-appointed committee on pricing and taxation of petroleum products has recommended that the oil companies should shift from an ‘import parity based pricing’ to a ‘trade based pricing’. It has also suggested the reduction in custom duties on petrol and diesel from 10 per cent to 7.5 per cent and the shifting of excise duty from an ad-valorem levy to a specific levy.

The oil marketing companies are expected to benefit from the current Union Budget proposal of lowering excise duty on vehicle fuels from 8 percent to 6 percent. This is expected to reduce the losses of oil marketing companies that are currently selling both petrol and diesel at discounted state-determined prices.

5.3 The India Opportunity

5.3.1 Investments under NELP

To increase investment in the upstream side, the Ministry of Petroleum & Natural Gas (MoPNG) has introduced a transparent bidding process for allocation of oil and gas blocks. Six rounds of competitive bidding under the Government policy, named New Exploration Licensing Policy (NELP), have already been done, around 185 blocks were awarded and reserves estimated at 700 MM\textsuperscript{T} of oil and gas have been discovered. However, the recent rounds of NELP bidding are still dominated by public sector. To bring new technologies and international practices into the oil and gas exploration sector, the government is keen on greater foreign participation under NELP process.

\textsuperscript{16} Price of gasoline and diesel are still fixed by the Government, although the linkage to import parity price has strengthened significantly over the years
In NELP-VI, the latest round, a total of 65 blocks including shallow water, deepwater and onland blocks were put on offer. NELP-VI was a success with 165 bids being received from both domestic and international companies for exploration rights. Going forward, Directorate General of Hydrocarbons has indicated that 70-80 blocks, including those in un-explored states, will be made available in NELP-VII.

5.3.2 Destination India as refining hub

India’s key advantages for developing itself as an export refining hub includes cost competitiveness and location advantage. India has significant lower cash operating costs on account of cheaper power and labor costs. The capital costs are also lower by as much as 25 to 50 percent over other Asian counterparts. Geographically, India is strategically located en route of Middle East crude for East Asian and Pacific-rim markets. In fact, India possesses surplus refining capacity and has already turned into a net exporter of products.17

Certain areas of the country have been already demarcated for the development of export-oriented refineries and dialogues are underway between MoPNG and some oil companies on implementation of the strategy; which also includes building supporting infrastructure for enabling exports.

By 2010, the expected worldwide deficit in refining capacity would be around 112 MTPA because of shutting down of some of the smaller refineries in developed economies. Smaller refineries in North America and Europe are finding it uneconomical to invest in cleaner fuels because of high compliance cost and cleaner fuel norms. In Japan and Australia, oil majors have rationalized their refining assets because they are becoming uneconomical to operate.

On the domestic supply side, India’s current refining capacity stands at around 143 MMT. The domestic refining companies have planned capacity additions to the tune of 90 to 100 MMTPA in the next 4 to 5 years. This large scale commissioning of capacities, when viewed against the expected demand of 196 MMT, suggests that India’s petroleum product exports are slated to rise from the current 17 percent of fuel processed in the country. It is expected that RIL’s (Reliance Industries Limited) refinery expansion of 580,000 bpd at Jamnagar would be only to supply to export markets in Europe and North America.

Exhibit 4.2: India’s petroleum exports on the rise since 2001

[Graph showing India’s petroleum exports on the rise since 2001]

Driven by …
- Sustained increase in refining capacity, driven by cost advantages over erstwhile importing countries
- Currently India possesses surplus refining capacity generating exportable products
- Significant proportion of exports driven by petrochemicals sale by Reliance

Source: Exhibit 4.2: ENI, Oil and Gas Outlook
Another development has been the receipt of foreign direct investment (FDI) in a public sector refinery for the first time. Hindustan Petroleum Corporation Limited (HPCL) has entered into a partnership with Mittal Investments for setting up the refinery-cum-petrochemical complex at Bhatinda in Punjab. This development might be viewed as the first step towards greater involvement by international oil firms in Greenfield projects.

Exhibit 4.3: Supply deficit and consolidation in refinery sector throws up opportunity for Indian exports

5.3.3 Increased investment in fuel quality upgradations
Prompted by stringent fuel specifications in the developing countries and the domestic “Auto Fuel Policy” which mandate Euro IV norms by 2010, significant investments have been planned for upgrading existing refineries. In order to hedge against variation in crude supplies and achieve cost-competitiveness by accommodating cheaper quality crude, it has become essential to upgrade the refineries to more complex configurations. Indian Oil Corporation Limited has planned investments of INR 60 billion towards upgradation of its Gujarat refinery, INR 140 billion for installation of a naphtha unit at its Panipat plant and INR 30 billion for its Haldia refinery. Similar investments have been planned by HPCL and Bharat Petroleum Corporation Limited (BPCL) for their Vishakapatnam and Mumbai refineries, respectively.

5.3.4 Building strategic petroleum reserve through public private partnership
Taking into account the oil security concern, the Government has decided to set up strategic crude oil storage at various locations in the country.
strategic storage would be in addition to the existing storage of crude oil and petroleum products with the oil companies and would provide an emergency response mechanism whenever there are any short-term supply disruptions.

Additionally, the government is also exploring the possibility of increasing the oil stockpile in the country through various innovative schemes such as leasing of storage space to international oil trading companies and building of additional storage terminals through the concessions route.

5.3.5 Acquisition of overseas oil assets
MoPNG has conceived a more coordinated approach towards acquisition of overseas oil assets through joint forays, bilateral engagements with other countries to benefit from each others strengths in areas of technology transfers, R&D, safety and training, as well as multilateral engagements such as the Asian Round Tables, International Energy Forum etc. Recently India has signed an MoU with China for joint bidding of hydrocarbon blocks.

5.3.6 Competition in the downstream (retail and institutional) segment
As per Petroleum Regulatory Board (‘PRB’) Bill, all upcoming pipelines would have mandatory open access. Creation of open access capacity would drive competition in the retail and the institutional segment.

In anticipation of competition, major oil firms are expanding their retail network and forming alliances with a host of product and services companies to offer non-fuel products and services as part of their overall proposition. On the institutional segment, incumbents are focusing on profitable segments for subsidized products like LPG (commercial & non-domestic) as well as on specialty products like Hexane.
When compared to mature natural gas (NG) based economies like Japan, Korea, and the United States, India is a relatively new entrant. However, the increasing significance of the fuel in the Indian context can be gauged from the fact that, by 2025, the country is expected to rival both China and Japan in having the largest NG demand in Asia. Demand in each of these countries is expected to be in the range of 350 MMSCMD\(^1\).

