# Summer Internship Report

On

# "Bridging the Coal Demand – Supply Gap through Imports & Roadmap to Coal Logistics"

Under the Guidance of

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MBA (Power Management)

National Power Training Institute
An ISO 9001 & ISO 14001 Organization
(Ministry of Power, Govt. of India)

Sector-33, Faridabad, Haryana.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
(A State University established under Haryana Act No. XXV of 1975)

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## DECLARATION

I, **Shriniwas Sunkewar**, Roll No **112**, Registration No.: **12NPTIF0084** student of **MBA - Power Management** (2012-14) XI$^{th}$ Batch at **National Power Training Institute**, **Faridabad** hereby declare that the **Summer Training Report** entitled **"Bridging the Coal Demand – Supply Gap through Imports & Roadmap to Coal Logistics"** is an original work and the same has not been submitted to any other Institute for the award of any other degree.

**A Summer Internship Presentation & Report was Presented and submitted on _____ and the suggestions as approved by the faculty were duly incorporated.**

_____ _____

**Signature of the Guide** **Signature of the Candidate**

**Countersigned**

**Director/Principal of the Institute**

## CERTIFICATE

## ACKNOWLEDGEMENT

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Thank you all for being there for me always.

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## EXECUTIVE SUMMARY

Coal is the most abundant fossil fuel resources in World. According to world coal institute over 860 billion tonnes of coal reserves are available in the world. In other words the economically recoverable reserves will last 130 years whereas Oil and Natural gas reserves will last up to 42 years and 60 years respectively.

Coal is the predominant source of energy in India and it has significant contribution in the rapid industrialization of the country. A cumulative total of 285862.21 Million Tonnes of Geological Resources of Coal have so far been estimated in the country. Coal India ltd. (CIL), world's biggest coal producing company, produces 77% of All India production. Power sector is biggest consumer of coal in India almost 67%.

As there is a gap in demand of coal and supply by Indian coal companies, so the power companies has to look for imported coal to fulfil their demand. Besides this the Indian coal is of poor quality having high ash content also suggests for a blend with high grade low ash coal. Transportation facilities also suffer a lot as demand and source stations are far situated. So for the western demand centres it is preferred to imported coal at ports.

The objective of the Project is to study about the various sourcing of coal (domestic + international) which is feasible for thermal power plant. The study focuses on the existing linkage of coal from CIL and also the implication to get fuel linkage. A thorough study of E-Auction done by CIL is analyzed in detail. As the demand for coal is increasing, consumers to meet their demand by Mining & Acquisition abroad or through import from countries like Indonesia, South Africa, Australia and evolving options for importing countries like Mozambique.

The present (30$^{th}$ June 2013) installed capacity of Indian power plant is over 225793.10 MW, of which around 132288.39 MW is from coal based thermal power plant. Nearly around 58.58 % of the generated power is from coal based power plant. The main source of the coal for the TPP is domestic coal. But due to various reasons the availability of domestic coal and

their linkages to power plant is been critical nowadays. So, study on availability of coal is a must in the coming scenario.

The second part of the project deals with the detail study of Supply chain challenges and present infrastructure of the coal logistics. The study tells about the complexity of the logistics and the demand projection of infrastructure needed for coal transportation. An analysis is done to estimate the requirement of the logistics and steps taken to strengthen the infrastructure.

The Internship project is to study and explore the coal sourcing and infrastructure required for handling coal in plant. Seeing the present and future coal supply and demand gap, it has become mandatory for power generation Company to analyze its coal sourcing option to meet its present and future requirement.

For this purpose company has to rethink on coal sourcing option and have to utilize a right mix of various options, so that cost of production will be minimum catering to its business. Various coal sourcing options are as follows:

- Linkage coal
- Imported coal
- E-Auction Coal
- Washeries & Rejects coal

Along with this, project will provide the detailed study of coal handling infrastructure keeping in view the future infra required for sustainable plant operations and to deal with coal logistics challenges and opportunities. As the plant operation mainly depends on fuel supply, so making fuel available to plant is utmost important task. To receive and handle this volume of coal, infrastructure development outside plant and inside plant is required. So, our focus in this project is on the infrastructure required for coal handling in plant. This project will find out the bottlenecks of the present coal handling Infrastructure and additional infra development required for future's sustainable plant operations.

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## LIST OF ABBREVIATIONS:

| | |
|---|---|
| ACQ | ANNUAL CONTRACTED QUANTITY |
| ADB | AIR DRIED BASIS |
| ARB | AS RECEIVED BASIS |
| BOL/ BL | BILL OF LADING |
| BOP | BALANCE OF PLANT |
| CEA | CENTRAL ELECTRICITY AUTHORITY |
| CERC | CENTRAL ELECTRICITY REGULATORY COMMISSION |
| CHP | COAL HANDLING PLANT |
| CIF | COST, INSURANCE & FREIGHT |
| CIL | COAL INDIA LIMITED |
| CPP | CAPTIVE POWER PLANT |
| DO | DELIVERY ORDER |
| ESP | ELECTRO-STATIC PRECIPITATOR |
| FSA | FUEL SUPPLY AGGREEMENT |
| GAR | GROSS AS RECEIVED |
| GCV | GROSSCALORIFIC VALUE |
| GDP | GROSS DOMESTIC PRODUCT |
| GIS | GEOGRAPHICAL INFORMATION SYSTEMS |
| IEGC | INDIAN ELECTRICITY GRID CODE |
| IPP | INDEPENDENT POWER PLANT |
| Kcal/Kg | KILO CALORIE PER KILOGRAM |
| LOA | LETTER OF ASSURANCE |
| LOC/ LC | LETTER OF CREDIT |
| MCL | MAHANADI COAL FIELDS LIMITED |
| MGR | MERY-GO-ROUND |
| MT | METRIC TONNE |
| MTPA | MILLION TONNES PER ANNUM |
| MU | MILLION UNITS |
| MW | MEGAWATT |
| NCDP | NEW COAL DISTRIBUTION POLICY |
| NM | NAUTICAL MILES |
| PAF | PLANT AVAILABILITY FACTOR |
| PLF | PLANT LOAD FACTOR |
| PO | PURCHASE ORDER |
| PPA | POWER PURCHASE AGREEMENT |
| RBCT | RICHARDS BAY COAL TERMINAL |
| RR | RAILWAY RECEIPT |
| TM | TOTAL MOISTURE |
| VM | VOLATILE MATTER |

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# CHAPTER 1

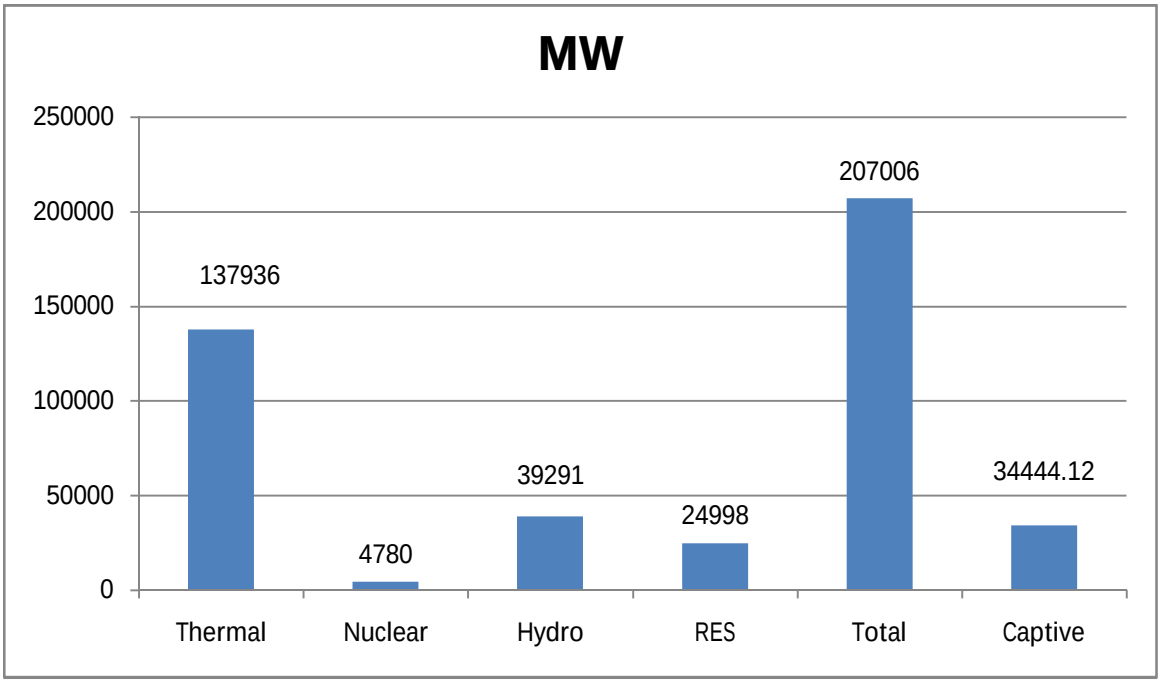
## ABOUT TO PROJECT

## 1. INTRODUCTION:

### 1.1 REVIEW OF INDIAN POWER SECTOR:

Over the years, the Electricity Industry has made significant progress, Installed capacity increased from 1,700MW (1950) to 225793.10 MW (30th June 2013) annual per capita electrical energy consumption is increased from 16 kWh/annum (1950) to over 778 kWh/annum (2012).

Figure 1-1: All India Generating Installed Capacity (MW)




Source: Ministry of Power (Data as on 31.08.2012)

**Indian Economy & Power Requirement:**

India experienced unprecedented economic growth of 8% [1] for the last several years. Even after factoring recent developments in global economy & local scenario, India is likely to maintain 9% [2] economic growth over 12th FYP. These growth rates are fairly higher than the economic growths observed in developed world and they are likely to increase our energy requirement at even higher rate.

[1] Report of the working group on power for 12th plan
[2] Report of the working group on power for 12th plan

India is currently facing energy shortage of 8.5% and peak shortage of 10.3% [3]. As per the 12th FYP, India's energy demand will grow 6% per annum and we would require installed power generation capacity of about 100 GigaWatts (GW). The power requirement, besides economic growth, is also driven by Government's aim to provide "power for all". Given the above scenario, it is becoming increasingly important for India to operate existing generation assets at peak of their capacity besides new capacity additions. A number of plants today are running at sub-optimal plant load factor (PLF)[4] levels due to various issues like fuel shortages, unplanned shut-down due to poor maintenance and time taken to rectify the problems. While, we have observed improvements in (PLF) of generating plants (from 57.1% in year 1992-93 to 75.1% in year 2010-11) [5], still there is significant improvement possible.

### 1.1.1 POWER GENRATION IN INDIA:

The capacity addition during the 11th five year plan FYP has been the highest till date in any FYP. As on 31st March 2012 the total generation stood at 199877.03 MW[6] as per the CEA report. The details of this generation capacity based on type of generation capacity and ownership of generation capacity is outlined in the following diagram

**Table 1-1: The Growth of power generation in various FYP**

| Plan/Year | Thermal | | | | Nuclear | Hydro | RES | Total |
|---|---|---|---|---|---|---|---|---|
| | Coal | Gas | Diesel | Total | | | | |
| End of 6th FYP | 26311 | 542 | 177 | 27030 | 1095 | 14460 | 0 | 42585 |
| End of 7th FYP | 41237 | 2343 | 165 | 43745 | 1565 | 18308 | 18 | 63636 |
| End of 8th FYP | 54154 | 6562 | 294 | 61010 | 2225 | 21658 | 902 | 85795 |
| End of 9th FYP | 62131 | 11163 | 1135 | 74429 | 2720 | 26269 | 1628 | 105046 |
| End of 10th FYP | 71121 | 13699 | 2102 | 86915 | 3900 | 34654 | 7761 | 132330 |
| End of 11th FYP | 112022 | 18381 | 1200 | 131603 | 4780 | 38990 | 24503 | 199877 |

**Source: Planning Commission.**

[3] National Electricity Plan (volume 1) Generation Report, January 2012

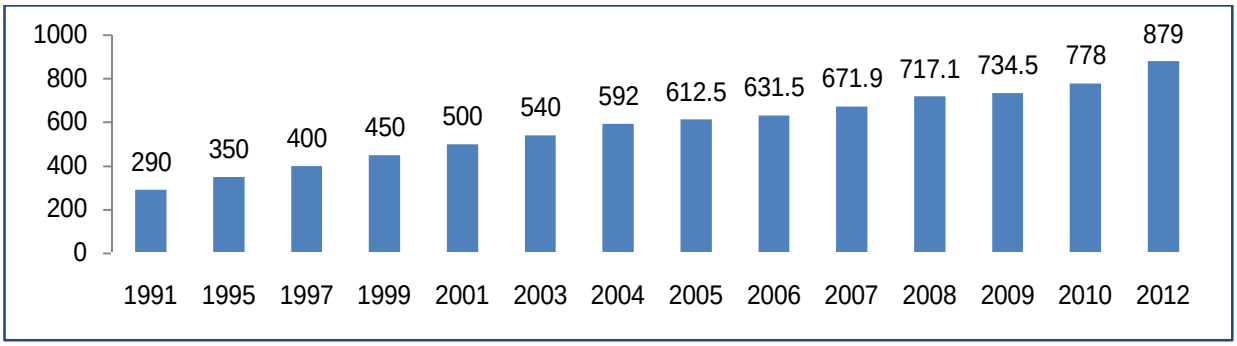
[4] CEA: Definition of PLF = [ (Energy generated during the period x 100) / (C x H)]
Where, C = Total capacity (MW) & H = Total Hours in the period under review.

[5] CEA: Operation performance of generating stations in the country during the year 2010-11.

[6] CEA: Growth of installed capacity since 6th FYP.

The total energy consumption/availability in India was 837 BU (LGBR Report-2011-12-CEA) making India the sixth largest energy consumer in the world. The per capita electricity consumption has also increased to about 767 kWh. The graph shows the increase in per capita energy consumption in India in the past two decades.

**Figure 1-2: Per Capita Energy Consumption in India (in kWh)**




**Source: Central Electricity Authority**

### 1.1.2 COAL REQUIREMENTS OF INDIA:

India is the fourth largest consumer of energy in the world after USA, China and Russia but it is not endowed with abundant energy resources. It must, therefore, meet its development needs by using all available domestic resources of coal, uranium, oil, hydro and other renewable resources, and supplementing domestic production by imports. High reliance on imported energy is costly given the prevailing energy prices which are not likely to soften; it also impinges adversely on energy security. Meeting the energy needs of achieving 8 per cent– 9 per cent economic growth while also meeting energy requirements of the population at affordable prices therefore presents a major challenge. It calls for a sustained effort at increasing energy efficiency to contain the growth in demand for energy while increasing domestic production as much as possible to keep import dependence at a reasonable level. Energy is one of the most critical components of infrastructure that determines the economic development of a country. The growth rate of demand for power is generally higher than the GDP (Gross Domestic Product) growth rate.

In order to achieve economic growth of 8-9%[7] in terms of GDP, country's total coal demand, even after allowing for the slippages that have occurred in the current plan period, has been projected to increase from the present ~ 730 million tons in 2010-11 to ~ 2,000

[7] **Planning Commission Report**

million tons in 2031-32. Of this, about 75 % of coal would go to power plants. Given the projected increase in coal requirement, the domestic coal industry alone cannot fully meet the demand. Present demand–supply gap is around 85 million tons and it is expected to increase gradually to nearly 140 million tons by 2017.

**Table 1-2: Projected Coal Demand (Million Tons)**

| Sector | 2005-06 | 2006-07 | 2011-12 | 2016-17 | 2021-22 | 2026-27 | 2031-32 |
|---|---|---|---|---|---|---|---|
| **Electricity (A)** | 310 | 341 | 539 | 836 | 1040 | 1340 | 1659 |
| **Iron & Steel** | 43 | 43 | 69 | 104 | 112 | 120 | 150 |
| **Cement** | 20 | 25 | 32 | 50 | 95 | 125 | 140 |
| **Others** | 53 | 51 | 91 | 135 | 143 | 158 | 272 |
| **Non-elect. (B)** | 116 | 119 | 192 | 289 | 350 | 403 | 562 |
| **Total (A) + (B)** | 426 | 460 | 731 | 1125 | 1390 | 1743 | 2221 |

Figures for 2011-12 and 2016-17 are of the Working Group for 11th FYP estimate and for 2031-32 are of the Integrated Energy Policy Report. Figures for intervening years have been extrapolated.

**Source: Ministry of coal & Planning Commission Report**

### 1.1.3 COAL RESERVES:

Coal is the most common used fossil fuel used in the power plant to generate electricity. Next to oil and gas the conventional resource which is available is coal. But oil & gas is a costly product and India is rich in coal. So, for most of the primary energy purpose coal is used. Coal fired generation in India accounts for 56%[8] of the total installed generation capacity and all future estimates of capacity addition show that coal will continue to be the dominant fuel source despite the recent short supply in the domestic coal. The Coal reserves of India up to the depth of 1200 meters have been estimated by the geological survey of India at 293.497 billion tonnes as on 01.04.2012. Coal deposits are chiefly located in Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Andhra Pradesh and Maharashtra. The envisaged coal based capacity for the 12th plan period is 62,695 MW i.e. 82.7% of the

[8] **Coal India Limited & Ministry of Coal**

total proposed capacity addition (75,785 MW).India has the total coal reserve of 293 billion tonne as on April, 2012 against 285.86 billion tonne on April, 2011.