The significant potential for NG demand, especially in the context of India’s projected GDP growth above 8 percent, is being driven by the following key factors:

- The share of natural gas in India’s energy basket is only around 9 percent as compared to the world average of around 24 percent. More than 50 percent of NG volume goes to sectors where it is a substitute to petroleum products and the rest go to the power sector where it substitutes coal. In this context, NG volume in the country will partly be driven as a substitute to petroleum products because it is cheaper and cleaner. In addition, reforms in the power sector would also encourage NG to be used as a cleaner substitute to coal in the long term. The share of NG in the fuel mix is expected to go up from the present 8.8 percent levels to 22 percent in 2031-32.

- Per capita consumption of NG in India is currently amongst the lowest in the world; being at 29 cu m as compared to a world average of around 538 cu m\(^2\).

- Demand for NG (at more than 120 mmmscmd) in the country has far outstripped supply (about 75 mmmscmd), and there has an increasing trend towards emergence of new NG demand as well as conversion from existing fuels to NG\(^3\).

### 6.1 Key Issues

India’s gas supply issues are different from that of oil, mainly because domestic onshore and offshore gas has been contributing to meet more than 90 percent of demand so far. Except for the LNG terminals at Hazira and Dahej, all other gas requirements are being met through domestic sources only. However, existing onshore and offshore fields have been facing a declining trend in production and are unlikely to contribute to growth in supply. It is projected that production in 2015 may be less than 50 percent of current production\(^4\). The identification of new sources of gas supply would be critical to sustaining the demand for gas in the country.

- **Domestic reserves/ production will not be sufficient:** While there have been new finds of about 70 Bcm a year in the last decade, unattractive market prices have contributed to production not increasing correspondingly. However, significant shortfall will mean that one way or the other these reserves will have to start getting utilized. Significant incentives are being offered by the government through its NELP programs to attract greater investment in this area.

- **Cross-border gas pipelines facing uncertainty, but attracting interest:** While initiatives related to cross-border NG pipelines with Iran, Pakistan,
Myanmar, Turkmenistan, etc. have been under discussion for quite some time, the political environment and international climate has been unfavorable, thus delaying these projects indefinitely. As LNG becomes even more expensive, the importance of these sources is increasingly being recognized. Interestingly, globally, transnational gas pipelines have rarely faced disruptions in supply once they have been put into use. Hence, this may be a good sign for India despite the political sensitivities involved

- **Inability to take international prices:** Due to the distinctive nature of the Indian market, current international prices cannot be passed through to major NG user’s viz. power and fertilizer sectors (which constitute over 70 percent of demand). These customers had traditionally been buying gas at administered prices of less than USD 3 per MMBtu up to a couple of years ago. However, due to existing plant efficiencies being significantly impacted by shortages in the recent past, gas is being purchased even at USD 6 per MMBtu. In the power sector, focus has temporarily shifted away from new gas-based capacity to coal-based capacity addition. Other industrial customers may still prefer gas because of the high prices of Naphtha, FO or LPG

### 6.2 Policy and Regulatory Framework

Over the past six years, the trend in natural gas regulation has been towards opening up the sector for greater investment, setting up an independent regulator to monitor post production activities, and enabling a transition from the administered control regime to a market driven mechanism. Significant regulatory issues which will impact the gas sector in India include:

- **Petroleum & Natural Gas Regulatory Board Act, 2006 (PNGRB Act, 2006):** The Act envisages setting up a Petroleum & Natural Gas Regulatory Board to regulate the refining, processing, storage, transportation and distribution, marketing and sale of petroleum, petroleum products and natural gas; excluding production of crude oil and natural gas. The objective of the board is to protect the interests of consumers and entities engaged in specified activities relating to petroleum, petroleum products and natural gas, to ensure uninterrupted and adequate supply of petroleum, petroleum products and natural gas in all parts of the country and to promote competitive markets in India.

- **Policy for Development of Natural Gas Pipelines and City or Local Natural Gas Distribution Networks:** The objective of the policy is to promote investments from public as well as private sector in natural gas pipelines and city or local natural gas distribution networks, to facilitate open access for all players to the pipeline network on a non-discriminatory basis, to promote competition among entities and to protect the end consumer. A Gas Advisory Board (GAB) will be set up to promote and develop the gas pipeline network in India.

- **Gas Linkage Committee:** The Gas Linkage Committee (GLC) was established to manage the allocation of gas to eligible customers. This was linked with the administered price mechanism which depressed domestic gas prices for certain sectors. However, new fields under the National NELP are already exempt from the purview of the GLC and can trade at market prices.
• **Infrastructure Status for gas pipelines**: Development of gas pipelines and related storage has been granted ‘Infrastructure Status’. While this would translate into a number of benefits for companies planning on developing gas transmission pipelines, it could also allow for lower gas transmission tariffs if part of these benefits are passed on to the end consumer. While some quarters expect the LNG import sector to be also given infrastructure status in the interest of increasing economical gas sourcing options for the country, the same has not happened yet.

• **Foreign Direct Investment in NG Sector**: Foreign Direct Investment of 100 percent is allowed in the exploration, pipeline infrastructure, LNG and trading segments; subject to approval. Combined with the attractiveness of the Indian market in the NG sector, this is likely to bring forth significant investments in the future. The integrated LNG policy is currently under discussion and is likely to be put in place soon.

6.3 The India Opportunity

Over the past six years, the trend in natural gas regulation has been towards opening up the sector for greater investment, setting up an independent regulator to monitor post production activities, and enabling a transition from the administered control regime to a market driven mechanism. Significant regulatory issues which will impact the gas sector in India include:

6.3.1 Domestic exploration of NG

The government sees significant potential in domestic exploration as an option for matching supply with demand. On an average, reserves of more than 70 bcm a year have been discovered over the past decade. The New Exploration License Policy (NELP) provides significant benefits to private players in terms of - allowing 100 percent FDI, a seven year tax holiday, free marketing rights in the domestic market etc. This has already attracted a number of players in the NELP VI round of bidding. NELP VII has already been announced opening up a new set of opportunities for investors. However, unless significant finds are made (similar to the KG basin) the country will still have to deal with a domestic shortage of gas.

After the formation of National Gas Hydrate Program, gas hydrate exploration has also received considerable impetus in India. In 2006, India became the third country after Japan and USA, to engage a specially designed vessel named “JOIDES Resolution” to carry out drilling activities in Indian waters for collecting cores for studies of gas hydrates habitation, contents, etc.

6.3.2 Is LNG the answer?

Given the shortages in domestic gas and uncertainties related to international pipelines, LNG may appear to be the answer. However, due to a number of reasons, LNG would still find it difficult to compete with other options in the short to medium term. The lack of a cross-country gas pipeline to enable transmission, the emphasis on coal as the preferred fuel for Ultra Mega Power
Plants and the gradual emergence of Coal Bed Methane make it difficult for LNG to compete. In addition, issues related to pricing and the limited potential LNG supply sources (i.e. Qatar, Iran, and Australia) to India need to be sorted out. In the long-term, with demand soaring even higher, LNG is likely to be one of the most significant areas of investment in the NG sector. The most attractive areas would be where pipeline gas is not expected in the near future.

6.3.3 Coal Bed Methane (CBM) and Underground Coal Gasification Opportunities

With proven reserves of 765 Mtoe and indicated reserves of between 1,260 – 2,340 Mtoe22, CBM could be a larger opportunity than either oil or natural gas. CBM exploration has already been taken up seriously, with more than 26 blocks awarded so far and more to be taken up as part of following phases of CBM bidding. Compression of CBM and marketing as CNG could be exploited in potential industries as a substitute to conventional natural gas. A related exciting technology is that of underground coal gasification, which is already being exploited in Russia at a small level. Given India’s large coal reserve, the UGC technology could potentially produce volumes of multiples of India’s free natural gas reserve. For example Gujarat’s coal reserves could produce as much as 70 times of ONGC’s current free gas reserves23.

6.3.4 Emergence of the retail gas user

Due to environmental and economic considerations, increasingly gas is reaching the retail user segment as a fuel for domestic and transportation purposes. The growth of Auto CNG and Piped domestic gas in major Indian urban centers has sparked off a new demand spurt for NG. Within five years, the proportion of auto CNG and piped gas together would increase from the current levels of 2 percent to about 7 percent of the total gas demand. The fast pace of growth can be assessed from the fact that in the next few years, at least 30 cities would be embraced for city-wide gas coverage by private and public sector players, as compared to the six cities currently. Supporting regulation related to conversion of public transportation to CNG in some major cities has helped this growth significantly.

6.3.5 Development of common gas market through National Gas Grid

The growth in each of the end user industries as well as the widespread growth of the retail segment would need to be supported by appropriate infrastructure. The planned National Gas Grid connectivity is with a view to harmonize the operations and provide interconnectivity to different gas pipelines.

The New Gas Pipeline Policy announced by the Government provides a framework for development of a National Gas Grid and with the setting up of the Petroleum and Natural Gas Regulatory Board private interest is expected to increase tremendously in the pipeline infrastructure segment.

22 Draft Report of expert committee on Integrated Energy Policy
23 Infraline report on status of CBM in India (April 2005)
The Government of India is pursuing nuclear energy as a long-term solution to meet the energy needs of the country. Besides being non-carbon emitting, its strategic importance lies due to the fact that known reserves of coal, India’s dominant energy source today, are expected to last for around 45 years only with current technologies for extraction.

7.1 Importance given to Nuclear Energy

The importance accorded to nuclear energy by the Government of India can be gauged from the following:

- Indian government’s willingness to co-operate and enter into civilian nuclear agreements with countries like U.S., France and Russia, despite internal opposition to opening up of its still-guarded nuclear reactors to international scrutiny.
- Deal with Russian Federation for setting up of 1000 MWe Light Water Reactors (LWR’s) under IAEA safeguards.
- Aggressive targets on the nuclear closed fuel cycle based three-stage nuclear power programme, where Bharatiya Nabhikiya Vidyut Nigam Limited (BHAVINI) has been setup for the construction of its first Fast Breeder Reactor (FBR) by 2010.
- Nuclear power plant capacity targets as envisaged by the Department of Atomic Energy (DAE) are given below:
  - 10,280 MWe by 11th Five year plan
  - 20,000 MWe by 2020
  - 50,000 MWe by 2030
  - 250,000 MWe of nuclear power by 2050

7.2 India’s Nuclear Power Programme

7.2.1 Three-stage Indian Nuclear Programme

The importance of nuclear energy was recognised in the 1940s itself by Dr.H.Bhabha who envisaged a three-stage nuclear power programme with the aim of utilizing the thorium potential of India. The closed nuclear fuel cycle has been the core strategy of the Indian Nuclear Power Programme being followed by the Department of Atomic Energy, Government of India.

The first stage of Nuclear Power Programme comprising setting up of Pressurised Heavy Water Reactors (PHWRs) is already in commercial domain.

- India has achieved considerable expertise in its first stage of nuclear power programme and about 10GWe of nuclear installed capacity is possible from indigenous uranium.
- Budgetary allocation for uranium exploration, including drilling, has been continuously increasing in recent years. DAE is actively exploring the idea of nuclear energy.
inviting domestic and foreign private sector firms to participate in uranium exploration activities in India

The second stage of Nuclear Power Programme comprising setting up of Fast Breeder Reactors (FBRs) backed up by reprocessing plants and plutonium-based fuel fabrication plants is in the technology demonstration stage.

- Energy potential of natural uranium can be increased to about 300GWe in the second stage through FBRs, which utilize plutonium obtained from the recycled spent fuel of the first stage along with thorium as blanket to produce U-233
- FBRs of 4000MW each will be built every year from 2021

The third stage of the Nuclear Power Programme requires a large capacity of FBRs to be built up.

- Research on the third stage is in progress with a 300MWe Advanced Heavy Water Reactor (AHWR) developed by Bhabha Atomic Research Center (BARC) to expedite transition to thorium based system
- Research on other advanced technologies like Compact High Temperature Reactor (CHTR), Accelerator Driven Systems (ADS) and indigenously built Tokamaks, as part of the nuclear fusion research programme, are in full swing at BARC

However, completing this ambitious three-stage plan successfully will require heavy investments and considerable development is required before the thorium cycle can be commercialized. The Government of India has been supporting all the investments required by the three-sage Nuclear Power Programme, with the ultimate goal of realizing energy security.