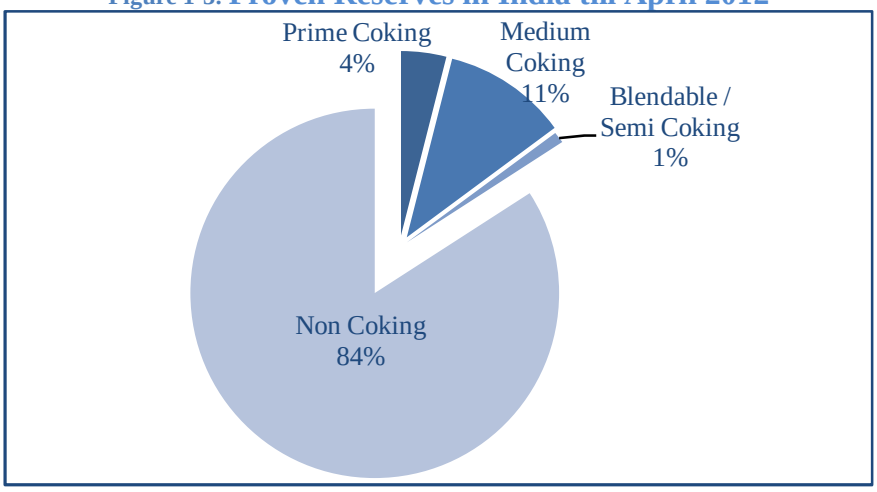
As a result of Regional, Promotional and Detailed Exploration by GSI, CMPDI and SCCL etc, the estimation of coal resources of India has reached to 2,93,497 Million Tonnes. The estimates of coal resources in the country during last 5 years are given below: (in Million Tonnes)

**Table 1-3: Status of Coal Resources in India during Last Five Years:**

| As on | Geological Resources of Coal | | | |
|---|---|---|---|---|
| | Proved | Indicated | Inferred | Total |
| 1.4.2007 | 99060 | 120177 | 38144 | 257381 |
| 1.4.2008 | 101829 | 124216 | 38490 | 264535 |
| 1.4.2009 | 105820 | 123470 | 37920 | 267210 |
| 1.4.2010 | 109798 | 130654 | 36358 | 276810 |
| 1.4.2011 | 114992 | 137471 | 34390 | 285862 |

**Source: Ministry of Coal & Geological survey of India**

**Figure 1-3: Proven Reserves in India till April 2012**

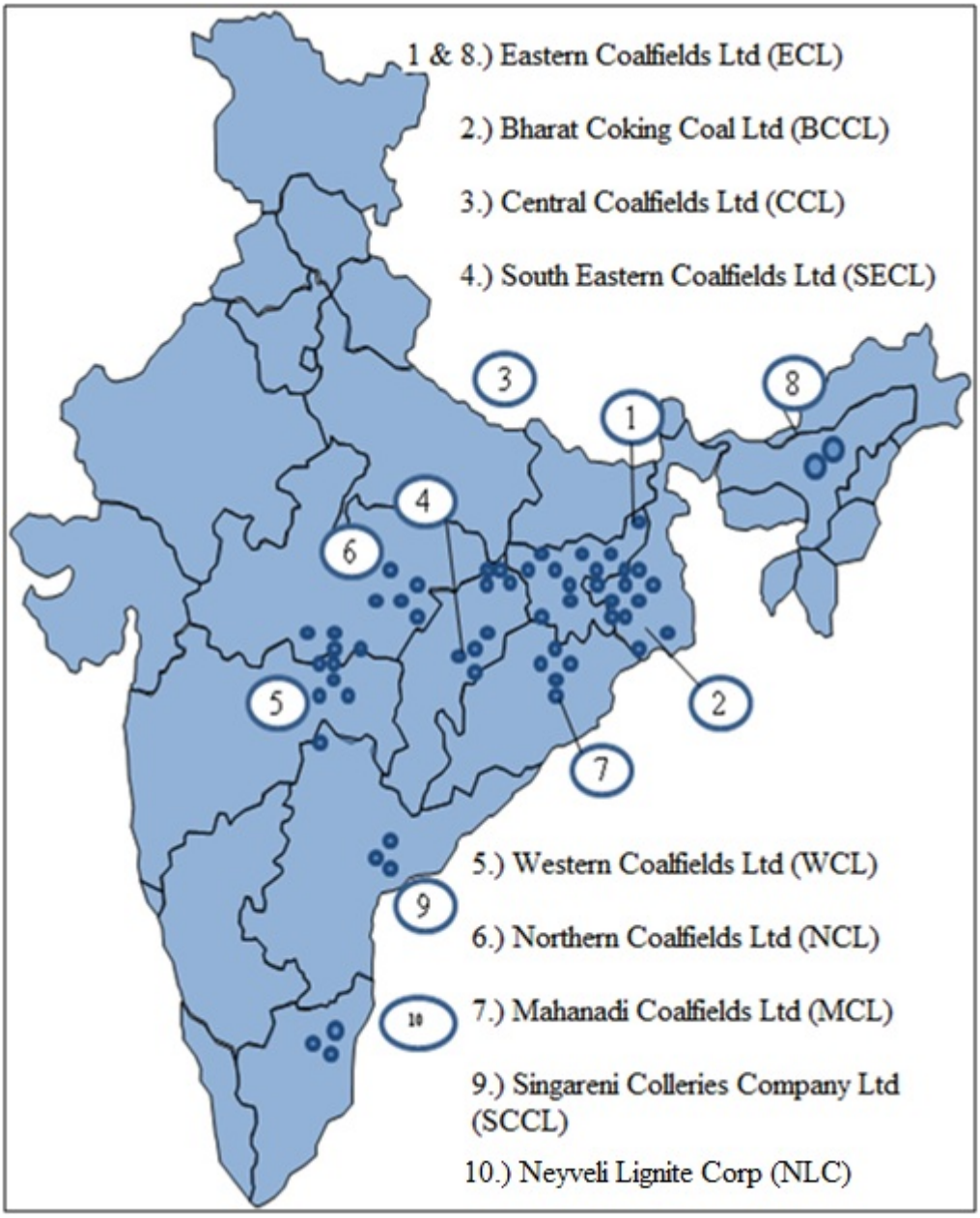



**Source: Ministry of Coal**

The coal reserve in India is unevenly distributed in the country. The central and the eastern part of the country is rich source of coal, while the consumption of coal is equally distributed throughout the country. In electricity generation the share of coal is highest with more than 55% of electricity production depend on coal.

CIL, Maharatna Company with 8 subsidiaries[9] has the maximum coal reserve in India The other company in coal production is Singraeni Collieries Co. Ltd and Neyveli lignite Corporation.

Figure 1-4: **Coal Reserve in India Coalfield wise**




**Source: COAL INDIA LIMITED**

The figure clearly explains the complexity of the coal reserve in India. The coal is concentrated high in one place while the power plants or the coal consumers are spread all over the country. So, there is required to manage the much needed coal reserve in the best efficient manner.

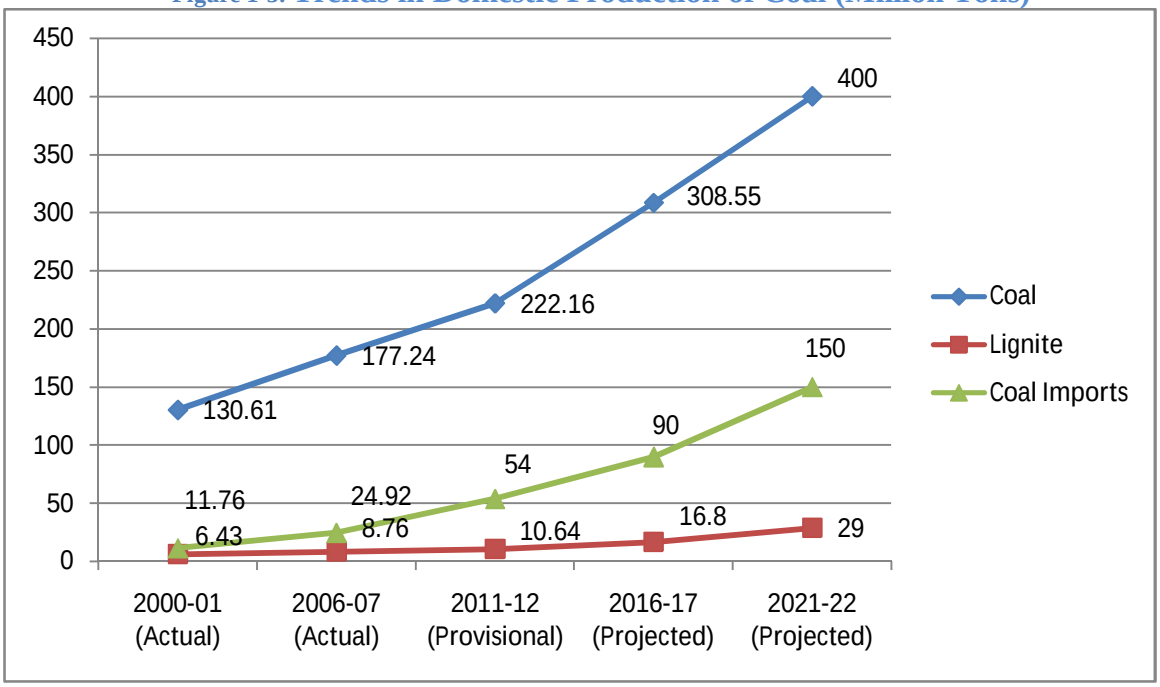
[9] **Coal India Limited Subsidiaries**

### 1.1.4 COAL PRODUCTION

Coal reserves have been distributed worldwide. In India we are having a very huge resource of around 250 billion tonnes. In spite of this huge reserve, still our Indian power plants and coal consumers are starving for coal. As per CEA the power plant has to maintain a minimum stock level of 15 days for Pithead[10] based TPP (Thermal Power Plant) and for other TPP it varies from 20 to 30 days depends upon their distance from the power plant. But still out of the 85 operational coal based TPP, ten TPP are running at a critical stock level of less than 7 days and nine TPPs are running at a super critical stock level of less than 4 days in FY2011.

So, there is a need to optimize the various coal sourcing option that are available to coal consumers both domestic and international based for the demand and need of the end users. Coal consumers have to opt for the different combination that suit best for them. The need for logistics for transportation of coal from mine to end use plant is also play a crucial role while going for different sourcing option and need of investment in infrastructure for expansion is a demand of the market.

**Figure 1-5: Trends in Domestic Production of Coal (Million Tons)**




**Source: Planning Commission (12th five year plan 2012-2017)**

[10] A **pit-head** plant means a plant at the coalmine itself so that there is no need to transfer the coal to the plant

### 1.1.5 COAL – DEMAND & SUPPLY GAP:

It is estimated that at the beginning year of 12th Five Year Plan (2012-13), the demand is projected to increase to about 778 Million Tonnes, Where as the indigenous availability be about 580.30 Million Tonnes. Therefore, there is likely to be a gap of 192.54 Million Tonnes, Which is required to be met through imports.

**Table 1-4: Coal Supply & Demand Gap (in Million Tonnes)**

| Source | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 12th Five year Plan Projected (2016-17) |
|---|---|---|---|---|---|---|
| **Supply** | 343.00 | 514.56 | 524.09 | 535.15 | 580.30 | 795.00 |
| **Demand** | 378.00 | 597.98 | 656.31 | 696.03 | 772.84 | 980.50 |
| **Gap to be met through imports** | 35.00 | 83.43 | 132.22 | 160.88 | 192.54 | 185.50 |
| **Total Imports** | 16.10 | 73.26 | 68.92 | 102.85 | 192.54 | 185.50 |

**Source: Ministry of Coal**

The availability may increase to 795 Million Tonnes at the maximum, subject to availability of requisite land for coal mining and all clearances in time. Therefore, the gap between the demand and indigenous availability is projected to be in the range of 185.5 Million Tonnes in the minimum to 265.5 Million Tonnes in the maximum. This gap is to be bridged by import of coal, The report predicts likely power demand of 1392 Billion Units in 2016-17 and if coal based thermal power plants continue to meet 70% of the power requirement of the country, coal based generation would be around 974 Billion Units, for which requirement of coal would be around 682 Million Tonnes if specific coal consumption remains at 0.70 Kg/Unit. As per the revised estimate, the demand of coal in the country in the terminal year (TY) of XI plan (2011-12) will be around 650 Million Tonnes against which indigenous availability would be around 545 Million Tonnes, leaving a gap of 105 Million Tonnes to be met through import.

### 1.1.6 REASONS BEHIND COAL DEMAND & SUPPLY GAP:

The main problem in the supply demand gap in the domestic coal is due to:

- Most of the coal mining areas are announced as No-go areas by Ministry of Environment & Forest.
- Insufficient Rail wagons and Rail infrastructure.
- Poor Loading/unloading infrastructure.
- Operational Inefficiencies & coordination issues.
- Sudden increase in demand.

**Bottlenecks in Exploration and mining Activities:**

Environmental considerations and land acquisition issues are hurting. Many of CIL exploration field fall in the No-Go Zone area as specified by the Ministry of Forest and Environment earlier. After the classification, around 203 coal blocks with reserves of over 600 million tonne in nine major coalfields had been barred from any mining activity.

According to Planning Commission data, the power sector alone was losing potential production of 143,000 mw of power due to the Ministry of Environment & Forestry policy.

**Main reasons for slippage in the implementation of projects:**

- Delay in acquisition of land and associated problems of rehabilitation.
- Delay in diversion of forest land and associated problems of rehabilitation.
- Delay in grant of Environmental & Forest Clearances.
- Delay due to adverse geo-mining condition.
- Delay due to restriction in exploration in forest area by MoEF.
- Other misc. problems such as delay or discontinuance of work by contractor, non participation in tender, DGMS permissions.

**Reasons for the Delay in Exploration & Transportation of Coal from mine to End User:**

| Sr. | Reasons | Indicators |
|---|---|---|
| 1 | Delay in Land Acquisition | Under the 11$^{th}$ five year plan, the envisaged land acquisition was greater than 6,000 Ha, against it, CIL was able to acquire only 25,000 Ha i.e. 40% of the target |
| 2 | Embargo imposed in view of comprehensive environmental pollution index (CEPI) | Pollutant concentration, expedience factors, impact on human health and level of exposure have been taken into consideration for the calculation of pollution indices for air, water and land (ground water) all these factors affect the coal movement. |
| 3 | Delay in Forestry & Environmental Clearances | Average time for stage I forestry clearance is about 4 years. Average time for stage II clearance is 3 years. Thus the total time for Forestry Clearance is 7 years against the normative time of 2-3 years. |
| 4 | Mismatch between production & Transport Capacities | In the last 8 years coal stock has been increased by approx 53 MT dye to non-availability of sufficient railway rakes. |
| 5 | Delay in Construction of New Railway Lines | Strikes and Natural calamities also effect the construction of New Railway Lines in Expanding Coalfields |
| 6 | Law & Order Problems in Jharkhand & Odisha. | Naxal problems and Curfews also affect the Coal Movement. |

## 1.2 PROBLEM STATEMENT

The demand for the coal has increase exponentially and reached to 696MT in FY12. It is estimated that at the beginning year of 12th Five Year Plan (2012-13), the demand is projected to increase to about 778 Million Tonnes, Where as the indigenous availability be about 580.30 Million Tonnes. Therefore, there is likely to be a gap of 192.54 Million Tonnes, Which is required to be met through imports. The sourcing demand of coal as primary fuel creates a huge demand supply gap and left various plant to run below their rated capacity. The constraints in the coal logistics also create a barrier as 17% of total coal production by CIL can't be supplied to coal consumers due to non-availability of rakes and infrastructure. In addition to that regulatory framework, financial risk as well as various technical risks due to which there is always a dilemma in choosing among various sourcing option. No coordination or mismatch between the development of infrastructure and required as per demand create a bottleneck in the whole coal transportation system.

This report is produced to study challenges facing by the power producers due to coal demand-supply gap and to provide best possible option to bridge this gap and also to analyze roadmap to coal logistics.

## 1.3 SIGNIFICANCE OF THE PROJECT:

The project has been carried out after observing the current scenario of coal for various power plants including Sterlite Energy Limited. A new thermal power plant needs to have out of box thinking thereby to survive in this competitive power sector. Thus, a basic research report has been prepared keeping in view the various pros and cons of the import options to Sterlite Energy Limited.

## 1.4 OBJECTIVE OF THE PROJECT:

The objective of the project is to find out the best coal sourcing option (Domestic + International) in India to bridge the coal demand- supply gap. As the demand for coal is increasing day by day so, the primary fuel coal reliability is a

major concern for various coal consuming sectors. The project will give the detailed feasibility analysis of various coals sourcing option available to coal consumers and comparative analysis of the different sourcing option. As the problems in the domestic coal are increasing day by day, so dependency on imported coal by the Indian thermal power plant is an unavoidable factor.

Not only implication and complexity in choosing the best coal sourcing option but also the bottlenecks in the logistics part for transportation of coal from coal mines to consuming area is also studied in detail. Main area of analysis deals with study of challenges faced by the power producers due to coal demand-supply gap and to provide best possible option to bridge this gap and also to analyze roadmap to coal logistics.

## 1.5 SCOPE OF THE PROJECT:

The project is to find out viable coal resources for importing coal to India. There are number of countries available for importing coal to India, but all countries are not economically viable for India. As India has a vast coastal line of 7517 km, so coal transport through sea will be the cheapest mode of transportation. Coal sourcing countries should also have good port connectivity. So a survey of all eligible countries like Australia, South Africa, Indonesia, and Mozambique has been done. The detail study of the present scenario and future projection of the different coal sourcing option is done.

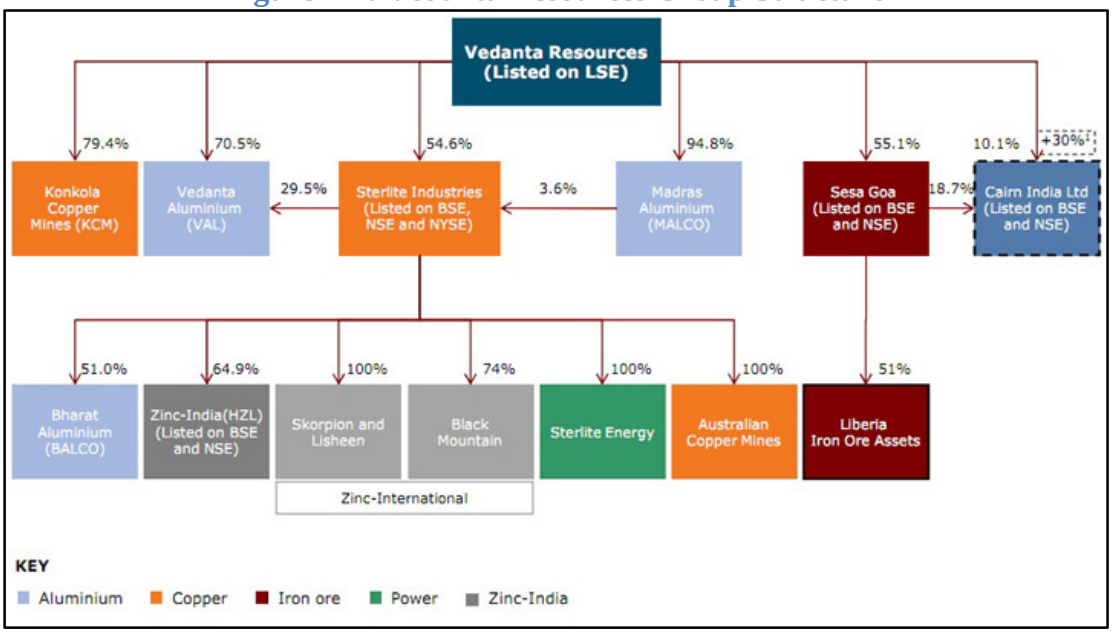
The transportation cost also play a major part in the landed cost of coal from the mine to power plant. The scope of study is Total Quantity Management of Imported Coal from port to site. The future projection of coal demand and correlation development require in the coal logistics infrastructure to sustain the projected demand.

## 2. ORGANIZATION PROFILE:

Vedanta Resources plc is a globally diversified natural resources group committed to sustainable development, supporting local communities and contributing to the economies of the areas where we operate. Its assets and operations are located in the high growth markets of India, Zambia, Namibia, South Africa, Liberia, Ireland and Australia. It is primarily engaged in copper, zinc, silver, aluminium, iron ore and power business. Vedanta Group Revenue for the fiscal year ending 31 March 2011 was US$ 11.4 billion. Vedanta Resources plc has spent approximately two-third of our US$ 19 billion capital expenditure programme as of 30 September 2011. It is the world's largest integrated Zinc Lead producer and among the top producers of copper, iron ore and silver. In the last five years, it has reduced our energy consumption by over 40%. Last year, we planted 759,000 trees bringing the total number of trees on our operations to 12 million.

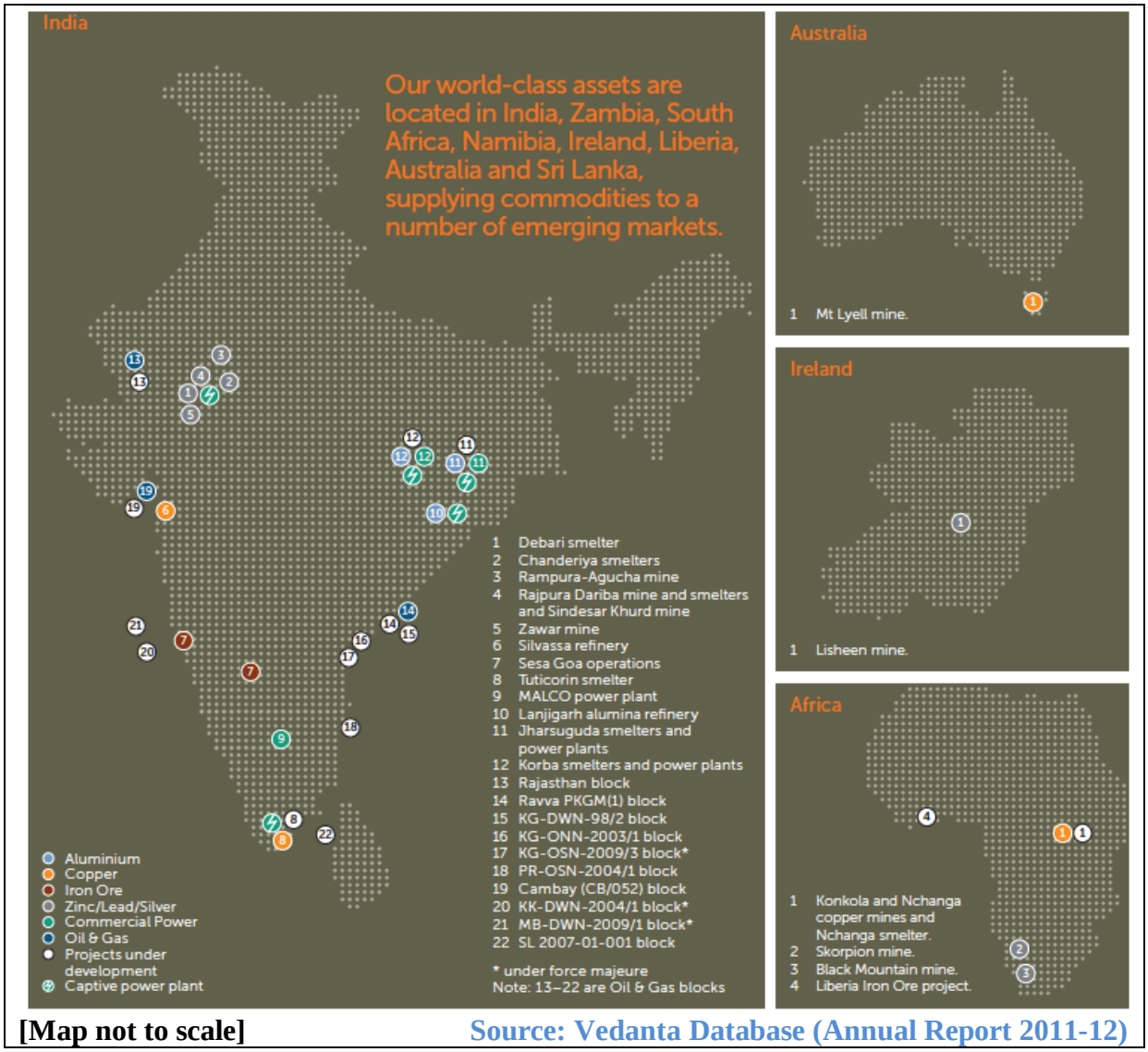
It has over 31,000 employees worldwide. The majority of its operations are certified to the International Management Systems Standard ISO 14001[11]. It has also won numerous awards for safety and environment: we won the 2005 Recognition of Commitment Award from the Institute of Internal Auditors, USA, for our demonstrated strengths and continued focus on achieving operational efficiencies and process.