7.2.2 Nuclear power projects in India: Planned and Under Operation

Currently, India has 17 nuclear power plants being operated by the Nuclear Power Corporation of India Limited (NPCIL) and the total installed nuclear power capacity is 4120MWe. The Kaiga-3, 220MWe plant achieved criticality on 26th February, 2007. Given below are the plans of nuclear power plant capacity addition in India by DAE26

- New capacity addition of 2660MWe to be under commercial operation by December 2008
  - Under Construction: 3 PHWRs (3 x 220MWe) and 2 LWRs (2 x 1000MWe)
- New capacity addition of 6800MW to be under commercial operation by 2012
  - LWRs (4*1000MWe) (Jaitapur, Maharashtra and Kundakulam, Tamil Nadu)
  - PHWRs (4*700MWe) (Kakrapar, Gujarat and Rawatbhata, Rajasthan)

http://www.dae.gov.in ; http://wwwnpcil.nic.in
Capital costs of nuclear power plants based on PHWR technology are in the range of INR 27 to 7 Crores per MW with a corresponding design life of more than 40 years. Gestation period for setting up of nuclear power plants in India has improved over years and is around 5 years with the current technology. Nuclear power competes economically with coal based plants at load centre generation of around 1000 Km from the pit head coal mines. Current power tariffs from some of the atomic power stations of NPCIL are in the range of INR 1.75 to 2.80 per unit, depending on the life of the reactor.

### 7.3 India Opportunity

#### 7.3.1 India – US Nuclear Cooperation

The India – US nuclear deal promises India access to a practically clean energy and will facilitate India in coming out of the 30 year old isolation from international nuclear technology. The final implementation of the Hyde Act and the 123 Agreement will enable India to legally enter into civilian nuclear energy cooperation agreements with nuclear energy suppliers like France, Russia and other countries with advanced nuclear capabilities. It will facilitate in dismantling all controls and constraints faced by India by enabling global access to fuel, technology and equipment; hitherto denied to India.

Some of the key elements of this agreement are - the need for segregation of the civilian and military facilities, applying specially negotiated IAEA safeguards on civilian facilities including additional protocol and negotiating Fissile Material Cut-Off Treaty (FMCT) along with the U.S.

Some of the likely gains from the partnership with U.S. are as given below:

- The agreement assures uninterrupted supply of fuel to reactors placed under the IAEA safeguards
- Access to latest nuclear reactors can serve the purpose of meeting the urgent short-term energy requirements of the country and hence, increase the share of nuclear energy in the energy mix
- Strengthen India’s case in the Nuclear Supply Group (NSG) to relax its non-proliferation guidelines towards India, which already has an unblemished safety record
- Facilitate India’s participation in international nuclear research community in developing cutting edge multilateral research and thereby benefiting its own indigenous research.
- Import options open up the possibility of significant capacity addition through high output plants (1000MWe), in addition to the indigenous capacity addition. Once the Atomic Energy Act is amended to facilitate private participation, foreign investment is also possible.
The actual passage of the 123 Agreement still involves a lot of hard negotiations because of the gaps between the provisions of the Hyde Act and Prime Minister Manmohan Singh’s suo-moto statement in Parliament. Some of the major issues of contention are in the areas of spent fuel reprocessing, access to enrichment and reprocessing technology, conditional access to nuclear fuel (subject to India not performing any further nuclear tests) and references to Indian foreign policy towards non-proliferation.

If the Indo-US agreement goes through and 123 agreement for civilian nuclear power cooperation is concluded early, then there is a good chance that the government will fast track its nuclear program. The fuel and technology availability from the NSG (Nuclear Supply Group) will ensure that India can run a parallel program based on either natural uranium or enriched uranium as fuel.

7.3.2 Public-Private Partnership in Commercial Civilian Nuclear Energy

Amendment to the Atomic Energy Act, 1962 will be necessary to enable any joint venture/private participation in India. Currently the law does not permit private sector participation in nuclear power generation and all investments in the nuclear energy sector were made exclusively by the central government.

Indian government is seriously considering amending the law to facilitate private participation in the non-strategic components of the Nuclear Power Programme

- Private players may enter into a joint venture with the Nuclear Power Corporation of India Limited (NPCIL) for setting up and operating the nuclear power plants
- With the possibilities of the civilian nuclear power cooperation agreements to be in place with countries like USA and France, there would be opportunities for domestic and foreign private investment in the nuclear power generation in India.

Some of the key challenges for the private sector would be in the areas of:

- Managing the decommissioning of the nuclear plant
- Spent fuel storage and subsequent fuel resource management procedures
- Unlimited liability in an unlikely event of a nuclear accident can have serious implication on the financial well being of the nuclear power generating company
India is endowed with very large, viable and economically exploitable hydroelectric potential which is estimated to be about 150,000 MW (84,000 MW at 60 percent load factor). The current hydel installed capacity in India is about 33,941 MW.

The Government of India has undertaken several initiatives to increase the share of hydel energy in the overall energy mix and the Prime Minister’s 50,000 MW Hydro-electric initiative is one of the major steps undertaken by the Ministry of Power in this regard.

8.1 Key Issues

Government of India is addressing various issues relating to the development of hydro power. Private sector participation is also being encouraged in a big way. However key issues still remain; with the major ones being:

- **Funding:** Hydro projects involve high initial costs with one of the lowest lifetime cost of power generation. To meet the funding requirements, the Government has decided that all Central Sector projects will be provided budgetary support. It is also proposed to levy a ‘power development cess’ in the country to fund hydro projects.

- **Geological risks:** Hydro projects present geological surprises when construction starts and this leads to an increase in project cost; ultimately culminating in additional risks to the investors. Survey and investigation of the potential hydro-sites, based on advanced scientific techniques, are an essential future requirement.

- **Long delays in obtaining clearances:** Projects are delayed because of the large time taken in acquiring land, difficulty in obtaining clearances and issues related to rehabilitation and resettlement. To resolve these, it is proposed that new projects should initially be taken up by government-owned companies for activities such as – conducting investigations, updation of DPRs, obtaining the necessary clearances and execution of pre-construction work. After the completion of these stages, the projects could be offered to the private sector for execution either on a ‘stand alone’ basis or for Joint Venture participation with the state owned companies.
• **Delays due to disputes between the states:** In case of hydro projects involving more than one state, disputes between the concerned states has led to substantial potential remaining locked up. Even though many mega hydro projects were well recognised as attractive and viable, they could not be taken up for implementation for these very reasons

• **Simplified procedure for transfer of clearances:** The immediate requirement would be to transfer the clearances already accorded to non-starting hydro projects in the State Sector to the Central Sector or to Independent Power Projects (IPP) or to Joint Ventures between IPPs and the Central Sector

### 8.2 Policy and Regulatory Framework

Some of the key policy initiatives undertaken by the Government for faster development of hydro potential sector are:

• **Rationalization of Hydro Tariff:** Recognizing the difficulties in execution of hydro projects, the Government has decided to rationalize the existing hydro tariff norms, improve the incentives for better operation and design a solution to the contentious issue of computing the completion cost

• **Estimates on Completion Cost (Geological Risks):** A realistic estimate of completion cost has to take into account the geological and hydrological risks, cost escalation and natural occurrences of land slides, rock falls, etc. The developer will be allowed to submit his proposal for enhanced costs to the Government