**Figure 2-1: Vedanta Resources Group Structure**




[11] SOURCE: www.iso.org - ISO 14001:2004 and ISO 14004:2004 focus on environmental management systems. The other Using ISO 14001 can provide assurance to company management and employees as well as external stakeholders that environmental impact is being measured and improved.

**Figure 2-2: Vedanta's Global Footprint & Operations.**




**[Map not to scale]** **Source: Vedanta Database (Annual Report 2011-12)**

## 2.1 ABOUT THE GROUP:

Vedanta Aluminium Ltd (VAL) is an associate company of the London Stock Exchange listed, FTSE[12] 100 diversified resources group Vedanta Resources Plc. Originally incorporated in 2001, and VAL is a leading producer of metallurgical grade alumina and other aluminium products, which cater to a wide spectrum of industries. VAL has carved out a niche for itself in the aluminium industry with its superior product quality based on state-of-the-art technology.

[12] ( **FTSE** - Financial Times Stock Exchange) Group is a British provider of stock market indices and associated data services, wholly owned by the London Stock Exchange. FTSE helps investors worldwide make informed investment decisions and benchmark the performance of their investments.

VAL has invested in a 0.5 mtpa[13] aluminium smelter and 1215 MW captive power plant supported by highly modern infrastructure at Jharsuguda, Orissa. In addition to this, construction of 1.1 mtpa aluminium smelter expansion project at Jharsuguda is under process. The company intends to expand the fully integrated aluminium smelting capacity to around 2.6 mtpa in near future.

## 2.2 ABOUT THE COMPANY:

### 2.2.1 ABOUT STERLITE ENERGY LTD.:

Sterlite Energy Limited (SEL) is a part of Vedanta Resources plc , a London listed FTSE 100 diversified metals and mining major with Aluminium, Copper, Zinc and Iron ore operations in India, Australia and Zambia, and a subsidiary of Vedanta group flagship company, Sterlite Industries (India) Limited. SEL was established to develop, construct and operate power plants and seeks to become one of India's leading commercial power generation companies.

SEL is well positioned to capitalize on India's economic growth, power deficit and large coal reserves to develop a commercial power generation business. It shall benefit from Vedanta group's experienced and focused management with strong project execution skills, experience in building and operating captive power plants, substantial experience in mining activities and the capacity to finance world-class projects.

### 2.2.2 Jharsuguda Power Project:

Sterlite Energy Ltd has taken a major initiative towards the advancement of the power infrastructure in Orissa through its 4 x 600 MW coal-based independent power plant (IPP) in Jharsuguda district. The IPP project envisages a total capital outlay of Rs. 8,200 crores. The two units have commenced commercial operation since Nov 2010 & April 2011 respectively. The project is expected to be fully commissioned in the third quarter of Fiscal 2012.

The power plant entails a number of pioneering achievements in the Indian power sector. Each of its four units has a capacity of 600 MW, which makes the units the largest commissioned in India till date. One of the largest coal handling plants to handle 44,000 MT of coal per day, which is equivalent to 14 rakes of coal a day and a power generation capacity

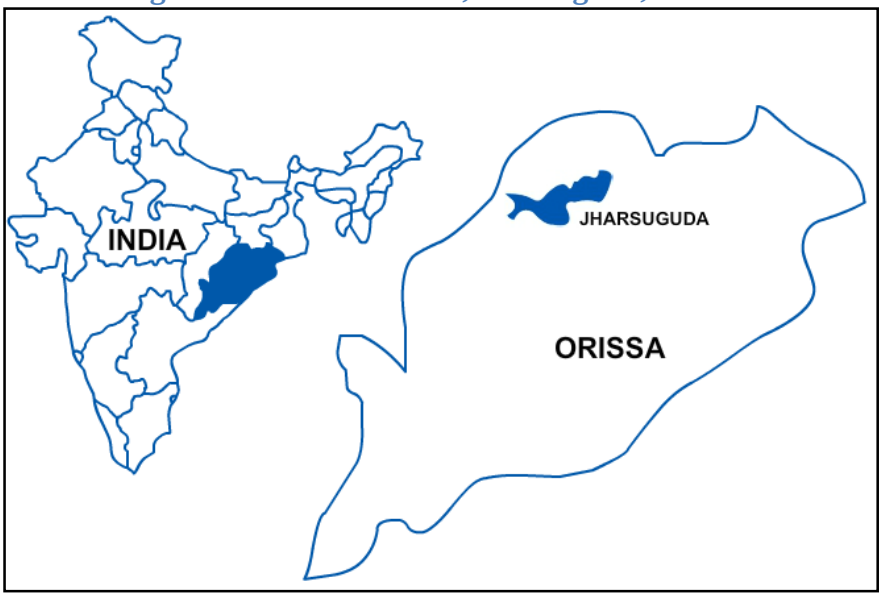
[13] **Mtpa -** Million Tons Per Annum

to produce 57 million units/ day. The plant also has a dual LP-flow steam turbine and four 160 meters high natural draft cooling towers. Other important features of the plant include two 275 meters high multi-flue stacks and a high concentration slurry disposal (HCSD) system for dry ash and highly concentrated slurry.

The company has made extensive arrangements to source raw materials for the power plant. The Hirakud Reservoir is being used as a water source and coal- the chief raw material, is being derived from the IB Valley coalfield.

As a prime advocate of sustainable development, Sterlite Energy Ltd. puts a premium on environmentally friendly construction technology. The plant employs hybrid ESP and fabric filter which maintains stack emission < 50 mg/m3 and HCSD system for ash disposal, which results in very low consumption of water compared to wet slurry system. The Jharsuguda IPP would therefore be a zero effluent discharge plant with stack emission

**Figure 2-3: Site Location, Jharsuguda, Odisha.**




**Source: Vedanta Resources**

Jharsuguda is the site for our Aluminium Smelter, Captive Power Plant and an Independent Power Plant (Sterlite Energy Ltd.). Jharsuguda is situated in the western part of Orissa on the State Highway No-10, at a distance of 335 K.M. from Bhubaneswar and 310 K.M. from Raipur. The details of these projects are given below.

1) 1.6 MTPA Aluminium Smelter.
2) 9x135 MW Captive Power Plant.
3) 4x600 MW Independent Power Plants by Sterlite Energy Ltd.
4) Rail infrastructure for Coal, Aluminium & finished product.
5) A state-of-the-art modern township.

**Figure 2-4: Showing details of 4X600MW Jharsuguda Power Plant**

| **Independent Power Plant** | **Jharsuguda, Orissa** |
|---|---|
| Proposed Installed Capacity | 2,400 MW (4x600 MW) |
| Technology | Thermal, sub-critical |
| EPC Contractor | SEPCO III, China. |
| O&M Contractor | Evonik Energy Services (India) Pvt. Ltd. |
| Estimated Coal Requirement | Approximately 12.49 mtpa |
| Coal Supply Status | 112.22 million tons coal block allocated(2); provisional coal linkage of 2.57 mtpa received, which will be sufficient for the generation of a substantial portion of the power in the first 600 MW unit, and coal linkage with respect to 1,800 MW of capacity applied for. |
| Off-take Status | Long-term PPA signed with GRIDCO providing right to purchase approximately up to 718 MW, intend to supply power to Vedanta Aluminium for its proposed 1.25 mtpa aluminium smelter expansion project at adjacent site and One unit power(600MW) being sold on merchandise basis through national grid. |
| Commissioning of the Units | First - August 2010<br>Second - January 2011 |
| Estimated Project Cost | Rs. 82,000 million |

## 2.3 BUSINESS OF THE COMPANY:

At Jharsuguda, Odisha VAL operates 500 ktpa aluminium smelter and an associated 1,215MW captive power plant. VAL also has a 1.25 mtpa[14] aluminium smelter project at Jharsuguda.

### Projects and Products

VAL is making huge investments to expand capacities of existing plants in order to address growing industry demand. Expansion of the Jharsuguda aluminium smelter plays a pivotal role in VAL's growth strategy. The firm has started construction of a new 1.1 mtpa aluminium smelter[15] at Jharsuguda which would expand smelting capacity from 0.5 mtpa to 1.6 mtpa in near future. For this, VAL has channelized funds towards the commissioning of additional units of power.

[14] **Mtpa -** Million Tons Per Annum

[15] **Aluminium Smelter -** Aluminium smelting is the process of extracting aluminium from its oxide alumina, generally by the Hall-Héroult process. Alumina is extracted from the ore Bauxite by means of the Bayer process at an alumina refinery.

# CHAPTER 3

## REVIEW OF LITERATURE

## 3. INTRODUCTION TO LITERATURE

Clemens Haftendorn, Franziska Holz, Christian von Hirschhausen presentated a paper at Berlin, September 2010 - **"COALMOD-World: A Model to Assess International Coal Markets until 2030"** has presented a tool of analysis for the future global steam coal market, the "COALMOD-World" model. He has shown how we can model this market and its future developments using a large scale equilibrium model that relies on microeconomics and game theory. The combination of model theory and detailed market analysis provides the ground for the development and the implementation of the model. The modelling framework used is the mixed complementarily (MCP) format. The model results show that the international steam coal trade will continue to grow. The projected growth of 42% between 2006 and 2030 is mainly driven by fast growing economies like India and China that will multiply the volume of their imports by 4.5. Imports from other countries will decline by 15% during the same time. This will increase competition between importing countries to secure steam coal supplies. In some producing countries today there are discussions about restricting exports, for example to protect the local demand for coal. However, our model results suggest that it would be beneficial for the producers not to restrict their exports. This is especially true for Indonesia, China and South Africa that are major suppliers to the international steam coal market. A future revival of the U.S. as a major exporter is threatened by environmental regulations, especially a possible ban on mountaintop removal mining. Also, restrictions on investment in production capacities in major markets could have a sign cant effect on global trade and increase the import dependency of India and southern China. Another important aspect for the future of coal markets is climate change and climate policies. Coal is considered by many to be the number one climate enemy. If more restrictions on emissions than in the IEA (2008c) World Energy Outlook's reference case were imposed, there would be a direct effect on electricity generation from coal. In the near future global trade growth would be smaller because the main importing developed countries like the EU or Japan are more likely to curb their coal consumption than India or China. The COALMOD-World model can be used for the implementation of a wide range of scenario model runs to

investigate the interaction of the national and international steam coal markets under various energy and climate policy scenarios until 2030.

## 3.1 REGULATORY & POLICY FRAMEWORK IN INDIA:

| Date | Event |
|---|---|
| 1972 and 1973 | Nationalization of coal mines. Coal mines that could not be nationalized were allowed to be worked by private lease holders. |
| Nov 1975 | Coal India Limited (CIL) was set up. |
| 1976 | Coal Mines (Nationalization) Amendment Act, 1976 was enacted terminated all mining leases with the private holders except those of iron and steel producers. |
| 14 July 1992 | A Screening Committee was set up by MoC to consider applications made by various companies interested in captive mining and to allocate coal blocks. |
| June 1993 | Coal Mines (Nationalization) Amendment Act, 1993 was passed which allowed Indian companies engaged in generation of power, in addition to iron and steel producers. |
| 15 March 1996 | Cement sector was notified as an end user by inserting an enabling provision in the Coal Mines (Nationalization) Act. |
| Feb 1997 | The Cabinet approved a proposal to amend the Coal Mines (Nationalization) Act to allow non-captive coal mining by an Indian Company. |
| 24 April 2000 | Coal Mines (Nationalization) Amendment Bill 2000 was introduced in the Rajya Sabha, seeking allocation of coal blocks to Indian companies for commercial mining. The bill is still pending in the House. |
| Feb 2006 | Government permitted 100% FDI under the Automatic Route for captive mining by companies in power , iron and steel and cement sectors and other eligible activities permitted under the coal Mines (Nationalization) Act. |
| 17 Oct 2008 | Mines and Minerals (Development and Regulation) Act 1957 Amendment Bill was introduced in the parliament. It envisaged making the system of Competitive Bidding applicable to all minerals covered under the said Act. |
| 08 Sept 2010 | The MMDR Amendment Act, 2010 was enacted. |
| 2009-10 | Establishment of Coal India Africana Limitada, a foreign subsidiary in Mozambique.<br>Award of 'Mini Ratna' status by the Department of Public Enterprises, GoI, to CMPDIL |
| 2010-11 | CIL signed a Memorandum of Understanding (MoU) with Ministry of Coal on 31st March, 2011 – for its key performance areas for the fiscal 2011-12. As per the MoU for the fiscal 2011-12, CIL's targeted production and coal off-take have been fixed at 452.00 Million Tonnes (MTs) & 454.00 MTs respectively for attaining an 'Excellent' rating. |
| 2011-12 | Coal India Ltd was granted the *'Maharatna'* status on 11 April, 2011.<br>Coal India joins Sensex, on 8 August 2011. |

| | |
|---|---|
| | Coal India Ltd on 31st January 2012 finalized the wage agreement for its 3.63Lakh strong non-executive work force by giving a 25% increase on gross wages as of 30 June 2011.<br>Pays Highest Interim Dividend to Government of India on 23 March 2012 of Rs.5400.49 Crores for the fiscal 2011-12. |

**Mines and Minerals (Development & Regulation) Amendment Act 2010[16]:**

The Act was amended in 2010 to make a special provision for granting reconnaissance permit, prospecting license or mining lease for companies engaged in captive mining of coal or lignite, though auction and competitive bidding37. These include companies engaged in production of iron and steel, generation of power, washing of coal obtained from a mine and such other end use that the government may by notification in the official gazette specify. The proviso to the section nevertheless makes it clear that competitive bidding shall not be applicable to an area containing coal or lignite, where such area is considered for allocation to a Government Company or Corporation for mining or such other specified end use or where such area is considered for allocation to a company or corporation that has been awarded a power project on the basis of competitive bids. The significant aspect of the 2010 amendment is that it allows for participation of foreign companies in the said competitive bidding process.

**Colliery Control Order 2000 and Colliery Control Rules 2004[17]:**

The Colliery Control Order and the Colliery Control Rules contains identical provisions save for a penalty provision68 and exemptions for acts in good faith69 which are included in the Rules. The Order and Rules empower the Central Government to prescribe the criteria for categorization of coal70 and the Coal Controller for prescribing the procedure for the categorization of coal71, inspection of collieries72 and quality surveillance73, etc. The Coal Controller74 has also been empowered to issue directions to any colliery owner regulating disposal of stocks of coal75, prohibiting or limiting the mining or production of any grade of coal76 and the requirement of prior permissions to open77 or sub-divide78 a coal mine.

[16] **Source:http://mines.nic.in/writereaddata/filelinks/37746cbd_Mines_and_Minerals_(Development_and_Regulation)_Amendment_Act,_2010.pdf**

[17] **Source: Colliery Control Rules,2004 - http://www.coal.nic.in/ccr2004.pdf**
**Source: Colliery Control Order, 2000 - http://www.coal.nic.in/ccoact.htm**

**Import Policy[18]:**

As per the present Import Policy, coal can be freely imported (under Open General Licence) by the consumers. Currently while import duty on coking coal is nil, import duty on non coking coal and coke is 5%. Presumably realizing the lack of good quality coking coal required by the iron and steel sector, the import duty on coking coal has been kept at nil. However, there is a 5% duty on non-coking coal and coke. While marginal, given the demand supply gap and the objective of making the domestic coal producers more competitive, this may need revision.

**Coal Mines (Nationalization) Act 1973[19]:**

The preamble to the act states that it is a legislation "to provide for the acquisition and transfer of the right, title and interest of the owners in respect to the coal mines specified in the schedule with a view to re-organizing, and re-constructing such coal mines so as to ensure rational coordinated and scientific development and utilization of coal resources consistent with the growing requirements of the country, in order that the ownership and control of such resources are vested in the State and thereby so distributed as best to sub serve the common good, and for matters connected therewith or incidental thereto."

**Mines and Minerals (Development & Regulation) Bill 2011:**

On 30.09.2011, the Union Cabinet approved the draft Bill of the new law which seeks to consolidate and replace the existing Mines and Minerals Act 1957. The primary additions in the proposed legislation is the sharing of 26% of the net profit of coal mining companies and 100% of royalty for other mineral mining companies with the people displaced due to such mining activities. The Bill also proposed to establish a National Mineral Fund54, establish national and state mining regulatory authorities55 and tribunals at state and central levels56. Clause 4 of the Bill states that no person shall undertake reconnaissance, prospecting, exploration, or mining, in respect of any mineral without obtaining an appropriate licence or lease. Sub-clause (2) of Clause 4 however, exempts the Geological Survey of India, Mineral Exploration Corporation Limited, Singareni Collieries Limited, Central Mine Planning and Design Institute Limited, the Directorate of Mining and Geology of any State Government, and such other government agencies as may be notified by the Central Government, from the need to obtain a licence in respect of reconnaissance or prospecting operations.

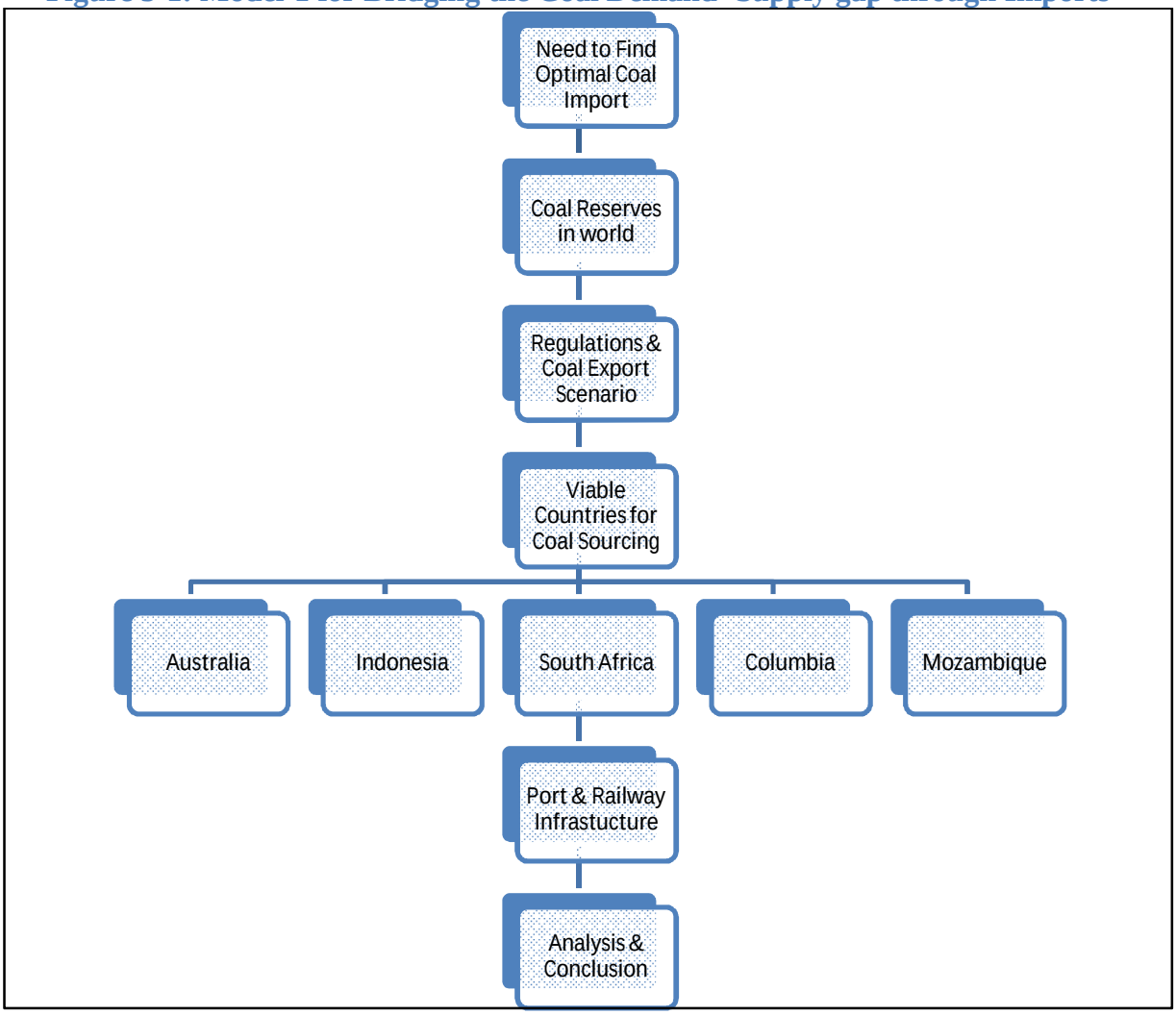
[18] **Source: Import Policy - http://coal.nic.in/eximp.html**

[19] **Source: Coal Mines (Nationalization) Act 1973 - http://www.coal.nic.in/ca7.pdf**

## 3.2 RESEARCH METHODOLOGY:

### MODEL 1: Bridging the Coal Demand- Supply gap through Imports

**Figure 3-1: Model-1 for Bridging the Coal Demand- Supply gap through Imports**




COAL Mod Model is a most prominent model that is being referred for coal sourcing from various countries. Some of the key aspects about the COAL Mod model are as described below:

- **Need to Find Optimal Coal Import Location**: Indian Thermal plant needs to find the prospective locations for coal sourcing to India. There are a number of countries like Australia, South Africa, Indonesia, Columbia, Mozambique etc.
- **Coal Reserves in world**: An analysis will be done about the various coal reserves that can be deployed by Indian thermal power plants companies like CLP.

- **Regulations & Coal Export Scenario:** Regulatory framework is studied in each of the country that will be chosen for coal sourcing to India. Moreover, coal export scenario during the past years are also given due importance.
- **Viable Countries for Coal Sourcing:** Australia, Mozambique, Indonesia, Mozambique, Colombia seems to be viable options for sourcing of coal for India based on the various deciding factors like regulatory aspects, price of coal etc.
- **Port &Railway Infrastructure:** Ports and railways infrastructure plays a very crucial role in ceding out the most viable options in order to import coal from various countries. Number of days in transit taken by the cargo ship is also calculated in order to get the more accurate picture.
- **Conclusion:** Finally conclusion is calculated after studying various underlying prospects associated with the coal sourcing for Indian thermal power plants like India.

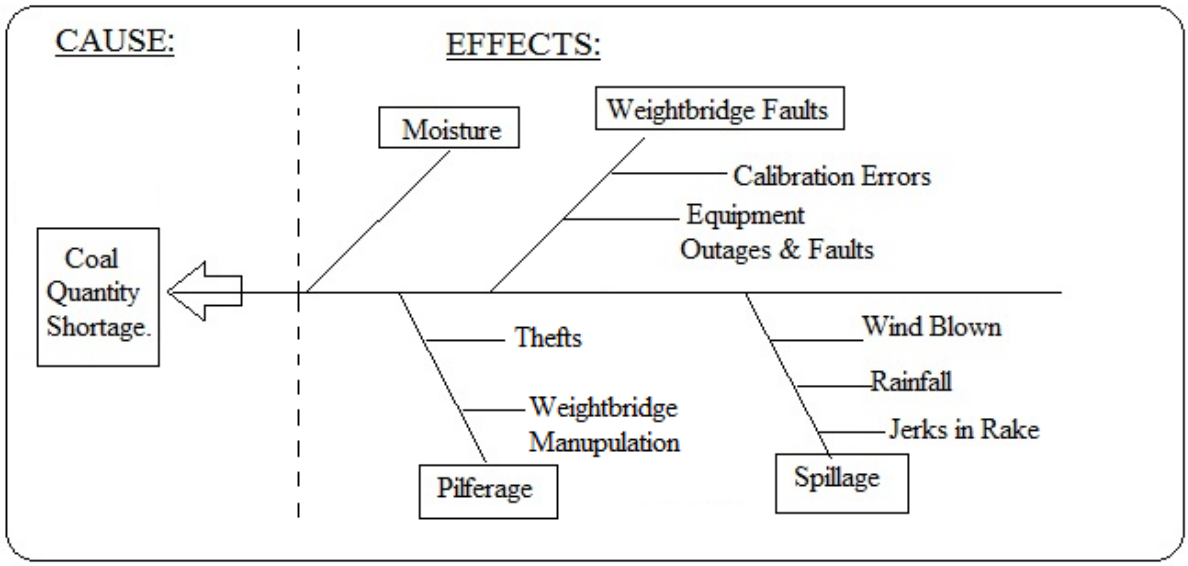
To carry out the research, I have collected data from various associations with various information organizations. Coal India Limited, Ministry of Power, Central Electricity Authority, Central Electricity Regulatory Commission is few to name. Most of the research inputs are obtained from Secondary sources such as Journals, Reports, Literature Review, R.T.I., Publications and from primary sources like Conferences and telephonic conversation with many power project developers.

**MODEL 2: Total Quantity Management of Imported Coal from Port to Site:**

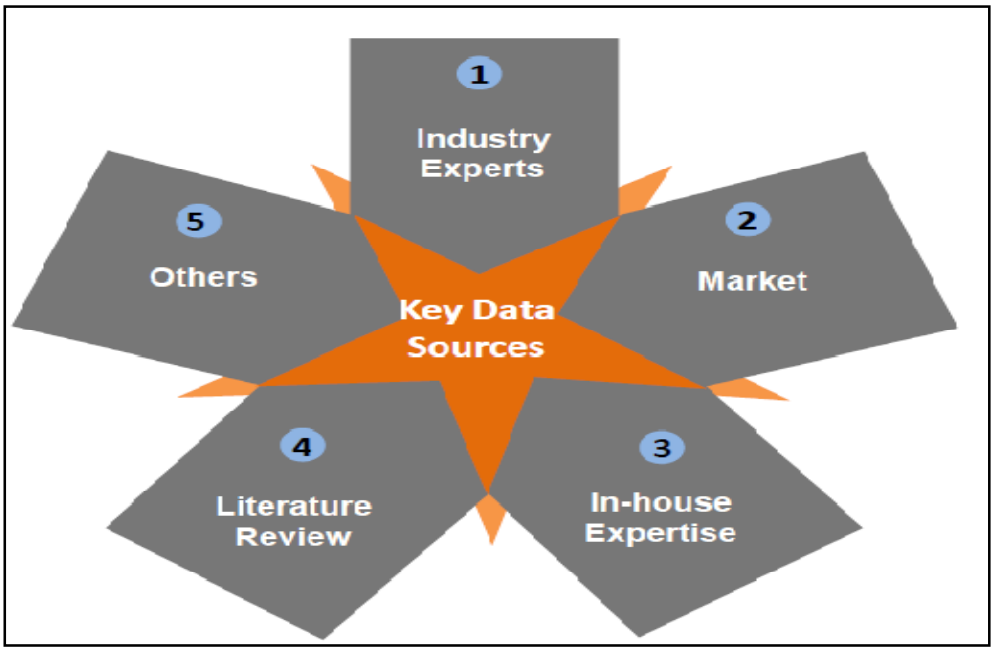
Major Challenges with Coal Logistics is coal quantity loss during transportation of Imported Coal from port to site. Research Methodology includes analysis of coal shortage analysis during transportation. Methods used is to prepare fishbone diagram[20] as shown below to list all the possible causes for the effect i.e. quantity shortages.

[20]**Fishbone Diagram - Developed by Kaoru Ishikawa (in 1968) - To break down (in successive layers of detail) root causes that potentially contribute to a particular effect.**

**Figure 3-2: Fishbone Diagram:**




## 3.3 SOURCES OF RESEARCH:

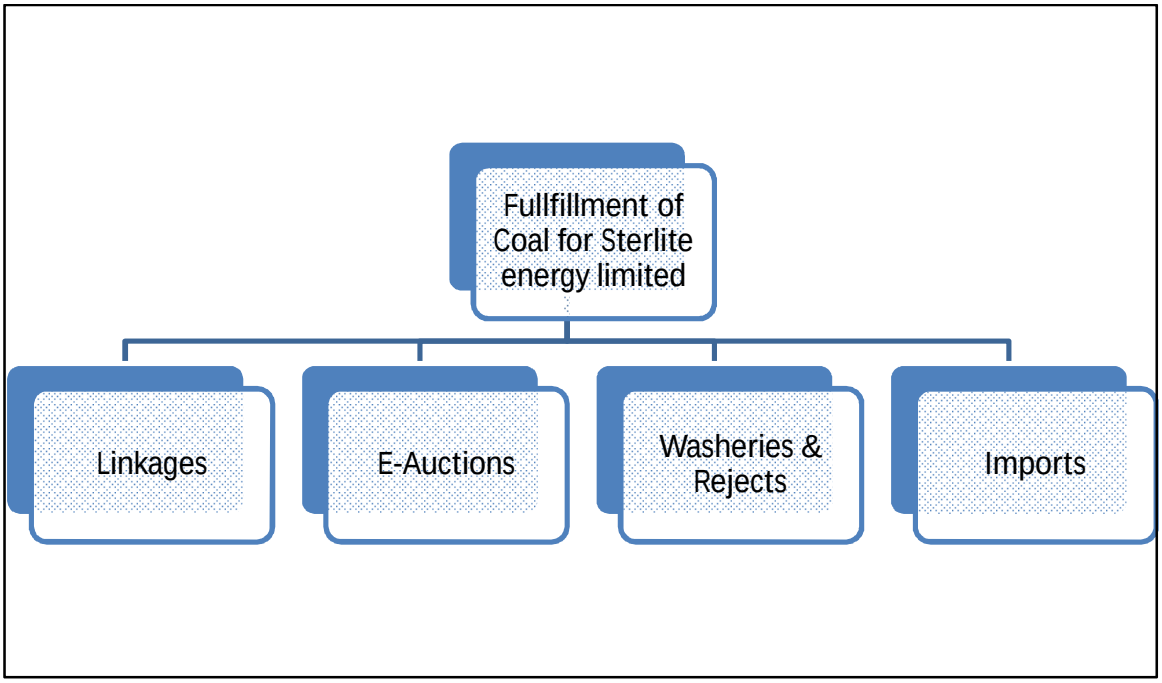



The inputs received and the data collected from the various sources is utilized in the formulation of business solutions and models, to determine the best fuel sourcing option based on the plant and their end use and capacity portfolio and to identify the demand pockets. The comparison is done between various coals sourcing option based of various parameters. The second part of report analysis the prevailing current scenario of coal logistics and estimate the required infrastructure based on the market survey and scenario and at last, risk mitigating solutions are offered.

# CHAPTER 4

## COAL SOURCING

## 4. INTRODUCTION TO COAL SOURING:




### 4.1 COAL LINKAGES:

#### 4.1.1 COAL INDIA LIMITED:

Coal India Limited (CIL) as an organized state owned coal mining corporate came into being in November 1975 with the government taking over private coal mines. With a modest production of 79 Million Tonnes (MTs) at the year of its inception CIL today is the single largest coal producer in the world. Operating through 81 mining areas CIL is an apex body with 7 wholly owned coal producing subsidiaries and 1 mine planning and Consultancy Company spread over 8 provincial states of India. CIL also fully owns a mining company in Mozambique christened as 'Coal India Africana Limitada'.

CIL having fulfilled the financial and other prerequisites was granted the "Maharatna" [21] recognition in April 2011. It is a privileged status conferred by Government of India to select state owned enterprises in order to empower them to expand their operations and emerge as global giants. So far, the select club has only five members out of 217 Central Public Sector Enterprises in the country.

**Unmatched Strategic Relevance:**

- Produces around 81.1% of India's overall coal production.
- In India where approximately 52% of primary commercial energy is coal dependent, CIL alone meets to the tune of 40% of primary commercial energy requirement
- Commands nearly 74% of the Indian coal market.
- Feeds 82 out of 86 coal based thermal power plants in India.
- Accounts for 76% of total thermal power generating capacity of the Utility sector.
- Supplies coal at prices discounted to international prices.
- Insulates Indian coal consumers against price volatility.
- Makes the end user industry globally competitive
- Thus, plays a key role in "India Growth Story" and making India incorporate globally competitive.

**Coal: choice for Indian energy.**

Coal is the most important and abundant fossil fuel in India. It accounts for 55% of the country's energy need. The country's industrial heritage was built upon indigenous coal. Commercial primary energy consumption in India has grown by about 700% in the last four decades. Hard coal deposit spread over 27 major coalfields, are mainly confined to eastern and south central parts of the country. The lignite reserves stand at a level around 36 billion tonnes, of which 90 % occur in the southern State of Tamil Nadu.

Under the provisions of the Coal Mines (Nationalization) Act 1973, only public sector companies can mine coal. The coal industry was reorganized into two major public sector companies, namely Coal India Limited (CIL) which owns and manages all the old Government-owned mines of National Coal Development Corporation (NCDC) and the nationalized private mines and Singreni Colliery Company Limited (SCCL) which was in existence under the ownership and management of Andhra Pradesh State Government at the time of the nationalization.

[21] **Maharatna**–A company with average annual turnover of more than Rs. 20,000 crore during the last 3 years.

### 4.1.2 FUEL SUPPLY AGREEMENT:

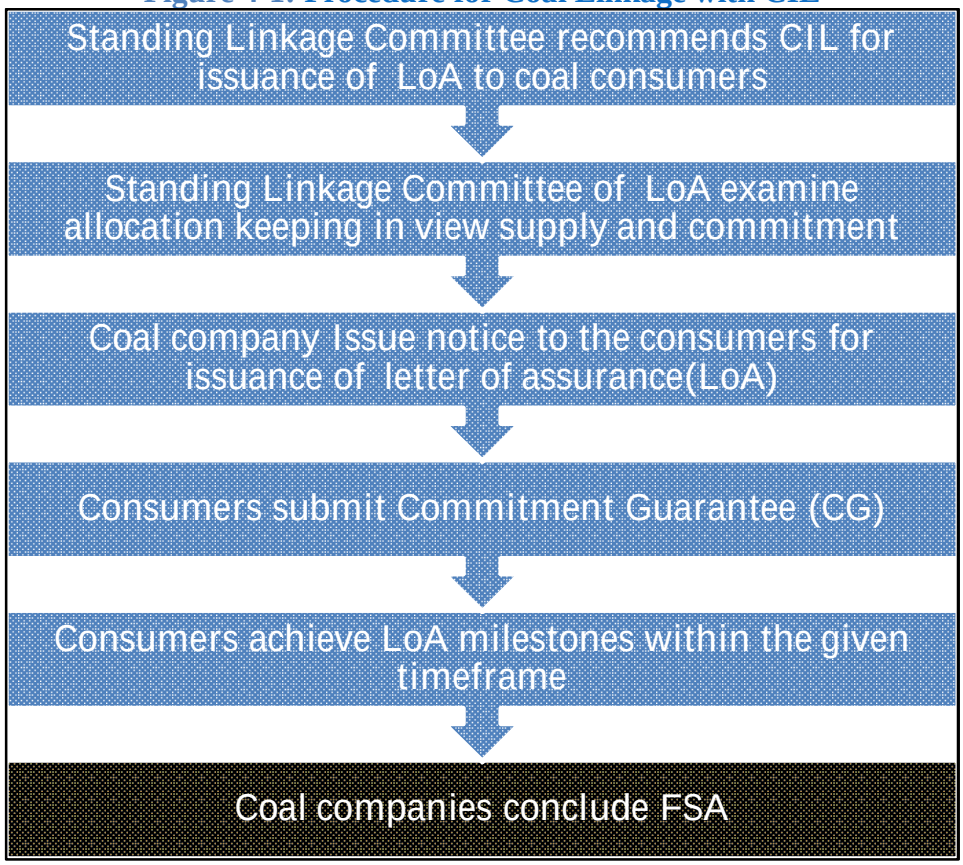
FSA stands for Fuel supply Agreement. As per New Coal Distribution Policy (NCDP)[22] Coal supplies are governed by legally enforceable agreements between the sellers (coal Companies) and the consumer under specific terms and conditions. As far as Sterlite Energy Limited (SEL) is concerned, it signed its Fuel Supply Agreement (FSA) with Mahanadi Coalfields Limited i.e. MCL.

Procedure for Coal Linkage:

To have coal linkage with CIL, the consumer has to submit the letter of issue to the standing committee. The Standing Linkage Committee will recommend CIL for the issuance of letter of assurance (LOA). The coal company will give the notice to the consumers for having the issuance of LOA. The consumers should submit the commitment Guarantee (CG) as per the new NDCP policy. The standing committee will give LOA to coal consumers on condition that the milestones to be achieved within deadline to convert the LOA to FSA.

The normal time specified to convert LOAs to FSAs is 2-3 years but due to various clearances issues, it generally take 4-5 years to have the fuel supply agreement.

**Figure 4-1: Procedure for Coal Linkage with CIL**




**Source: CIL & Sterlite Research**

[22] **NCDP - Ministry of Coal:** http://coal.gov.in/policy181007.pdf

***FSA Aspects w.r.t Sterlite Energy Limited (SEL), Jharsuguda, Odisha.***

**Period of Agreement:**

- FSA was signed between SEL and MCL, Mahanadi Coalfields Limited (Subsidiary of CIL Ltd.) on 20th Sept, 2011.
- The Agreement has been signed for a period of 20 years and after completion of 5 years, either party can approach for review of the agreement.

**Security Deposit:** The purchaser is required to submit a security deposit equivalent to 6 % of the basic price of grade of coal that is taken into consideration while signing the agreement.

**Quality:**

- Seller should make adequate facilities not to supply coal less than 3200Kcal/Kg (GCV). In case seller supplies such quantity of coal, purchaser should limit price of coal to Re 1/tonne.
- F Grade coal is to be supplied to SEL with GCV Values.

**Table 4-1: Grades of Non-coking Coal**

| Grade | Useful Heat Value (UHV) (Kcal/Kg) UHV= 8900-138(A+M) | Corresponding Ash% + Moisture % at (60% RH & 40$^{O}$ C) | Gross Calorific Value GCV (Kcal/ Kg) (at 5% moisture level) |
|---|---|---|---|
| A | Exceeding 6200 | Not exceeding 19.5 | Exceeding 6454 |
| B | Exceeding 5600 but not exceeding 6200 | 19.6 to 23.8 | Exceeding 6049 but not exceeding 6454 |
| C | Exceeding 4940 but not exceeding 5600 | 23.9 to 28.6 | Exceeding 5597 but not exceeding. 6049 |
| D | Exceeding 4200 but not exceeding 4940 | 28.7 to 34.0 | Exceeding 5089 but not Exceeding 5597 |
| E | Exceeding 3360 but not exceeding 4200 | 34.1 to 40.0 | Exceeding 4324 but not exceeding 5089 |
| F | Exceeding 2400 but not exceeding 3360 | 40.1 to 47.0 | Exceeding 3865 but not exceeding. 4324 |
| G | Exceeding 1300 but not exceeding 2400 | 47.1 to 55.0 | Exceeding 3113 but not exceeding 3865 |

**Source: Coal India Limited**

**Quantity:**

- The Annual Contracted Quantity of coal to be supplied will be 42.75 lakhs per tonne from the seller mines.
- Monthly scheduled quantity will be 1/3rd of the quarterly quantity.