• **Promoting Hydro Projects with Joint Ventures:** With a view to bring in additional private investment in the hydro sector, there has been emphasis on schemes through joint ventures between the public and domestic / foreign private enterprises. Relaxation in certain rules pertaining to mandatory sharing of power with neighbouring states is provided in the case of joint venture projects

• **Support for Acquisition, R&R, Catchment Area Development:** The acquisition of forest and private land involves Government procedures and difficult negotiations with the land owners. As per the policy adopted by the State Government, it is now the responsibility of the State Government to acquire the land (whether be it government-owned, private or forest) for the project and also negotiate at its own terms with the land owners. In case any cost is incurred by the developer, it would be considered as ‘cost to the project’ and allowed to be considered for tariff determination

• **Preparation of DPRs:** With the objective of reducing the time and cost overrun of hydro projects (which have largely taken place on account of poor and hasty investigation and non-availability of proper infrastructure in terms of access roads and land) the Government has recently introduced a three stage process for development of new hydro electric projects in the Central Sector. The three Stages are:
- Stage-I: Survey & investigation and preparation of pre-feasibility report
- Stage-II: Detailed investigation, preparation of DPR and pre-construction activity including land acquisition
- Stage-III: Execution of the project after investment decision through PIB/CCEA

• The Ministry of Power had come out with a set of guidelines for the development of Large Hydropower Projects (i.e. over 100 MW) by private sector through competitive tariff-based bidding. With an aim of developing the large potential of the yet-to-be-developed hydel power in states like Uttarakhand, Himachal Pradesh and the North Eastern parts of the country, the guidelines envisaged supply of surplus power to the deficit states; with host states securing benefits such as 12 percent free power

• Given the reservations expressed over the applicability of the tariff based competitive bidding process to hydro power, the government is planning to come out with a new hydel power policy for allocation and development of hydel projects by the private sector. The new policy would aim to attract private players and is likely to exclude states from following a tariff based bidding process for hydro power projects

8.3 The India Opportunity

Only about 17 percent of the vast hydel potential of 150,000 MW has been tapped so far. Countries like Norway, Canada, and Brazil have all been utilizing more than 30 percent of their hydro potential; while on the other hand India and China have lagged far behind. India ranks fifth in terms of exploitable hydro-potential in the world. As per an assessment made by Central Electricity Authority (CEA), India is endowed with economically exploitable hydro-power potential to the tune of 148,700 MW. The basin-wise assessed potential is²⁹:

<table>
<thead>
<tr>
<th>Basin/Rivers</th>
<th>Probable Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indus Basin</td>
<td>33,832</td>
</tr>
<tr>
<td>Ganga Basin</td>
<td>20,711</td>
</tr>
<tr>
<td>Central Indian River system</td>
<td>4,152</td>
</tr>
<tr>
<td>Western Flowing Rivers of southern India</td>
<td>9,430</td>
</tr>
<tr>
<td>Eastern Flowing Rivers of southern India</td>
<td>14,511</td>
</tr>
<tr>
<td>Brahmaputra Basin</td>
<td>66,065</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>148,701</strong></td>
</tr>
</tbody>
</table>

Source: Narmada Hydroelectric Development Corporation website

²⁹ http://www.nhdcindia.com/avd.html
Under the Prime Minister’s 50,000 MW hydro electric initiative, the Central Electricity Authority (CEA) has already completed the preparation of the pre-feasibility report for 162 schemes covering an installed capacity of 47,930. Most of this untapped potential lies in the North and the North-Eastern states of the country.

In addition, 56 number of pumped storage projects have also been identified with a probable installed capacity of 94,000 MW. In addition to this, hydro-potential from small, mini & micro schemes has been estimated as 6,782 MW from 1,512 sites. Therefore, in totality, India is endowed with hydro-potential of about 250,000 MW. However, only 17 percent of the hydroelectric potential has been harnessed so far and another 5 percent is under various stages of development.

While private participation is currently low at 3 percent, private participation in future will be important to meet the ambitious target of 50,000 MW capacity addition in the next ten years.

8.4 Small Hydro opportunity

Small and mini hydel projects have the potential to provide energy in remote and hilly areas where extension of the grid system is considered un-economic. Realizing this fact, the Government of India is encouraging development of small and mini hydro power projects in the country.

India has 420 small hydro power projects of upto 25 MW station capacity, with an aggregate capacity of over 1,423 MW. Over 187 projects in this range with an aggregate capacity of 521 MW are under construction.

Potential

An estimated potential of about 15,000 MW of small hydro power projects exists in India. The Ministry of Non-Conventional and Renewable Energy has created a database of potential sites of small hydro and 4096 potential sites (with an aggregate capacity of 10,071 MW) of upto 25 MW capacity have been identified.

MNRE Incentives in Small Hydro Sector

In order to accelerate development of small hydro power in the country, MNRE is giving incentives for - survey and investigation, detailed project report preparation, interest subsidy for commercial projects, capital subsidy for SHP projects in the North-Eastern region, renovation & modernization of old SHP stations and development / up-gradation of water mills.

Manufacturing Base in India

India has a reasonably well-established manufacturing base for the full range of small hydro equipment. There are over 8 manufacturers in the country in the field of small hydro, supplying various types of turbines, generators, control equipment, etc.
Renewable Energy Sources (RES) are an important element of India’s power policy aimed to meet the power needs of remote areas in an environmentally friendly way. India is the first country to have a dedicated ministry for developing and promoting non-conventional energy sources in the country (MNRE). Certain forms of renewable energy sources (such as wind energy, small-hydro and biomass) have already been able to establish a strong presence. In response to the policy and incentives extended to the participants, there is a strong participation seen from the private sector. One such example is the fact that a significant share of the wind-power based generation capacity has been set-up by the private sector.

### 9.1 Key Issues Facing the Sector

The major issues currently being faced by the renewable energy sector are as the following:

- High capital costs and low plant load factors make renewable energy more expensive. Given the heavily subsidised nature of electricity in the Indian context and the poor financial condition of the State Governments, the ability to absorb the higher cost of renewable electricity is a major concern. However, technological evolution in renewables and the huge power deficit in the country has meant that power utilities are actively looking towards renewables to complement their supply.

- Regulatory certainty on tariff and other conditions of power procurement will continue to remain crucial for maintaining private sector interest in this area.

- Adoption of renewable energy technologies in certain cases may lead to increased competition for land-use which will need to be managed whenever usage of such technologies becomes more widespread.

- In some instances, the capacity of the transmission network has also been seen to be a constraint in power evacuation. Lack of grid presence in remote areas where renewable energy opportunities may be distributed hence becomes an issue.