- Coal Quantity greater than 80% but less than 100 % has to be supplied by the supplier to the purchased. Failing to provide the aforesaid quantity will acquire a compensation of 0.01 % of the failed quantity of the coal.

**Method of Order Booking:**

- Purchaser should submit the order for the next month at least 7 days prior to the commencement of next month either by road or by rail.
- Modalities for Billing, Payments, Claims:
- The purchaser shall make advance payment for a month in 3 instalments separated by 10 days stating from day 1 of the month.
- A purchaser should issue irrevocable letter of credit to the seller.

**Adjustments for Coal Quality/Grade:** Analysis of Coal Quality should be supported with relevant documents related to

- Total Moisture (%)
- Equilibrated Moisture (%)
- Ash (%)
- GCV (Kcal/Kg)

**Force Majeure**[23] **Conditions & Termination of Agreement**

- In case of Force Majeure conditions, affected party has a time limit of giving 90 days prior to the termination of the agreement.
- In case there is any change in the material, then purchaser has the power to terminate the agreement within 30 days.

| **Benefits to CIL** | **Benefits to Customer(SEL)** |
|---|---|
| 1. Assured market for the coal due to loyal customers. | 1. Assured supply of Contracted quantity of coal uniformly as per agreed dispatch schedules enforced by bonuses and penalties. |
| 2. Better Planning and Monitoring of Quality, Production and Dispatches due to the prior knowledge of quality and quantity of coal to be supplied. | 2. Supply of committed grade of coal enforced by bonuses and penalties. |
| 3. Scope for maximizing sales revenue by earning bonuses due to better performance | 3. Customer can avoid the repetitive processes, delays and costs involved in procurement of coal. |

[23] **Force Majeure**-An event that is a result of the elements of nature, as opposed to one caused by human.

### 4.1.3 **SWOT ANALYSIS OF COAL LINKAGES:**

| | |
|---|---|
| **Strength** | (i) Adequate reserves<br>(ii) Huge workforce comprising of expert and highly skilled man power is available with the coal companies<br>(iii) Adequate and rising domestic demand for coal.<br>(iv) Coal reserves are available at relatively shallow depth which can be easily extracted by cost effective open cast mining methods. |
| **Weaknesses** | (i) Poor quality of thermal coal available in India - mostly E and F grade coal.<br>(ii) Inadequate extractable reserves of coking coal.<br>(iii) Low productivity in coal mines operated by CIL.<br>(iv) Coal sector not truly opened up for commercial mining.<br>(v) Lack of adequate infrastructure for speedy evacuation of coal produced.<br>(vi) Coal reserves are available mostly in the eastern part of India whereas the demand of coal is through-out India. This leads to high transportation cost of coal or higher transmission losses of power generated at pit-head power plants.<br>(vii) Long time taken in getting the environment and forest clearance for new coal projects.<br>(viii) Problems in land acquisition and rehabilitation & re-settlement.<br>(ix) Law and order problem in Eastern coal producing states.<br>(x) Constraints in exploration of coal - Out of 277 billion tonnes geological reserves, only 110 billion tonnes reserves are in “proved category”.<br>(xi) Problems and constraints in underground mining – use of old technology labour intensive processes for mining and safety issues. |
| **Opportunities** | (i) A fast growing economy offers a huge domestic market (with relatively inelastic demand) for coal.<br>(ii) Bulk of power generation is coal based and likely to remain so in the foreseeable future.<br>(iii) As other energy sectors viz. oil and gas, power etc. have been opened up, opening up of coal sector for private investment will give a big boost to the sector.<br>(iv) Wide gap between the price of domestic coal and that in the international market should give comfort to domestic industry and encourage higher investment in the sector. |
| **Threats** | (i) Delays in obtaining statutory clearances (environment and forest) and land acquisition cause delays in the commissioning of new coal project.<br>(ii) Law and order problem in some of the Eastern States can adversely impact coal production and movement.<br>(iii) Delay in the development of coal blocks allotted to new players (both public and private sector) would place intense pressure on public sector companies.<br>(iv) Opposition from various quarters to the opening up of coal sector to private sector investment for commercial mining will impede speedier growth of the sector. |

## 4.2 COAL E-AUCTIONS[24]:

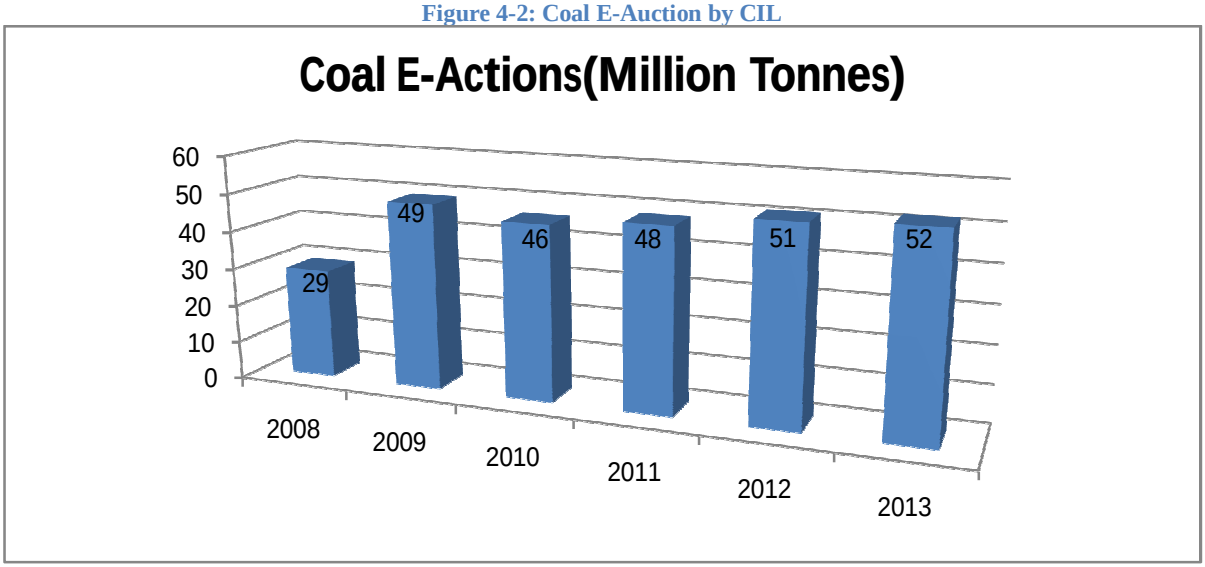
Another source of coal option provide by CIL is e-auction. The CIL has the authority given by the ministry to sell 10% of total coal production by e-auction. Coal distribution through e-Auction is governed to provide access to coal for such coal consumers who wish to have an assured supply over a long period through e-auction mode so as to plan their operation. The quality & quantity offered from CIL-Subsidiary is declared earlier than 7 days, so the buyers can plan accordingly. The reserve price is fixed by CIL and the buyer has to bid for the price above the reserve price. The MSTC India and Coal Junction is the service provider for the e-auction. The detail of the spot e-auction and the forward e-auction is provided on CIL website as well as the MSTC India and Coal Junction.

### 4.2.1 E-AUCTION TYPES:

1. **Forward E-Auction**
2. **Spot E-Auction**

The methodology used in both the type of auction is same; the only difference between them is the duration for which the e-auction. The spot e-auction is done for coal supply for short duration while comparing to forward e-auction.

Figure 4-2: Coal E-Auction by CIL




Source: Coal India Limited.

[24] An **auction** is a process of buying and selling goods or services by offering them up for bid, taking bids, and then selling the item to the highest bidder

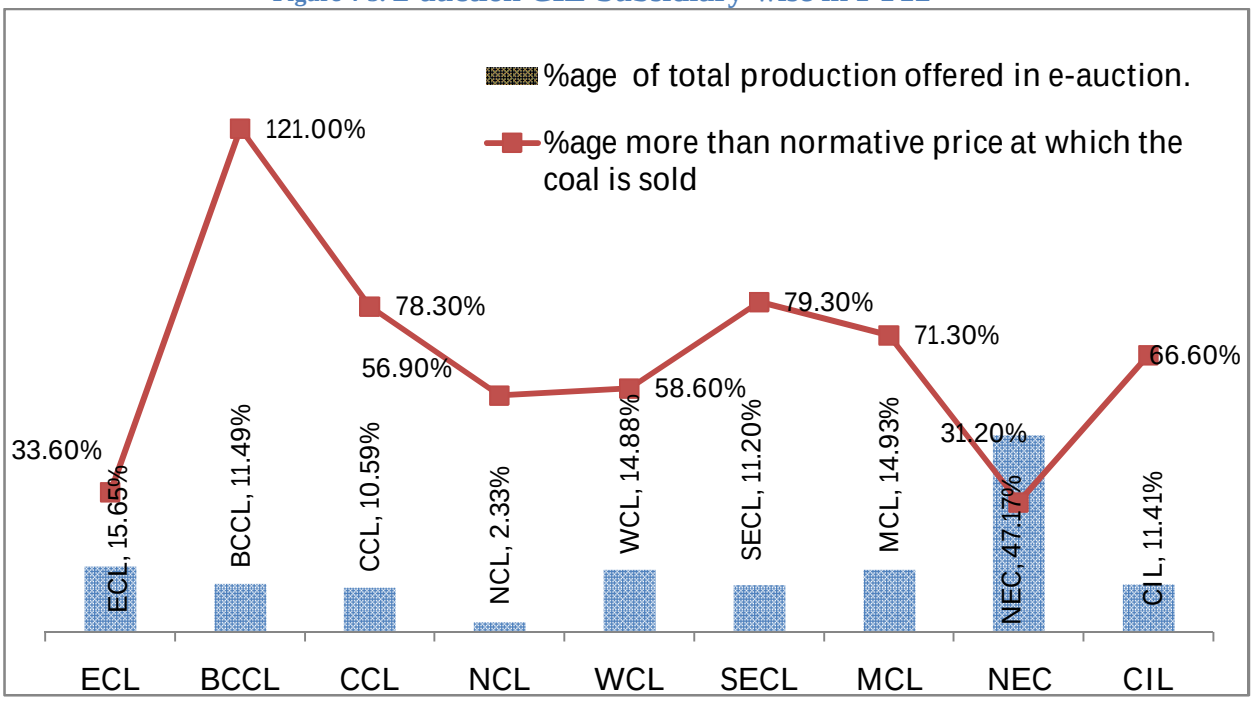
4.2.2 **BIDDING PROCESS:**

- Prospective Bidders are entitled to Bid for quantity to the extent of amount of EMD.
- The Buyers while bidding shall quote their "Bid price" per tonne in Indian Rupee as base coal price on FOR/FOB colliery basis equal or above the reserve price.
- The other charges like statutory levies, surface transportation charges, sizing/ beneficiation charges, taxes, cess, royalty, & any other shall be beard by Buyer's.
- The Bidder shall offer his Bid price (per tonne) in the increment of Rs.10/- (Rupees ten) during the Normal e-Auction period.
- During the extended period of first two (2) hours, the Bidder shall offer his Bid price in the increment of Rs.20/-. Beyond this extended period of two hours the bid price increment would be Rs. 50/- (Rs. Fifty) only.
- Preference will be given to highest bid price in descending order.
- In case two parties bid the same price, preference to higher quantity.
- In case two parties bid the same price & quantity, preference will be given to party bid first with reference with the time.

**COMPARATIVE ANALYSIS CIL SUBSIDIARIES:**

The analysis of the quantity and price offered by CIL each subsidiary wise show a pattern a large pattern variation in price and the quantity.

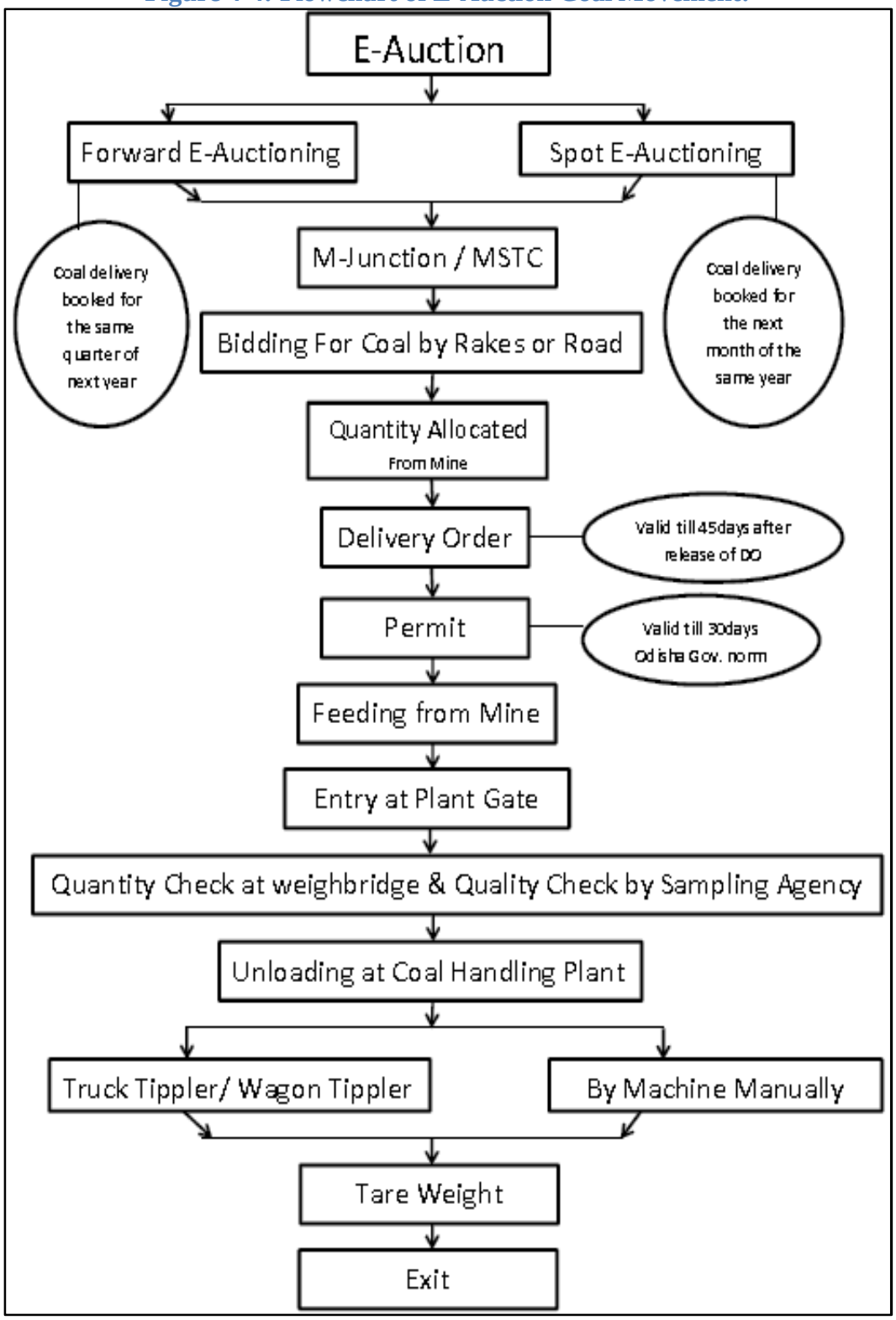
Figure 4-3: E-auction CIL-Subsidiary-wise in FY12




Source: Infraline Research

ECL mine rich in coking coal offered 15.6% of total production for auction with average of 33.6% price above the normal price. BCCL; offered 11.49% of coal with price variation of maximum 121% above the normative price. Overall CIL in all together offered 11.4% of with average of 66% above the normative price.

**Figure 4-4: Flowchart of E-Auction Coal Movement:**



## 4.3 WASHERIES & REJECTS:

### PROPOSED WASHERIES OF CIL:-

Coal India Limited has planned to set up 20 nos. of coal washeries (Coking and Non-Coking) having total capacity of 111.1 Mt of raw coal throughput in the first phase. Out of the total capacity mentioned above, 105.1 Mt capacity of washery will come up under "Build, Operate & Maintain (BOM)" concept whereas 6.0 Mt capacity of washery will come up on turnkey basis with a view to supply washed metallurgical and washed thermal coal to steel sector and power stations other than those located at pit head. CIL would provide capital for construction of these washeries. Details of subsidiary wise, number of washeries to be set up & their capacities are listed below:

**Table 4-2: Proposed washeries of CIL:**

| S.No. | Subsidiary | Washery | Capacity (Mt) | Type | Scheme |
|---|---|---|---|---|---|
| 1. | ECL | Chitra | 2.5 | Non-coking | BOM |
| 2. | ECL | Sonpurbazari | 8.0 | Non-coking | BOM |
| 3. | BCCL | Madhuband | 5.0 | Coking | BOM |
| 4. | BCCL | Patherdih | 5.0 | Coking | BOM |
| 5. | BCCL | Patherdih | 2.5 | Coking | BOM |
| 6. | BCCL | Bhojudih | 2.0 | Non-coking | BOM |
| 7. | BCCL | Dugda | 2.5 | Coking | BOM |
| 8. | BCCL | Dahibari | 1.6 | Non-Coking | BOM |
| 9. | CCL | Ashoka | 10.0 | Non-coking | BOM |
| 10. | CCL | New Piparwar | 3.5 | Non-coking | TURNKEY |
| 11. | CCL | Karo | 2.5 | Non-coking | BOM |
| 12 | CCL | Konar | 3.5 | Non-coking | BOM |
| 13. | CCL | Dhori | 2.5 | Coking | TURNKEY |
| 14. | SECL | Kusmunda | 10.0 | Non-coking | BOM |
| 15. | SECL | Baroud | 5.0 | Non-coking | BOM |
| 16. | MCL | Basundhara | 10.0 | Non-coking | BOM |
| 17. | MCL | Jagannath | 10.0 | Non-coking | BOM |
| 18. | MCL | Hingula | 10.0 | Non-coking | BOM |
| 19. | MCL | IB Valley | 10.0 | Non-coking | BOM |
| 20. | WCL | Kolarpimpri | 5.0 | Non-coking | BOM |
| TOTAL | | | 111.1 | | |

**Source: Coal India Limited.**

Out of 18 number of washeries to be constructed under Build-Operate-Maintain (BOM), Global tenders have been floated for construction of following ten washeries i.e Sonepur Bazari, Madhuband, Patherdih, Dugda , Dahibari , Ashoka, Basundhara, Jagannath , Hingula and Kusmunda washeries. Evaluation of Madhuband, Patherdih and Ashoka washeries completed and LOA have been issued to the selected bidders. Evaluation of balance 7 washeries is in progress. The reports of remaining 8 washeries are under preparation.

## 4.4 IMPORTS:

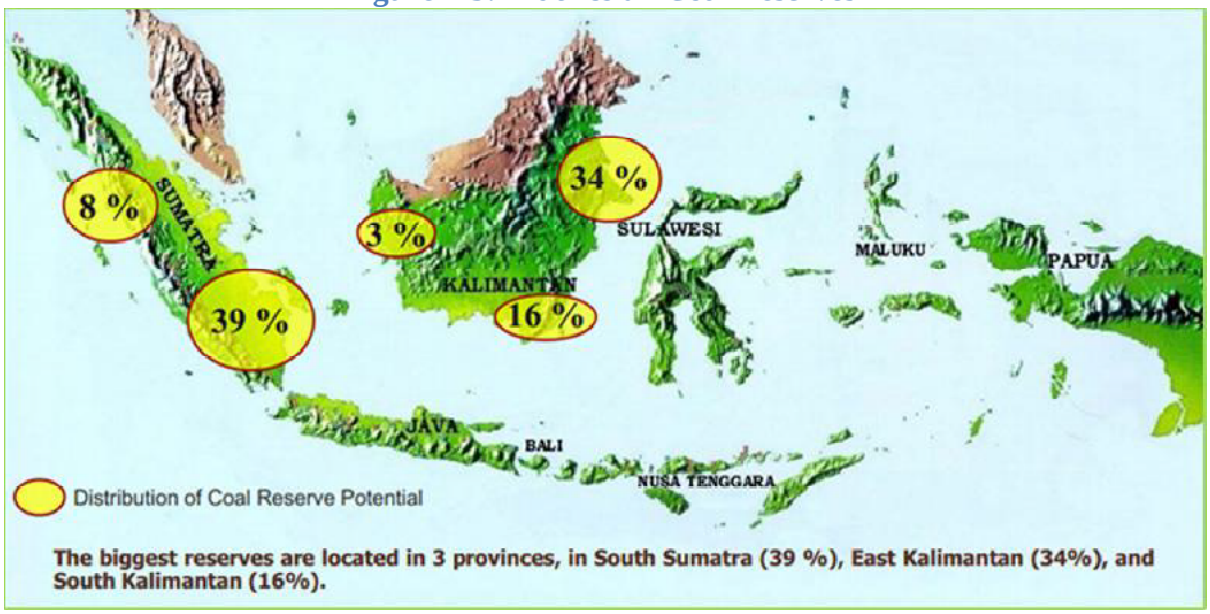
Indonesia is having a resource of 104.16 billion tonnes, out of which the economically recoverable reserves are around 18.78 billion tonnes.