### 9.2 Policy and Regulatory Framework

Some of the key legislative, policy and other measures initiated by the various stakeholders for promoting RES are:

- The Electricity Act provides for State Commissions to fix a minimum percentage for purchase of energy from renewable energy sources. Some of the State Commissions have already initiated measures in this direction.

- The policy recognizes that renewable sources of energy should be offered a preferential tariff till the time that technologies evolve when they can compete with other conventional sources of electricity generation.

- The policy encourages generation and distribution of electricity in notified rural areas without any need for obtaining a licence from the State Electricity Regulatory Commissions.
• The policy encourages generation and distribution of electricity in notified rural areas without any need for obtaining a licence from the State Electricity Regulatory Commissions.

9.2 Policy and Regulatory Framework

India has an enormous potential of renewable energy across the various sources as indicated in the table below.

<table>
<thead>
<tr>
<th>RES</th>
<th>Potential</th>
<th>Existing Installed Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>45000 MW</td>
<td>~ 6190 MW</td>
</tr>
<tr>
<td>Small Hydro (upto 25 MW)</td>
<td>15000 MW</td>
<td>~ 1850 MW</td>
</tr>
<tr>
<td>Biomass power / cogeneration</td>
<td>19500 MW</td>
<td>~ 950 MW</td>
</tr>
<tr>
<td>Solar Photo Voltaic Power</td>
<td>50,000 MW (20 MW/sq.km)</td>
<td>~ 30 MW Very low exploitation.</td>
</tr>
<tr>
<td>Solar Water Heating</td>
<td>140 million sq. m collector area</td>
<td>1.5 million sq. m collector area</td>
</tr>
<tr>
<td>Urban and Industrial Waste-based power</td>
<td>70000 MW</td>
<td>~ 34.95 MW.</td>
</tr>
<tr>
<td>Biogas plants</td>
<td>12 million</td>
<td>3.8 million</td>
</tr>
<tr>
<td>Improved Biomass Chulhas (Cook-Stoves)</td>
<td>120 million</td>
<td>35.2 million</td>
</tr>
</tbody>
</table>

SOURCE: MNES Website

The current installed capacity of around 9,220 MW\textsuperscript{32} constitutes about 7.3 percent of India’s total installed generation capacity. And given that only a small percentage of it has been utilized, it offers an exciting opportunity for various participants, including generator and equipment manufacturers, to explore and establish a strong presence.

• India ranks fourth in the world in wind energy potential. Given the technological evolution happening in this sector, the growth prospects continue to be very good. High demand coupled with supply constraint has meant that turbine prices have been rising sharply. This has generated interest amongst some new entrants in this space. Technology access and availability of wind sites is going to be important for new entrants. India could also emerge as a manufacturing hub for some components for turbines for the region.

• The other area to keenly watch out for is the Solar Energy space. Technological evolution has meant that, globally, costs of electricity generated by solar PV have been coming down significantly. Moreover, some players are viewing India as a manufacturing hub for export oriented businesses. As the cost of...
power generation comes down further, India itself could emerge as a huge market for solar energy; given the high solar incidence in India (there are about 300 clear sunny days in a year in most parts of India and the daily average solar energy incident over India varies from 4-7 kWh/m², depending upon location) and the need to electrify vast remote off-grid areas. Government support in form of subsidy would play a crucial role because, unlike in developed countries, the trend would be towards remote off-grid applications where affordability is likely to be an issue

• Potential for biomass based power generation is huge due to the vast agricultural base. But for this sector to show significant growth, innovations in fuel supply chain is crucial. Sourcing of agricultural residues and wastes and optimising the logistics cost are the dual requirements for growth of this sector

• Potential for small and mini-hydel (defined as less than 25 MW) is also large and is mainly confined to the hilly states of the north and north-east part of India. Knowledge of local situation and access to good sites are needed to minimise the risks

• The final growth area is in the area of bio-fuels. The government is actively encouraging bio-diesel and ethanol. Norms for ethanol blending have already been announced. In order to promote plantations for bio-diesel, various State Governments have announced land at discounted rates. Bio-diesel based on jatropha plantation is being experimented in some states. In the recently announced Union Budget, exemption was also provided from certain indirect taxes for bio-diesel. Fiscal benefits combined with the minimum blending requirement should give bio-fuels the required policy impetus. The oil majors have already announced their intentions of entering this space.
10 Electricity

As per the Constitution of India, “electricity” falls within the concurrent jurisdiction of the Centre and the States. In most states in India, the sector consists of vertically integrated State Electricity Boards - most of which are now unbundled into Generation, Transmission and Distribution companies which continue to be state-owned. In a few States, private licensees for power distribution are also in operation. Currently only 10.6 percent of the total installed capacity is in the private sector. Distribution is privatised in the state of Orissa and some cities such as Delhi, Kolkata, parts of Mumbai, Ahmedabad and Surat in the western state of Gujarat.

10.1 Demand Supply Position and Expected Trends

The projected elasticity of electricity w.r.t. GDP is 0.95. With this, the growth rate in electricity consumption is expected to be 7.6 percent. The per capita consumption presently stands at 606 kWh (2005), far below the world average of 2,429 kWh. At an 8 percent GDP growth, the per capita consumption of India in 2032 is estimated to be 2,643 kWh, which is just comparable to the present day world average.

<table>
<thead>
<tr>
<th>Year</th>
<th>Installed Cap. Req. (GW)</th>
<th>Energy Req. (Billion kWh)</th>
</tr>
</thead>
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<tr>
<td>2003-04</td>
<td>131</td>
<td>633</td>
</tr>
<tr>
<td>2006-07</td>
<td>153</td>
<td>761</td>
</tr>
<tr>
<td>2011-12</td>
<td>220</td>
<td>1097</td>
</tr>
<tr>
<td>2016-17</td>
<td>306</td>
<td>1524</td>
</tr>
<tr>
<td>2021-22</td>
<td>425</td>
<td>2118</td>
</tr>
<tr>
<td>2026-27</td>
<td>575</td>
<td>2886</td>
</tr>
<tr>
<td>2031-32</td>
<td>778</td>
<td>3880</td>
</tr>
</tbody>
</table>

With an installed capacity of 123 GW, the country currently faces energy shortage of 8 percent and a peak demand shortage of 11.6 percent. In order to
sustain a growth rate of 8 percent, it is estimated\(^\text{36}\) that the power generation capacity in India would have to increase to 306 GW in the next ten years which is 2.5 times current levels.

10.2 Key Issues Facing the Sector

10.2.1 Socio-Political Influences
Over the decades, the power sector in India has become an instrument for implementation of State Government’s social policies. It is characterized by heavy subsidies, mostly poorly targeted and State Government’s involvement in functioning of the power utilities. This combined with poor state of State Government finances led to inadequate compensation to the power utilities contributing to degradation of the financial position.

10.2.2 High level of network losses
The power utilities in India suffer from a very high level of network losses of as much as 30 to 40 percent largely due to theft, pilferage and non-collection of dues and also due to the state of the network involving long low voltage lines. Non-realization of revenue for power generated has led to financial degradation and spiral of worsening performance.

10.2.3 High level of financial losses
Due to the reasons mentioned above, the power sector in India suffers huge financial losses to the tune of USD 6 billion per annum. These losses have accumulated over time and resulted in inadequate financial resources for capacity augmentation.

10.2.4 Inadequate Generation and Transmission Capacity
Inadequate resource generation for investments has led to generation capacity shortfall of over 15 percent. The poor financial resources of the SEB leads to their poor capacity for escrow and this acts as a major constraint for attracting private capital. Payment security mechanisms for private players have been difficult to provide on account of the financial situation. Likewise, inadequate transmission capacity in the country has led to a situation where regional surpluses remained unutilized to meet deficits elsewhere.

10.2.5 Poor Quality of Supply
Inadequate generation capacity and the poor quality of the distribution network have resulted in poor quality of supply. Supply is characterized by planned and unplanned interruptions and deviations in voltage and frequency from prescribed parameters. There has been some improvement in these parameters in recent years owing to penalties and incentives for utilities for deviations.

Lately, availability of fuel for power generation is becoming a significant constraint. Coal shortages are increasing and gas shortages are leading to a situation where plants are not able to operate to full capacity.

10.3 Policy and Regulatory Framework
Electricity being a concurrent subject under the Constitution of India, a Central level as well as a State level jurisdiction is in place. The policy framework now
hinges on bringing in competition, private sector participation and independent regulation (especially attempts bringing in independence from Government interference in state owned utilities). There is also a new emphasis on rural electrification under the Rajiv Gandhi Gramin Vidyutikaran Yojana (RGGVY).

The regulatory system now consists of a Central Electricity Regulatory Commission (CERC) regulating all matters pertaining to more than one state, State Electricity Regulatory Commissions (SERC) for matters within a state and an Appellate Tribunal (being the higher court of appeal against the two regulators). In addition, there is a Central Government authority – the Central Electricity Authority (CEA) responsible for power planning for the country and according approvals for large hydro projects.

The legislative framework is governed by the Electricity Act, 2003. This along with subsequent policies including the National Tariff Policy, the National Electricity Policy and the Rural Electrification Policies define the policy landscape. With the growing maturity of the India power sector and also growing realization by the Indian power utilities a number of elements of the new act are getting operational. The main enablers for competition are:

- All new generation in private sector has to be contracted through competitive bidding and even in case of public sector the same should be done in five years time. Regulated pricing applies only when competitive bidding has not been adopted. A number of states like have initiated the bidding process from the private sector for long term procurement of power through competitive bid process using price as the basis of determination of suppliers.

- Open access on common carrier principle is allowed on transmission networks and is being phased in on distribution networks. This enables competition in procurement of bulk power as well as in retail supply to large consumers who will soon be able to contract supply on their own. There are issues related to cross-subsidy surcharge in retail supply which is a surcharge payable by the supplier or consumer to the incumbent to compensate for loss of cross-subsidy. The National Electricity Policy lays down that the amount of cross-subsidy surcharge should not be so onerous that it eliminates competition which is intended to be fostered in generation and supply of power directly to the consumers through open access.

- Provisions for parallel competitive distribution networks in existing areas are made. However, parallel networks are likely to come up only in areas where the existing network is in very poor state and the consumer profile is very favorable.

The national tariff policy now also requires reduction of cross-subsidies in tariffs and bettering targeting of Government subsidies.

The policy allows 100 percent Foreign Direct Investment (FDI) in generation (other than atomic reactor power plants), transmission, distribution and trading. There is no limit on the project cost and quantum of FDI.
10.4 The India Opportunity

10.4.1 Generation
In generation segment, opportunities exist due to the large demand-supply shortfall. A number of private projects have come up in recent times. While most of the generation would be sold through long-term contracts, there is a policy focus on enabling open access that would allow generators to sell directly to large consumers. In the bulk power market too, short-term prices of power have risen steadily and sharply reflecting the demand-supply position. This and the evolving power trading market will give an impetus to merchant plants. We are beginning to see instances of merchant plants coming up in the country.

The Government has also initiated the setting up of ultra mega power projects (projects of size greater than 4,000 MW). The concept involves a Government agency doing the preparatory work related to land acquisition, environmental clearances etc. and then awarding the projects to private developers on a competitive basis. The bidding process of two of the UMPPs Sasan and Mundra based on domestic and imported coal respectively has led to a new and much lower price discovery for long-term power contracts. Bidding process for four more UMPPs is expected to be conducted by end of 2007.

Generators can also take up coal mining for captive use. These measures along with fiscal concessions for large generation projects such as waiver of customs duty make this a very attractive opportunity.

The opportunity for generators appears to be brighter than what it was earlier. This is substantially different from the approach adopted in the 1990s IPP policy. The present policy is focusing on the entire value chain - a focus on improving the health of existing distribution segment including a push for franchising, interlinking of grids, increased transmission capacity, opening up of new market for industrial/high value consumers through open access, power trading and efforts to create a power exchange. Based on Government’s plans, by 2012, a capacity addition of 76,460 MW has been identified through the public and private sectors.

10.4.2 Transmission
Private investments in transmission can be through Independent Power Transmission Company (IPTC) or a Joint Venture Company (JVC). Under the IPTC route, the private promoter will have 100 percent ownership, whereas, in the JVC route a minority holding will reside with the state owned Central Transmission Utility (CTU) viz. PGCIL.

Both forms of private participation are envisaged in creation of the National Grid37 along with the CTU. The required capital outlay for this purpose is around USD 4.4bn. There are issues relating to payment security and obtaining right of way (ROW), environmental clearances, etc. that need to be addressed to promote private investment.

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37 Formation of the National Grid is a plan for strengthening of the inter-state and inter-regional transmission network that will enable unrestricted flow of electricity across regions and enable development of a deep electricity market in India
The new approach to bring in private sector investment in transmission was taken on the lines of Ultra Mega Power Project where two shell companies have been promoted by REC and PFC. The shell companies would take all the clearances and the project will be awarded to the transmission service provider (TSP) based on tariff based competitive bidding process. Currently, the EOI stage has been reached and the final bids for these projects are expected in next few month. If this is successful, many other transmission projects may be put up on the same lines.