The major coal fields in Indonesia have been distributed in two Islands which are:

- Kalimantan (East Kalimantan & South Kalimantan)
- Sumatra

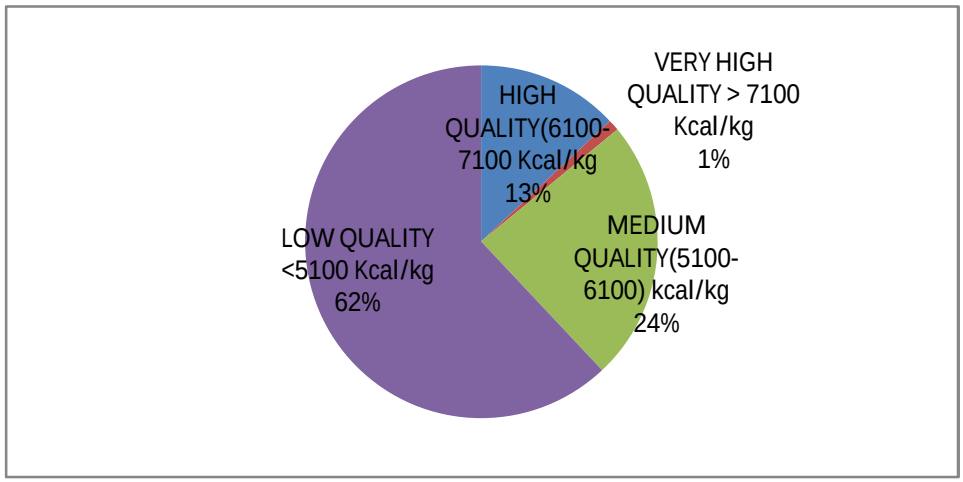
The Kalimantan province is having reserves of 7.15 billion tonnes and the Sumatra Island is having reserves of 11.15 billion reserves

**Figure 4-5: Indonesian Coal Reserves**




**Source: Indonesia Coal Reserves**

**Figure 4-6: Quality reserves in Indonesia**




**Source: www.worldcoal.org**

### 4.4.1 GEOGRAPHICAL LOCATION:

Compared to other coal importing countries, Indonesia is the closest one to our Indian ports both in east coast as well as west coast.This distance from Indonesian port to various ports in India is given below:

Table 4-3: **Distance from Indonesian port to various ports in India**

| INDONESIA | HALDIA | PARADIP | VISHAKAPATNAM | ENNORE | COCHIN | MORMA GOA | MUNDRA |
|---|---|---|---|---|---|---|---|
| **East Kalimantan** | 3218 | 3155 | 3243 | 3124 | 3280 | 3593 | 4298 |
| **South Kalimantan** | 4147 | 3442 | 3129 | 2973 | 3092 | 3442 | 4147 |
| **Sumatra** | 2259 | 2195 | 2283 | 2158 | 2314 | 2627 | 3332 |

Note: Distance is measured in Nauticalmiles.1Nautical Mile=1.852 KM

**And the approximate travelling time from Indonesian ports to our Indian ports is:**

**Table 4-4: Travelling time from Indonesian ports to our Indian ports**

| INDONESIA | HALDIA | PARADIP | VISHAKAPATNAM | ENNORE | COCHIN | MORMA GOA | MUNDRA |
|---|---|---|---|---|---|---|---|
| **East Kalimantan** | 214.53 hours (9 days) | 210.33 hours (9 days) | 216.2 hours (9 days) | 208.27 hours (9 Days) | 218.67 hours (9 days) | 239.53 hours (10 days) | 286.53 hours (12 days) |
| **South Kalimantan** | 276.48 hours (12 days) | 229.47 hours (10 days) | 208.6 hours (9 days) | 198.2 hours (8 days) | 206.13 hours (9 days) | 229.47 hours (10 days) | 276.47 hours (12 days) |
| **Sumatra** | 150.6 hours (6 days) | 146.33 hours ( 6 days) | 152.20 hours (6-7 days) | 143.87 hours (6 days) | 154.27 hours (6-7 days) | 175.4.13 hours ( 7-8 days) | 222.13 hours ( 9 days) |

Note: Units are in days and the ship speed has taken an imaginary value of 15 knots/hour. The abovementioned time is exclusive of the turnarounddays of the ships in both the source and destination ports. The turnaround days will be varying depends upon the port traffic and climate conditions.

### 4.4.2 SWOT ANALYSIS FOR INDONESIAN COAL:

| | |
|---|---|
| **STRENGTHS**<br>• Nearest To India – Logistics Rates will be lower.<br>• Good Connectivity to Port.<br>• Internal Rivers-Tug Pulling Barge system<br>• Floating Trans-shipment Facilities of 170 Mtpa | **WEAKNESS**<br>• Poor in Quality compared to other countries<br>• Poor Land Transportation in Indonesia |
| **OPPORTUNITIES**<br>• Sumatra is Very Close to India and still a lot of mine resource is available to explore. | **THREATS**<br>• Uncertainties in Government regulations.<br>• Prone to natural calamity like earth quake &Tsunami. |

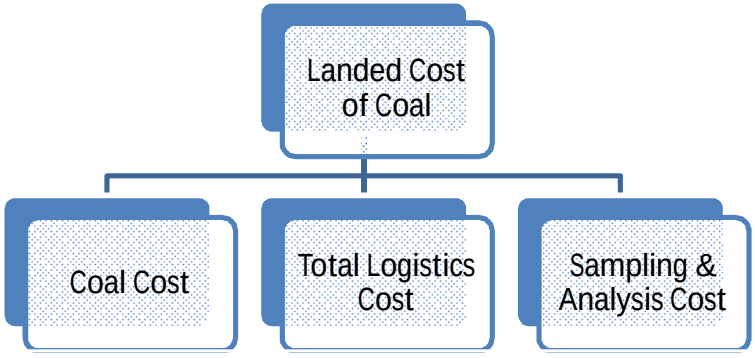
Import from the coal rich country is now considered as a reliable source as the coal production in India can't able to meet the total demand. The import is considered as reliable with other complexity and risk is still attached to it like Regulatory changes in the Indonesia has impacted the cost of the imported coal from the Indonesia.

### 4.4.3 ANALYSIS OF COAL MIX ON THE PER UNIT FUEL COST:

As per FSA, CIL is deemed to supply 80% of the coal to CLP India group but due to various complications arising out of this, CIL will not be able to supply more than 50-55% of the coal as per the recent notification released by CIL. Owing to this various cases have been taken for fulfilling the shortfall requirement.

**Methodology Used:**

**Figure 4-7: Components of Coal's Landed Cost**



**Components of Coal Cost are:**

- Base Price of Coal: The price of Coal as disclosed by CIL on its website
- Clean Energy Cess: The Tenth Schedule to the Finance Act, 2010 prescribes a statutory rate of cess of Rs.100 per tonne for all three categories, namely, coal, lignite and peat. As per Annexure 2A its Rs 50/MT.
- Stowing Excise Duty: Every owner, agent or manager of a coal mine is supposed to provisionally assess the duties of excise levied on the total raw coal dispatched in a given month and pay the same into the treasury. The remittance is credited to the Central Govt. in a special account; As per Annexure 2A its Rs 10/MT.
- Surface Transportation Charge(STC): As per Annexure 2A,its Rs 77/MT
- Crushing and Sizing Charge.
- Loading Charge
- Fixed Royalty
- Excise Duty of Basic Price, Sizing charge and Surface Transportation Charge.
- CSE of 2 % is also added on the Coal Cost

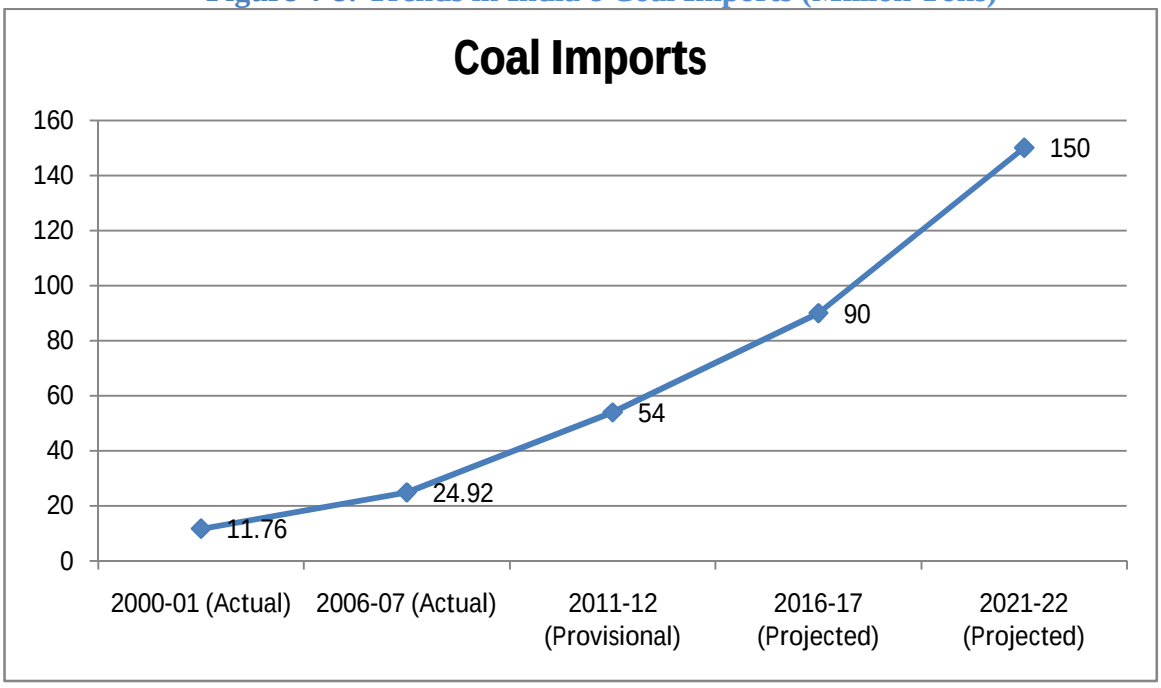
**A. Components of Total Logistics Cost are :**

- Basic Freight: Indian Railways has divided various commodities under various classes like Class 100,110,120,130,140,150,160,170,180,190.For Coal Freight rates, under class 150 is taken into consideration.
- Busy Seasonal Charge: Indian Railways has increased the Busy Seasonal Charge in March 2011 notification from 7% to 10 % in lieu of heavy traffic during some particular time of the year.
- Development Surcharge: Accordingly Indian Railways has also increased the Development Surcharge from 3% to 5%.
- Sampling and Analysis Cost: This is the cost involved in carrying out various sample tests of coal and thus adding A+B+C will give the total Landed cost of coal.
- Various Different Mixes of Coal has been taken like 70 % from CCL (FSA Linkage), 10-15% from imported coal market like South Africa, Indonesia, and remaining %age from E-Auction and open Market.
- Then Weighted Average Cost has been calculated owing to the corresponding GCV value available after mixing with all qualities of coal.
- Per Unit Fuel Cost has been calculated accordingly with different mixes of Coal as shown in the sheets below.(Please Refer Annexure -2)
- As we know that Imported coal has high GCV value so that particular coal cannot be mixed directly with the other available quality coal, so in order to cope with this problem blending of coal will done to reduce the effective GCV of coal to a acceptable level.

The above calculation has been described in Annexure 1 & 2.

### 4.4.4 INDIA'S COAL IMPORT TRENDS:

**Figure 4-8: Trends in India's Coal Imports (Million Tons)**

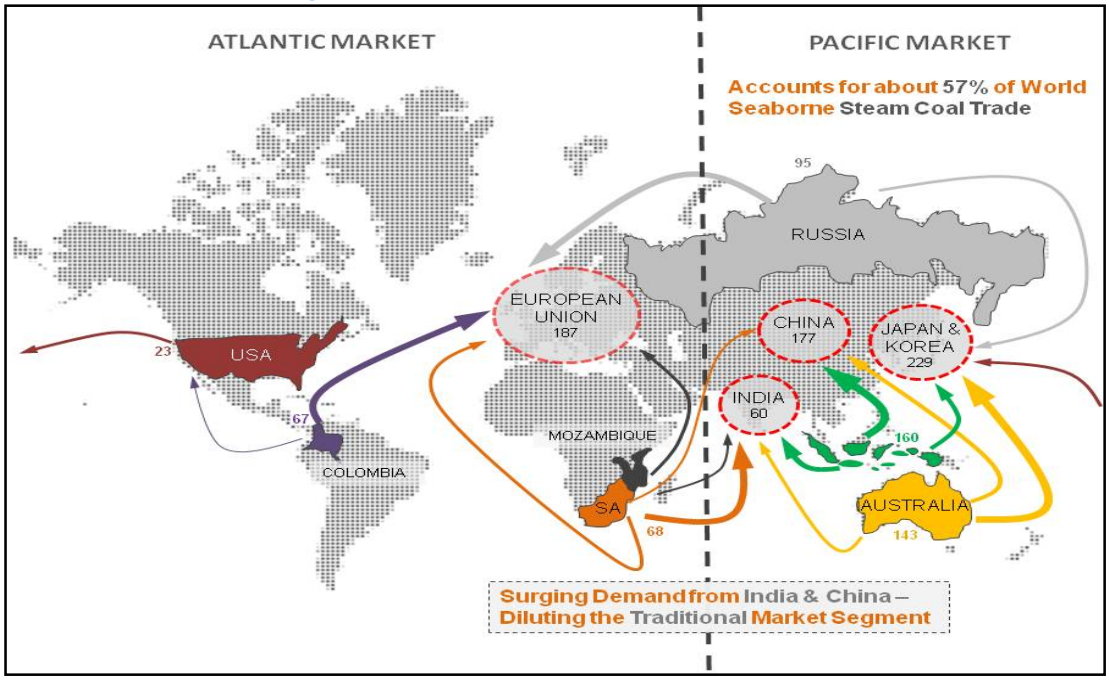



**Source: Planning Commission (12th five year plan 2012-17)**

### 4.4.5 WORLD COAL TRADE MARKET:

The surging demand especially from India and China in Pacific market has changed the scenario of imported coal market from Atlantic market to Pacific market.

**Figure 4-9: World Coal Trade Orientation**

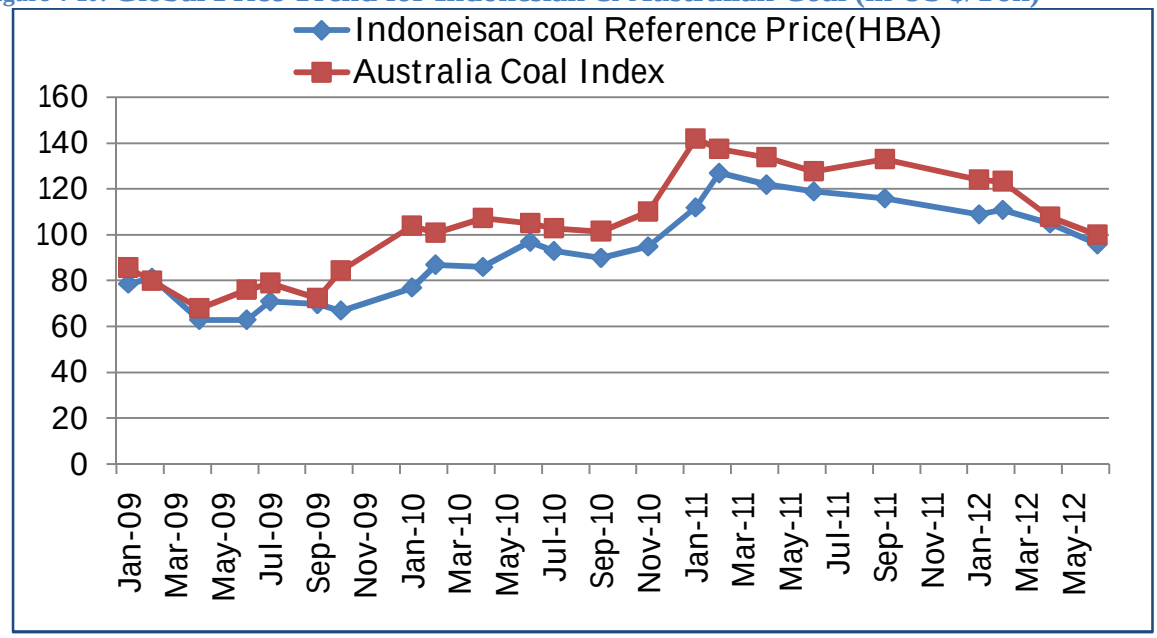



**Source: Infraline Research**

### 4.4.6 GLOBAL PRICE TREND FOR DIFFERENT COUNTRIES:

The price of coal in the global market is driven by the demand and supply scenario prevailing in the market. The graphs show the price of the Indonesian coal and the Australian coal during the past 3 years.

**Figure 4-10: Global Price Trend for Indonesian & Australian Coal (in US $/Ton)**




**Source: Coal Spot**

The majority of coal is priced using OTC contracts with negotiations between the involved parties. Physical spot market and derivatives are traded on exchanges around the world. Standardized coal trading agreements are also available and generally preferred by participants based on benchmark prices. Various benchmark prices index are currently operating in global coal market. These indexes quotes prices for internationally traded bulk coal on the spot market according to the specifications. The consumer in India has the edge as the price of coal in India is generally low as compared to global of the same calorific value

### 4.4.7 COUNTRYWISE COAL IMPORT TREND OVER THE DECADE:

The table below shows the import of coal from the different countries on yearly basis; to meet the surging demand of coal from the sector like power; steel and cement.

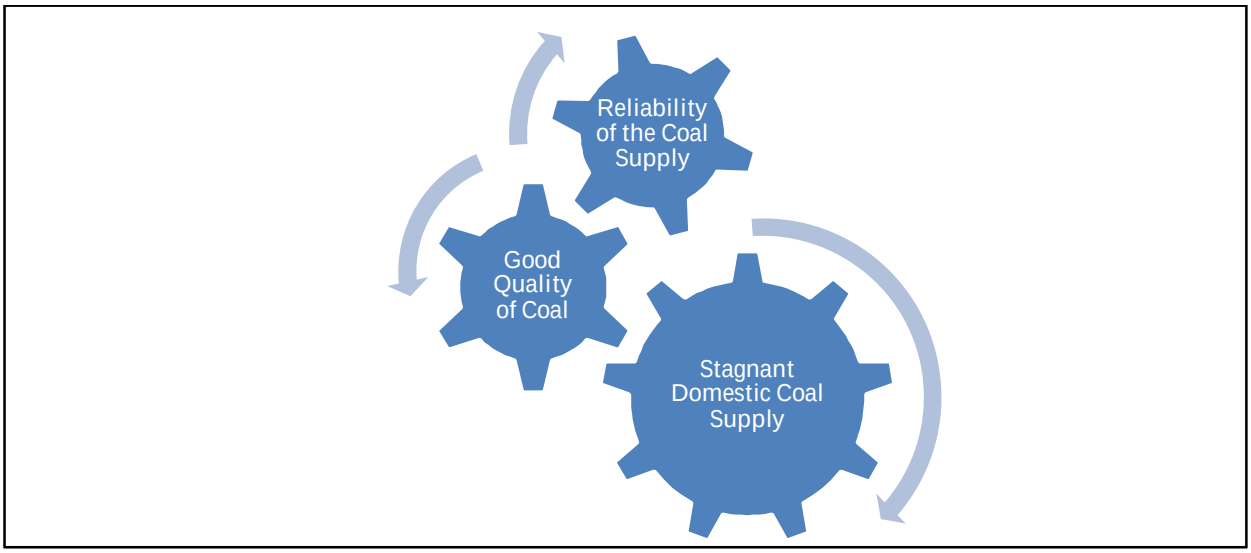
**Table 4-5: Coal import trend in India country wise for the last 10 year (in MT)**

| Country | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 | FY10 | FY11 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Australia** | 10.84 | 12.7 | 13.3 | 12.3 | 14.36 | 15.88 | 20.7 | 19.59 | 22.83 | 15.944 |
| **USA** | .043 | 0 | .019 | .714 | 1.022 | .877 | .53 | 1.215 | 1.401 | 1.771 |
| **South Africa** | 3.10 | 3.59 | .64 | .53 | 3.24 | 2.38 | 6.97 | 7.09 | 14.49 | 11.214 |
| **Russia** | .27 | 0 | 0 | .19 | .045 | .05 | .10 | .43 | .14 | .423 |
| **New Zealand** | .173 | .148 | .093 | .248 | .606 | .69 | .76 | .84 | 1.05 | .795 |
| **Indonesia** | 3.42 | 3.99 | 5.67 | 9.12 | 16.05 | 18.74 | 19.51 | 28.76 | 32.16 | 35.94 |
| **China PRP** | 2.55 | 1.99 | 1.70 | 2.31 | 3.08 | 4.09 | .553 | .52 | .044 | .242 |
| **Others** | .119 | .861 | .239 | 3.475 | .165 | .35 | .65 | .53 | 1.11 | 2.58 |

**Source: Dedicated Freight Corridor Corp of India (DFCCIL) & Infraline Research**

### 4.4.8 FACTORS DRIVING FOR COAL ACQUISITION ABROAD:

There are various factors that drive the coal consumers to go for the Coal mining acquisition abroad. Some of them are:




Based on the facts that price in the international market is much higher than indigenous coal price. So, totally based on imported coal is highly risky till you have high capacity portfolio.

4.4.9 **SWOT ANALYSIS OF COAL RICH NATIONS:**

| Countries | Australia | Indonesia | South Africa | Mozambique |
|---|---|---|---|---|
| **Reserves (bt = Billion Tonnes)** | 39. 2 bt (2009-10) Economic recoverable reserves. | 18.7 bt (2007 study done by New Energy Development Organization & Government of Indonesia) economic recoverable reserves. Accuracy of the figure is subject to controversy. | 55. 3 bt (2001-02) economic recoverable reserves. Exact current figures are not known as no serious geological study conducted in this regard. | 16 bt (2009-10 study by Mozambique Ministry of Mineral Resources) economic recoverable reserves. |
| **Coal Regions** | Queensland (overly exploited), New South Wales (overly exploited), Surat Basin & Galilee Basin (open for exploration) | Sumatra (overly exploited), Kalimantan (overly exploited), Papua, Java, Maluku & Sulawesi (partly exploited). | Highveld (overly exploited), Witbank, Ermelo, Waterberg, Vereeniging South Rand, Utrechet and Klip River. All regions are open for exploration. | Tete and Niassa. All regions are open for exploration. |
| **Cost of Mining** | Very costly | Moderate. | Moderate. | Moderate. |
| **Coal Quality** | Very good. | Mainly sub-bituminous and lignite but its low sulphur and ash content make it desirable for power generation. | Mostly bituminous and anthracite. Low grade coal is used by the indigenous industry. For export, coal requires washing. | Coal is high in quality. |
| **Infrastructure** | Existing but needs upgradation. | Existing but needs upgradation. | Require heavy investment for infrastructure upgradation. | Require heavy investment for infrastructure upgradation |
| **Political Stability** | Stable | Stable | Stable | Stable |
| **Proximity to Indian Ports** | Not very attractive. It takes 18 days to-Indian west coast and 14 | Attractive. It takes 12 days to-Indian west coast and 9 days to Indian east coast. | Good. It takes 12 days to-Indian west coast and 14 days to Indian | Good. It takes 10 days to-Indian west coast and 12 +1/2 days to Indian east coast. |

| | | | | |
|---|---|---|---|---|
| **Tax Regime** | Not very complex. But new Carbon tax and Mineral Resource Rent tax is clouding the mining sector. Though it is not implemented yet but possibility of introducing the same cannot be ruled out. If implemented, it will further increase the cost of mining. | Not very promising as Government of Indonesia is frequently changing their mining laws. Apart from the above, coal contract policy favours domestic companies. | Does not have any explicit coal policy in place. But the situation is not alarming like Indonesia. | Conducive but they are ranked (139) very low in Business environment by the World Bank. Apart from the above, Mozambique does not have any local ownership or equity requirement for the miners. |

4.4.10 **POTENTIALATTRACTIVENESS OF COAL RICH NATIONS:**

| **Countries** | **Australia** | **Indonesia** | **South Africa** | **Mozambique** | **Colombia** |
|---|---|---|---|---|---|
| **Reserves (bt = Billion Tonnes)** | 5 | 6 | 5 | 4 | 4 |
| **Coal Regions** | 5 | 6 | 5 | 4 | 4 |
| **Cost of Mining** | 6 | 4 | 4 | 4 | 4 |
| **Coal Quality** | 3 | 4 | 4 | 4 | 4 |
| **Infrastructure** | 4 | 4 | 5 | 5 | 5 |
| **Tax Regime** | 5 | 7 | 5 | 5 | 3 |
| **Political Stability** | 4 | 4 | 4 | 5 | 5 |
| **Proximity to Indian Ports** | 6 | 4 | 5 | 4.5 | 7 |
| **Total** | 38 | 39 | 37 | 35.5 | 36 |
| **Aggregate Ranking** | 4.22 | 4.33 | 4.11 | 3.94 | 4 |
| **Remarks** | Good for acquiring Coking coal mines not for thermal coal. | Not looking very promising for the future Because of frequently changing mining laws. | Good option. Here companies must see how they will tackle the presence of big companies who already have got good foothold in the coal mining sector & are securing export entitlements. | Best. Because of lower shipping cost and Indian companies have already got a good foot hold in the country. | Very good. As coal plays a small part in electricity generation in the country & most of the coal produced is meant for export purpose |

Note: Greater the rank, less preferable is the destination (1= Best; 10 = Worst)
Rankings are based on the objective personal assessment of the author from secondary information

### 4.4.11 **CONCLUSION:**

The growth of the Indian economy has led to a robust rise in demand for power. The government, in turn, has promised to unleash a 'revolution' in the energy sector; it vowed to produce thousands of megawatts of power by increasing private participation in the coal sector and allowing other Public Sector Units to get into the business. Although there have been many voices in various conferences in New Delhi pushing for a gradual move to other energy alternatives, reality suggests otherwise. A bulk of the planned capacity additions for the near future is still coal-based. On a day-to-day basis when coal supply is interrupted by bureaucratic regulations or social unrest-as was the case in July 2012-the nation goes literally dark. Other sources fail to fill the gap. Given that India has created a system of electricity generation and distribution that is based on the economics of poorly paid miners inefficiently digging out coal in open cast mines, it is unlikely that it will adopt radical alternatives unless it invests substantial sums. India's continued use of coal is justified on the basis of the surrounding socio-political economy. Importing coal will certainly be of help. However, given that Indian domestic coal is sold at government controlled prices, the import option will pump up the power costs and both companies and consumers will have to pay more. Rising costs of imported coal, along with high power tariff, are forcing many companies to surrender their supply contracts. Despite the problems, overseas acquisition need not become the answer to problems in developing Indian domestic coal blocks[25]. Domestic issues must be addressed on a war footing while imports serve as a temporary solution in the interim.

[25] A Coal block is an area from which the government has granted permission in the form of a mining license to mine coal**.**

# CHAPTER 5

## ROADMAP TO COAL LOGISTICS

## 5. INTRODUCTION: COAL TRANSPORT INFRASTRUCTURE

Hitherto, the development of new coal mines was taking place wherever transport infrastructure for evacuation of coal and its further transportation to various designated destinations could be managed without much of a problem. With the increased demand, more and more new and far-flung coalfields are being taken up for development to meet the increasing demand of coal in the country. Initially such developments can go along with road transport. But road haulage is not easy due to lack of road infrastructure of adequate strength. This highlights the need for development of railway facilities for all such locations. Similarly, for handling and transportation of increasing volumes of imported coal, integrated port and railway infrastructure has to be established.

Railways are the main stay for the coal transportation and account for about 50% and will be the most desirable in the future. Roadways contribute 27.06% of movement of coal and generally used for small amount within 300 km range. The captive source like MGR, belt and ropeways also contribute for 22%, generally used for pithead plant.

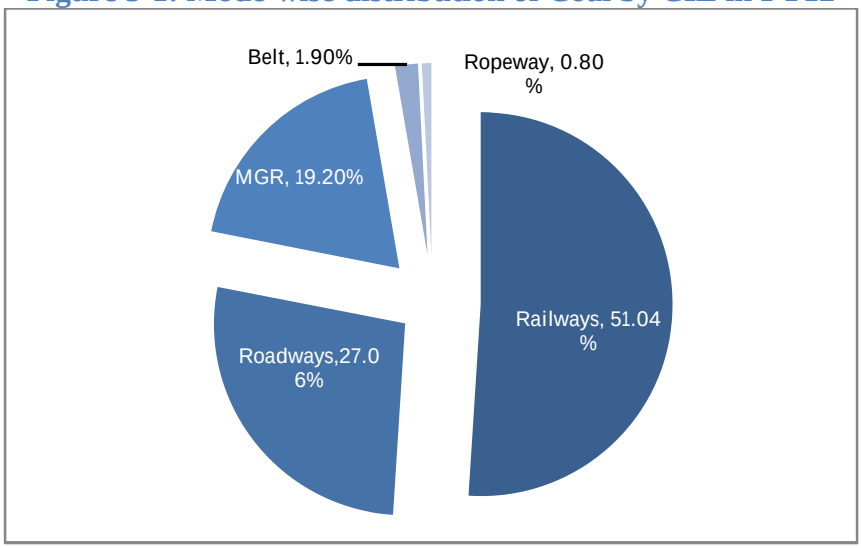
Since CIL accounts for more than 85% of indigenous coal production, a reasonably fair picture of transport logistics of total indigenous coal sector may be extrapolated from the facts and figures pertaining to CIL. Hence, we will analysis the transportation and logistics part of coal by CIL and assure the same pattern for the rest of coal producing company or parties.

**Table 5-1: Characteristics of Coal Logistics**

| Means | Characteristics | Quantity in FY11 |
|---|---|---|
| Railways | Economical, cheapest and fastest mode for bulk amount for long distance | 2108.79 MT |
| Roadways | Viable ,beneficial for distance between 50 to 300 meters and for small quantity | 1117.91 MT |
| MGR | Best suitable for pithead power plant and for bulk amount | 793.53 MT |
| Belt/Ropeways | Useful for plant near mines and for small amount | 78.5 MT/33.19 MT |

**Source: CIL**

**Figure 5-1: Mode-wise distribution of Coal by CIL in FY12**




**Source: CIL**

The distribution of coal by different mode of transportation for IX; X and XI Plan is been tabulated below. The below table clearly demarcate that railways will account for 50% of coal logistics and rest will be taken care with road; merry go round and for pit head plants rope ways; belt will be most effective and economical.

**Table 5-2: %age contribution of Different modes of Transport in Coal Dispatch**

| Period | Rail | Road | MGR | Belt/Others |
|---|---|---|---|---|
| **2001-12(IX Plan)** | 53.3 | 18.2 | 22.7 | 5.8 |
| **2006-07(X Plan)** | 47.1 | 25 | 23.2 | 4.6 |
| **2007-08(X Plan)** | 49.2 | 26.5 | 18.7 | 5.6 |
| **2011-12(XI Plan)** | 49 | 27.2 | 19.1 | 4.7 |

**Source: Coal India Ltd.**

## 5.1 ROADWAYS:

### 5.1.1 ROAD LOGISTICS INFRASTRUTURE IN THE PLANT:

The most important advantage of coal transportation by road is its flexibility; it provides almost full control on scheduling delivery of coal to plant. As scheduling can be done according to the requirement of plant it is not possible with rail transportation for rail transportation it will depend on availability of rakes But road transportation is much more costly than railway transportation. The following Infra acts:

| | |
|---|---|
| Gross Weight bridge | •The Gross Weight bridge measure the weight of loaded trucks |
| Sampling Machine | •There is mechanical sampling machine called Augar for coal sampling |
| Proclain Machine | •The Proclain machine is used to unload coal from truck into the hopper |
| Tare Weight Bridge | •It will measure the weight of unloaded trucks |
| Truck Tippler | •This tipples or unload coal into the truck hopper |

## 5.2 RAILWAYS:

### 5.2.1 WAGON TYPES:

#### 5.2.1.1 BOBRN Rakes:

BOBRN Rakes are those rakes whose wagons have the opening at bottom, for pouring their coal in to hopper directly. The capacity of BOBRN rakes on average is about 3617 metric tonnes and it takes about 2 hour to unload coal in the hopper. The TAT for the BOBRN rake is around 4hr on an average. Capacity of the each BOBRN wagon is 63 Tons.

**Constraint:-**

- Presently we can handle 7-8 BOBRN rakes in a day, at given full system availability due to railway constraints, of connectivity of plant. But we are receiving presently 4 to 5 rakes per day. Traffic handling capacity of Indian Railway on this route is limited due congestion b/w Sambhalpur to Burandamal.
- Problem faced in completion of undergoing project of MGR[26] (Merry Go Round).

**Recommendation:-**

- Present Railway infra can handle 7 BOBRN rakes which can be increased to 10 rakes with proper management.
- Try to complete the undergoing project of MGR at maximum pace, as the delay in project would also lead to increment in project cost.

[26] **Merry Go Round** is a block train of hopper wagons which both loads and unloads its cargo while moving.

#### 5.2.1.2 **BOXN RAKES:**

BOXN Rakes has the higher capacity than the BOBRN rakes, but it doesn't have the facility of bottom opening to unload the Rakes so it requires the wagon tippler to unload the rake. Each wagon of the BOXN rake has capacity of around 67Ton. Unlike BOBRN rakes it has 59 wagons. The ideal TAT for the BOXN rake is 6hrs, and 5 hours is free period time provided by railway for unloading BOXN rakes, without any demurrage charges. While, in plant unloading time is approx. 6-7 hrs. Total capacity of the BOXN rakes is around 3894Ton.

**Constraint:-**

- System installed for unloading BOXN rakes is not performing as it was designed for. So, due to this rakes take more time than estimated. And for that company has to pay demurrage charges. Since the TAT for the BOXN is more than 8hrs so, we can handle at most 6 BOXN rakes in a day.

**Recommendation:-**

- If we are able to reduce the TAT for rakes, we can save demurrage charges. Fast unloading will be the key for this.

### 5.2.2 **RAILWAY LOGISTICS INFRASTURCTURE IN THE PLANT:**

1. **Way in-motion weigh-bridges**
2. **Wagon Tippler**
3. **Track hopper**
4. **Diesel loco**
5. **Track length**

#### 5.2.2.1 **Way in-motion Weighbridge:**

Two way in-motion weighbridges are used for weighing the rakes. Rakes coming from the mines are weighed in motion weighbridge in motion. It takes around 10 minutes for this purpose. The Load cell can weigh the rake when its speed is less than 10 km/hr.

**Constraint:-**

- When rake moves at a speed higher than 10km/hr then there are chances of either skipping of wagons or weighing errors.
- Load cell and digitalizer problem can led to the skipping of rake weighing and power problem failure problem sometime leads to manual restarting of system, during that period rake can escape from weighing.

**Recommendation:-**

- Rakes speed must be between 8-10 km/hr. for proper weighing of wagons.
- Backup power and checkups of load cell is required. So that no manual start-ups is required and no rake could escape.

5.2.2.2 **Wagon Tippler:**

The wagon tippler is machine to unload the BOBXN rakes. In order to unload the wagon, the wagon is separated from the rake and is lifted by the wagon tippler in order to unload the wagon into the hopper directly. The capacity of the wagon tippler is 20 wagons per hr.

There are two Wagon Tipplers in SEL. The capacity of the wagon tippler is 20 wagons per hr. Each takes around 3-4 minutes to unload a BOXN rake. At max it can handle four rakes in a day.

**Constraint:-**

- There is a regular mechanical breakdown of wagon tippler due to hydraulic pressure failure and lubrication problem.
- The system might get struck due to mechanical breakdown.
- There may be a problem of clamp lowering because of this, clamp may not fit at angle of 45 degree hence tippler is not able to hold the wagon properly.
- Problem of specific hopper jam arises due to belt break down.

**Recommendations:-**

- There should be the regular maintenance of the wagon tippler.

- Its hydraulic pressure should be checked & maintained regularly.
- Proper inspection and maintenance of belt be done.
- Before rake arrival it should be checked for proper functioning by trial run and if there is any problem it should be sorted out before arrival of rakes.
- Hopper may also get jammed due to over feeding of coal in hopper. This may be avoided by running conveyor continuously when unloading rack.

5.2.2.3 **Track Hopper:**

Track Hopper Track Hoppers are mainly used for coal storage & handling in power plants. The coal is generally transported from coal mines either by BOBR wagons (Bottom Open Bottom Discharge), or by Top open wagons & rarely by trucks. A standard Track hopper is approximately 210m long. Hopper is a big funnel to unload and store the coal. There are two hoppers for BOBRN rake, two for BOXN rake and four for truck tippler. The capacity of each BOBRN track hopper is around 4500 Tons, whereas the BOXN hopper has the capacity of 240 Tons each. Since the capacity of the hopper is large so it can hold one rake coal in it. In BOBRN hopper at a time 23 wagons can be unloaded.

**Constraint:-**

- The major problem occurring in the hopper jam due to the wet coal or due to coal boulders.
- Frequent belt breakdown, due to which, unloading stops.
- Sometimes due to the fault in the motor, the movement of the belt stops.
- Problem of specific hopper jam arises due to some technical issue.

**Recommendation:-**

- Coal boulders and wet coal should be avoided. It is advised to breakdown boulders into small pieces by hand crushers.
- As plant sources coal from different sources which have different quality of coal to be unloaded, so at least one of the hopper should be emptied. To unload coal within given time at the hoppers.

- Proper maintenance and pre checking of belt is required for its proper functioning.
- It is better to use nylon belt having high mechanical strength.
- Similarly, for motors regular bearing heat and other technical specifications should be checked.
- In case of hopper jam, system should be stopped immediately and hopper jam be cleared manually.

5.2.2.4 **Diesel loco:**

For the purpose of internal movement of rakes from unloading point to the holding point, formation of BOXN rake sit is used.

| | |
|---|---|
| In-Motion weigh bridges | • Motion weigh bridge measures each wagon weight in motion (below 10 km/hr) |
| Wagon Tippler | • It is used to unload BOXN rakes having wagon |
| Diesel loco | • Used for the internal movement of rakes in plant |
| Track hopper | • It has a length of 210 m and can unload 23 BOBRN wagon at a time. |

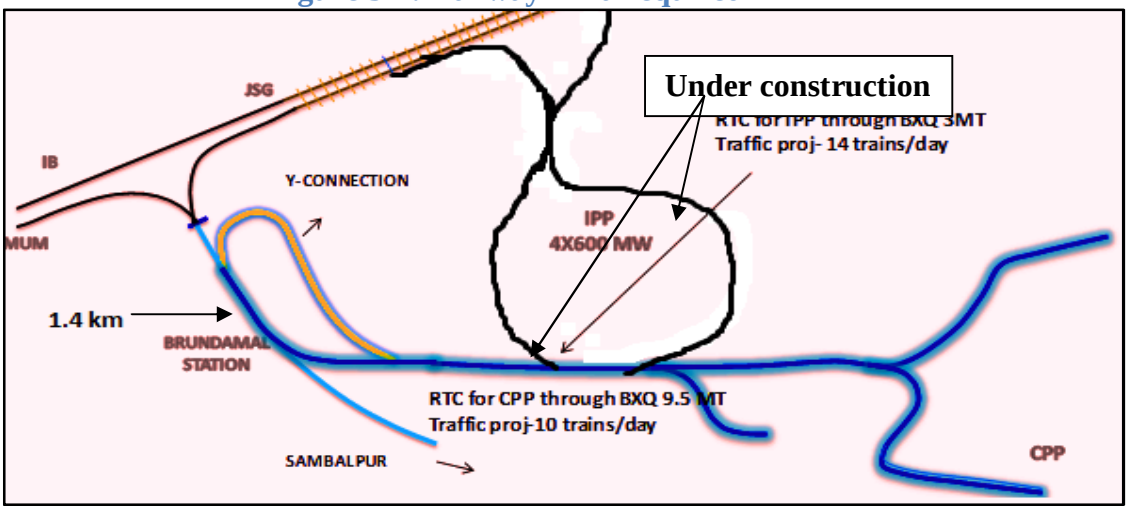
5.2.2.5 **Track length:-**

Take off from Brundamal Station of East Coast Railways; 18.6 Km. Take off from Jharsuguda Yard. Track Length 37 Km. Interconnections of CPP and IPP Railway.