10.4.3 Distribution

While the experience of private participation in this segment has not been to the expected level, the recent policy initiatives provide adequate signals in terms of attractiveness of this segment for private investment. The Act provides for parallel and second distribution licensee in same area of supply, which enables setting up parallel distribution lines (and arguably more efficient ones) in specific areas.

Privatization of existing distribution utilities is possible, though good opportunities are few owing to the large risks involved. Till risks related to measurement of operational parameters such as losses (due to inadequate metering), regulatory risks (due to relative immaturity and lack of sufficient independence from Government), information risks (state of assets in the ground) and political risks (preventing cost reflective tariffs) are not minimized, the privatization opportunities may be limited. However, privatization of urban areas might be a possible opportunity in the future (privatization of Delhi distribution in 2002 is an example) as also opportunities related to franchising of certain distribution operations.

In the immediate future, distribution franchising seems to be the way out to bring in the private sector players in power distribution. The successful handover of a circle in the state of Maharashtra to a private player is a welcome development. The challenges for making distribution franchising a success are the following:

- The distribution area needs to be packaged, in terms of the load profile and consumer mix, such that good players in private sector are interested
- Due diligence is done to ensure that the baseline data is reliable and saleable
- Improvement trajectories are well defined to ensure that the commercial and technical improvements brought in by the franchisee are in line with the international standards

10.4.4 Trading

Power trading volumes in India, though small, have been growing steadily over the years. Investment opportunities arise due to the following:

- Open access in transmission and distribution networks will facilitate trading and enable direct sales to large consumers.
• The policy of allowing 100 percent FDI in power trading will result in entry of foreign players in the trading market and the depth and maturity of the market will increase.

• While inadequate transmission is a constraint at present, efforts of the Government to enhance transmission capacity including inviting private participation and setting up of National Grid are expected to address this.

• There is an emerging trend of new private generators selling power to traders rather than financially weak distribution utilities. Traders are in a better position to manage risks relating to payments and demand uncertainties. Besides, with rising short term prices of electricity, traders have the potential to earn larger returns. However, there are issues relating to regulating trading margins which are the current subject of much debate.

• The issue of guidelines by the Central Regulator and efforts to set up the power trading exchange will go a long way in maturing of the Indian power trading market and will assist in bringing in the required depth, transparency and structure to the market.

10.4.5 Energy savings and Demand Side Management

A study for the Asian Development Bank (ADB, 2003) estimated an immediate market potential of energy saving of 54,500 million kWh (which is 16 percent of the total demand) and peak saving of 9,240 MW. This has an investment potential of over USD 3 billion. Additional savings are possible by reduction of auxiliary consumption in generation plants. Investment in this area is also likely to aid in reducing carbon emissions and therefore, part of the investments can also be financed through the Carbon Credits generated.

Some of aspects which need attention in order to encourage energy efficiency (EE) are:

• Incentivising investment in EE by the utility by allowing them to keep the savings achieved on EE for any investment made by the utility

• Developing novel financing mechanism for funding EE for energy service companies

• Developing consumer awareness and making EE labeling mandatory for all high energy consuming equipments.

• Setting of the load research centers with the regulators so that load research can be carried out, if possible, at the equipment level in a most scientific manner.

10.4.6 Equipment manufacturing

The large growth needs implies growing demand for generators, lines and equipment, meters, etc. While it is estimated that the existing manufacturing capacity in the country can support addition of about 6,000 MW of capacity, the future requirement is 15,000 MW every year for the next ten years.
## Annexure: Few Major Players in India

<table>
<thead>
<tr>
<th>No</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coal Sector</td>
</tr>
<tr>
<td>1</td>
<td>Coal India Ltd</td>
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<td>Exploration and Production</td>
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<td>1</td>
<td>NTPC Limited</td>
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<tr>
<td>2</td>
<td>National Hydroelectric Power Corporation (NHPC)</td>
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<tr>
<td>3</td>
<td>Nuclear Power Corporation (NPC)</td>
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<tr>
<td>4</td>
<td>BBMB</td>
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<td>5</td>
<td>NEEPCO</td>
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<td>6</td>
<td>GVK</td>
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<td>7</td>
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<td>8</td>
<td>Lanco</td>
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<td>9</td>
<td>Essar</td>
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<td></td>
<td><strong>Transmission</strong></td>
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<tr>
<td>1</td>
<td>Powergrid Corporation (PGCIL)</td>
</tr>
<tr>
<td></td>
<td><strong>Generation &amp; Transmission</strong></td>
</tr>
<tr>
<td>1</td>
<td>DVC</td>
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<td></td>
<td><strong>Generation, Transmission &amp; Distribution</strong></td>
</tr>
<tr>
<td>1</td>
<td>Tata Power</td>
</tr>
<tr>
<td>2</td>
<td>Reliance Energy</td>
</tr>
<tr>
<td>3</td>
<td>CESC Limited</td>
</tr>
</tbody>
</table>
## India Demographics

<table>
<thead>
<tr>
<th>Population:</th>
<th>1.08 billion(^{39}) (July 2005 est.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic Size:</td>
<td>3.28 million square</td>
</tr>
<tr>
<td>Ethnic groups:</td>
<td>Indo-Aryan 72 percent, Dravidian 25 percent, Mongoloid and other 3 percent (2000):</td>
</tr>
<tr>
<td>Languages:</td>
<td>English; Hindi is the national language and primary tongue of 30 percent of the people; Other languages: Bengali, Telugu, Marathi, Tamil, Urdu, Gujarati, Malayalam, Kannada, Oriya, Punjabi, Assamese, Kashmiri, Sindhi.</td>
</tr>
<tr>
<td>Religions:</td>
<td>Hindu 80.5 percent, Muslim 13.4 percent, Christian 2.3 percent, Sikh 1.9 percent, other 1.8 percent,</td>
</tr>
<tr>
<td>Climate:</td>
<td>varies from tropical monsoon in south to temperate in north</td>
</tr>
<tr>
<td>Currency:</td>
<td>Indian Rupee(INR)</td>
</tr>
<tr>
<td>Key memberships:</td>
<td>ASEAN (dialogue partner), G-6, G-15, G-24, G-77, International Labor Organization, International Monetary Fund, SAARC, SACEP, SCO (observer), WHO, WIPO, WMO, WToO, WTO</td>
</tr>
</tbody>
</table>

\(^{39}\) US World Fact Book
The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavor to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.