Track Length: **12 Km**

**Present Railway Infrastructure at VAL**

**Figure 5-2: Railway infra required**




**Source: Vedanta Resources**

## 5.2.3 RAILWAY LOGISTICS:

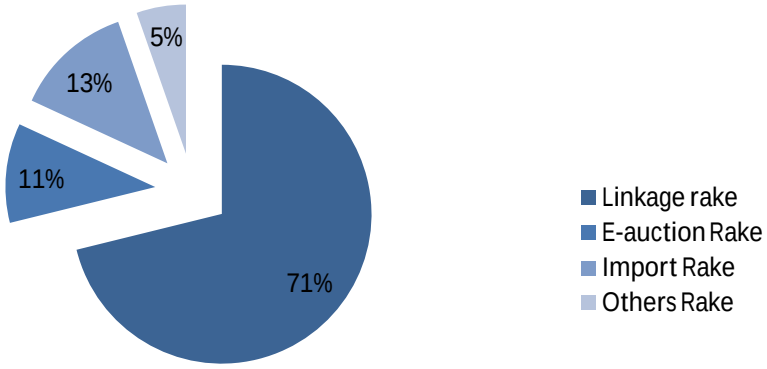
**Railways** provides coal transportation in large quantity and in less costly compare to road transportation and expenses for unloading a rake[27] of quantity 3717MT is far lower than unloading same quantity of coal by trucks**.**

The coal for the IPP plant is received through the Mumbai-Howrah line from IB valley area and Talcher region. The rakes are coming to the BRUNDAMAL station. Brundamal is serving station for CPP & IPP both; it has the two ends: Sambhalpur end and the Jharsuguda end. There is Y-connection made in BRUNDAMAL line to handle more rakes and to avoid engine reversal. Because of the Y-connection rakes from both the ends can come directly to the plant. Rakes take around 30-45min to reach plant from the station.

The rakes coming from Sambhalpur end come to plant through Y-connection line and the drawn out is through same line. While the rakes arriving from JSG end arrive and t exit through same JSG to Sambhalpur line.

[27] A **Rake** a line of Railway wagons coupled together as one unit. Usually 59-60 wagons are there in a typical rake.

**Figure 5-3: Monthly Rake Break-up**




**Source: Vedanta Resources**

5.2.3.1 **Constraint of railway network:**

1. The SEL railway network presently can handle 10 rakes at max (7 BOBRN, 3 BOXN), given all system working properly, but on average the presently system is handling 6 rakes a day.
2. For rake to be drawn out it takes half an hour, soundless the rake is drawn out another rake cannot be taken in.
3. Secondly, when there is rake on Brundamal station rake cannot be drawn out or placed on the CPP line before station, as this will block the IPP track line.
4. Out of two holding line only one line can be used for rake holding while the other one is for engine reversal or rake formation.
5. For rakes drawn out engine reversal takes much time. There is no provision for direct rake drawn out without engine reversal.
6. Since, for BOXN rake engine provided by the railways so it usually takes more times depending upon the availability of engine by railway.

**Recommendation:-**

1. With the development of Railway Merry-Go-Round system for rake movement, the rake handling capacity can be increased.
2. Doubling of Sambhalpur end line is required for smooth rake drawn out from plant.

3. Construction of five more lines at Brundamal station for movement of rakes is going on, which would increase the traffic movement capacity of Indian Railway. Then number of rakes to be moved towards SEL per day will increase, as lane would be available for movement. If BOXN unloading time reduced 3-4hours then power would be available inside the plant, as per Indian Railway engine unloads standards.
4. Track length should be made more than rake length in case of holding line, which is less in case of BOBRN hopper
5. Length of Brundamal-Sambhalpur end line to Y- connection crossing should be increased to full rake length, so that a rake can be placed in case of train at Brundamal station during drawn out.
6. Without engine reversal, direct drawn out line is required for handling future coal requirement of plant.
7. Proper co-ordination with the railways is required for smooth rake movement.

5.2.3.2 **Bottlenecks in Railways for Coal Transportation:**

**a) AT PLANNING LEVEL**

- Lag in synchronization of railway infrastructure build up with developments of up-coming projects – delay or under-utilization of projects
- Mines forced to find out alternative stop-gap arrangement – transport cost escalation, discontinuance of the stop-gap arrangement leads to socio-economic disturbance
- Planning normally restricted to developing infrastructure at trunk routes—supply chain in coal bearing areas remains clogged
- Planning concentrates on track development- mismatch between track and rolling stock capacity
- Plan for rolling stock in totality without taking into consideration sector-wise nature of requirement –inadequate availability of wagons during peak production periods
- Lack of coordinated efforts between Local administration and Coal Companies in planning of roads and other comprehensive area development

### b) AT PRODUCTION POINT

- Natural adversities – unavoidable seasonal fluctuations in coal production/demand
- Difficult warehousing conditions – stocks exposed to pilferages and natural weathering
- Linking coal to siding from large number of small mines in traditional coalfields
- Poor road infrastructure, fair weather bridges -- transportation to Railway sidings gets affected
- Link-roads mostly through congested locality – socio-economic disturbances
- Fluctuating schedule of arrival of empties – idling of loading equipment.

### c) IN Railways Routes

- Movement of Freight and passenger traffic through same track – transit delay
- All trunk routes including Golden quadrilateral and its diagonals saturated or super saturated – constraint for throughput handling
- Multi-commodity handling rolling stocks –prioritized movement of food grains, fertilizers affects wagon supply for coal in peak production months.
- Limited yard availability – restricting load and empty rakes handling capacity
- Smaller rake size, higher dead load – restricting haulage quantity
- Absence of electrification in coal moving tracks – delay for changing locomotives
- Bifurcations of Zone Railways – indulging intra-zone wagon movement, particularly in peak season

### d) AT UNLOADING POINTS(POWER STATIONS)

- Unloading system equipped to handle particular type of wagon – flexibility of rolling stock throttles
- System not equipped to work 24X7, delay in unloading during shift changes – Railway operation continues un-interrupted

- No time schedule available for arrivals of loads– idling infrastructure & restricting planned maintenance
- Monthly requirement of coal not equitably distributed --- bunching of rakes at unloading points
- Delay in cross-over, exchange-yard --bunching of rakes often creating problems even in main operational lines

#### 5.2.3.3 **Methods to mitigate the bottlenecks in Coal Transportation:**

- Up-gradation of yards and signalling arrangement attuned to projected capacity of freight corridor.
- Compatible linking of coal-bearing areas with the freight corridor to ensure express movement of coal rakes to Destinations.
- Introduction of GPS tracking system for forecasting timings of arrivals of empties at loading points and loads at unloading points for optimum utilization of related plants and machineries
- Upgrade existing coal unloading terminals and develop new terminals for improving distribution network introduction of timetable for rake placement for loading points of capacity less than one rake a day for optimum utilization of loading Equipment.
- Elimination of cross-subsidy of passenger traffic from freight traffic.
- Allowing dedicated movement for wagons owned by Consumers and Coal producers.
- Inviting logistics companies to run their rolling stock on wheeling charges.

#### 5.2.3.4 **Railways Expansion & Future Vision 2020:**

The expansion plan by Indian railways in the tracks; doubling of lines or electrification of the lines are going to smoothen the coal transportation from mines to coal consumption plants. The detail analysis of effect has been tabulated below.

The railways expansion is done by keeping in the mind the coal demand in the future as coal account for around 40% of total traffic of Indian Railways. Most of the route in the eastern parts of the country will be dedicated for only coal transportation in the near future for the end user plant

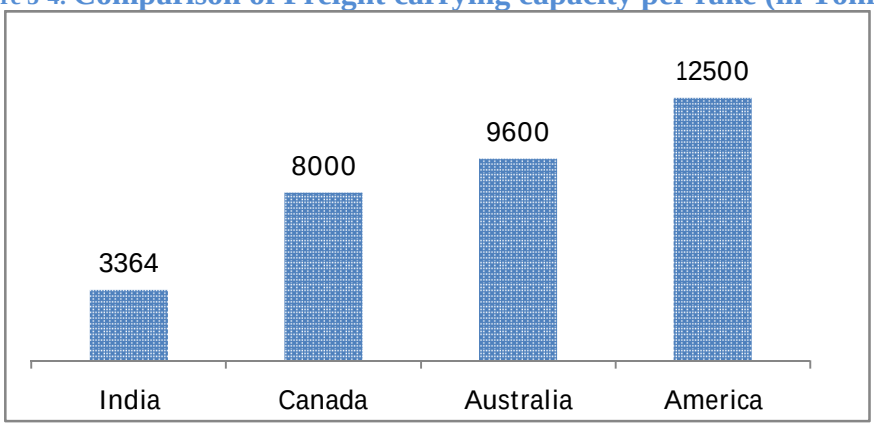
Table 5-3: **Railways Expansion & Future Vision 2020 for Freight Traffic**

| S. No | Name of sections | Features | KMs |
|---|---|---|---|
| 1 | Talcher-Sambalpur, Sambalpur-Jharsuguda, Sambalpur-Titlagarh, Titlagarh-Raipur, Vizianagaram-Titlagarh and Damanjodi-Singapuram Road | Doubling of SBP-Titlagarh-Raipur route<br>Link to Vishakhapatnam & Gangavaram port | 1007 |
| 3 | Vijayawada-Gudivada-Bhimavaram-Nidadavolu & Gudivada-Machilipatnam and Bhimavaram-Narsapur | Connect with Machilipatnam port | 221 |

**Source: Ministry of Railway**

The freight carrying capacity of India is around 3364 tonnes per rake. While in Canada; Australia and America freight carrying capacity is 8000; 9600 and 12500 tonnes per rake. Comparing with other counties like Canada, America and Australia is about 2.37; 2.85 and 3.17 times less respectively. In simple words, in India it will take 2.37 rounds to transport same amount of commodity than what is done in 1 round in America.

Figure 5-4: **Comparison of Freight carrying capacity per rake (in Tonnes)**




**Source: Worldcoal.org & Infraline Research**

Indian railways traffic increases to 969.8MT in FY12 from minimal 73.5MT in FY51. Coal account for 455.8MT of freight in FY12 compared to 420.37MT in FY11. To achieve the 1GW target for XII Plan, the railways have to play a crucial role in the logistic part. Coal account for 46% of total freight of Indian railways in FY11.

5.2.3.5 **Technology Innovation in Coal Transportation Logistics**

The technological step and innovation d taken by CIL for transportation of coal from mine to end use plant. The different method or technological steps taken are explained in detail below:

1. **Coal-by-wire** -Power-grid networking, over the years, has immensely helped in curbing requirement of physical movement of coal, particularly in long haul. Instead of coal movement, the electricity produced by coal is transmitted to the user end.

2. **Coal Beneficiation** -CIL is planning to dispatch only beneficiated coal to all consumers except those located at pitheads. This would likely to reduce haulage need by 6-10%.

3. **Coal-by-pipeline** -In-situ coal gasification and Coal Bed Methane exploration would be the major ventures in years to come in the energy market of the Country bringing a new vista in transportation logistics.

4. **Coal-by-slurry** -In coal by slurry methodology, the coal is formed in the slurry form by mixing with the water and at the receiving end it is extracted and coal is dried to removal the excess water. The coal by slurry metrology is prevailing in vogue in USA.

## 5.3 PORT INFRASTRUCTURE: Overview

- India's seaborne trade 95% by volume & 70% by value.
- Length of the coastline 7,517 km.
  - 9 maritime States & 5 UTs.

- Parallel competing port management & legal Systems
  - 12 under Major Ports Act, 1963
  - 1 (Ennore) under Company Act
  - 187 Non-major ports

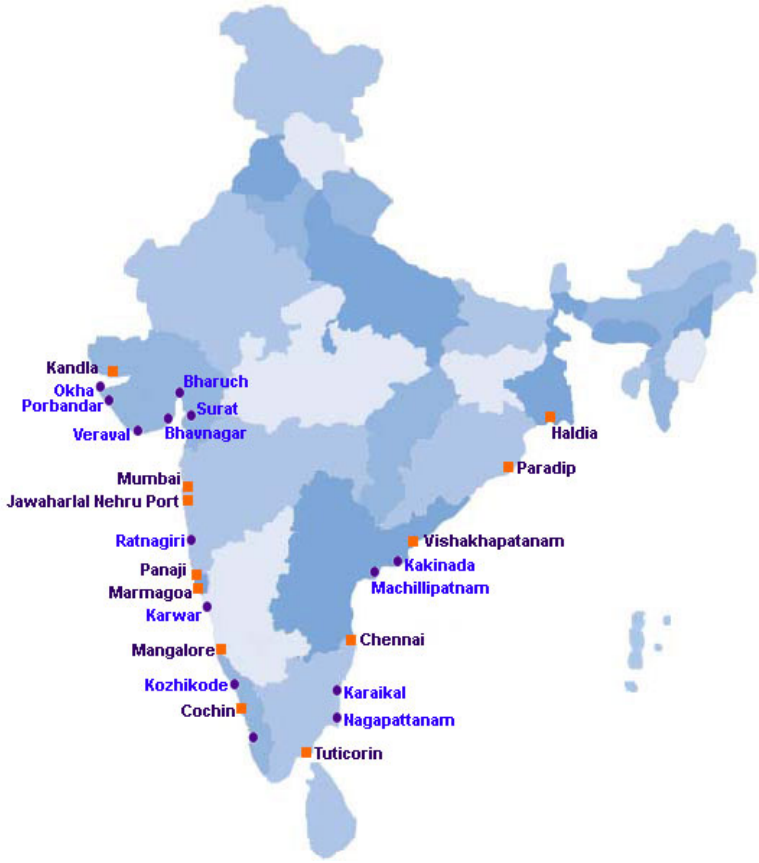
- Port legislation & Structure
  - Indian Ports Act, 1908 allows Maritime States to set up their own port systems
  - Major Port trust Act, 1963, regulates 12 major ports.

- Major Ports fall under operational & financial control of Ministry of shipping & subject to tariff regulation by Law
- Minor ports: under State Maritime Boards & free from formal tariff regulation

India has a vast coastline measuring about 7517 km. India has a rich heritage of about 200 ports. It has 12 major ports, and 187 non-major ports and one major corporate port. The cargo

increase during the next decade is estimated to grow at a CAGR of 7 percent. Imported coal has contributed a significant percentage (8-9 %) in the total cargos handled at ports.

Figure 5-5: **Ports marked on Indian map**




**Source: Infraline Research**

5.3.1 **TYPES OF VESSELS:**

1. **Handymax:** Vessels having capacity less than 60,000 DWT.
2. **Panamax:** Vessels having capacity greater than 60,000 DWT and less than 80,000 DWT.
3. **Cape size:** Vessels having capacity above 80,000 DWT up to 2,00,000 DWT.

Table 5-4: **Major & Minor Ports with their Handling Capacity Vessels**

| Types of vessels | Major ports | Minor Ports |
|---|---|---|
| **Handy max** | Kolkata, Haldia, Chennai,Tuticorin, Kandla, Cochin, Paradip, Vishakapatnam | Gopalpur, navlakhi, Bhavnagar, Magdalla, jafrabad, Bedi,Jakhau, Okha, dighi,, haji Bunder, Dharamtar, Kakinada,Ennore, Pipavav, New mangalore, Mundra, Gangavaram and Krishnapatnam |
| **Panamax** | Paradip, Vishakapatnam, Tuticorin, Mormugoa | Kakinada, Ennore, , pipavav,, New mangalore, Mundra,Gangavaram and Krishnapatnam |

| | | |
|---|---|---|
| **Cape size** | Nil | Mundra , Gangavaram and Krishnapatanam |

**Source: Infraline Research**

**Table 5-5: Rail Connectivity at Major Indian Ports & Traffic Handled till FY11**

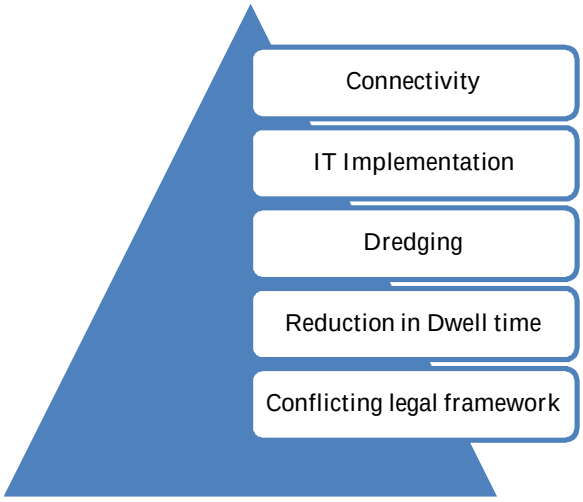
| Port | Existing Rail Connectivity | Traffic Handled by Rail /Road/Pipeline (MT) |
|---|---|---|
| **Kolkata Port** | Eastern Railway's Sealdah-Budge Budge Branch Line connects Kolkata Port with main lines at Majherhat Junction. | 12.5 |
| **Haldia Port** | South Eastern Railway's Panskura-Haldia Branch Line connects Haldia Port to main trunk line of Indian Railways | 34.9 |
| **Paradip Port** | Paradip Cuttack rail link connects Paradip Port with Howrah-Chennai Trunk line | 56 |
| **Visakhapatnam Port** | Port is connected by railways to Chennai Howrah main line of East Coast Route. | 68 |
| **Ennore Port** | Port is connected by rail to the Chennai- Gudur Section of the Southern Railway. | 11 |
| **Chennai Port** | Madras Beach Railway connects Chennai Port to Southern parts of Tamil Nadu. And via Rayapuram the Southern Railway trunk line connects the port to north India. | 50.5 |
| **Tuticorin Port** | Port is connected by broad gauge (BG) rail link with major cities in south India. | 25.7 |
| **Cochin Port** | Port is connected to Shornur-Trivandrum main line of Indian Railways, at Ernakulam through broad gauge rail. | 17.9 |
| **New Mangalore Port** | Is connected by broad gauge line to Southern India and through Konkan Railway to northern part of the country. | 32.1 |
| **Mormugao Port** | Is connected by broad gauge line to Konkan Railways. | 50 |
| **Mumbai Port** | Is connected to Indian Railways main line at Raoli Junction, Wadala. | 54.6 |

| | | |
|---|---|---|
| **Jawaharlal Nehru Port** | Port is connected to Panvel by Railway. | 64.3 |
| **Kandla Port** | Is has dual gauge railway connectivity to rail network connecting Mumbai & Delhi. | 81.8 |

**Source: DCCIL & Infraline Research**

### 5.3.2 CHALLENGES IN PORT INFRASTUCTURE:

The challenges and the bottlenecks at the ports infrastructure slow down the trade with ports.




Poor efficiency caused by slow evacuation of cargo from ports or slow turnaround of ships. For container handling, adequate electronic environment with Enterprise Resource Planning (ERP), which enables the resources of ports to be used in an even and efficient manner, is yet to be established in a full-fledged manner. During the $X^{th}$ Plan only 11 percent of the target for dredging could be achieved. The $XI^{th}$ Plan target is more than two times. It is observed that the port's role in the entire logistics chain is barest minimum to provide the infrastructure facilities for handling of vessels and other cargo. It revealed that the total time taken by the port authority, cumulatively, is 3.5 to 5.5 hrs for import and 3.3 to 5.3 hrs for export. Thus it can be observed that the rest of the time the container dwells in the port is on the account of other stakeholders like shipping agents, customs, Clearing agents / transporters etc .The average dwell time in major container terminals is 1.88 (import) and 3.78 (export) days. These are some of the challenges and bottlenecks that the port infrastructure is facing now a days.

## 6. RESULTS:

The growth of the Indian economy has led to a robust rise in demand for power. The government, in turn, has promised to unleash a 'revolution' in the energy sector; it vowed to produce thousands of megawatts of power by increasing private participation in the coal sector and allowing other Public Sector Units to get into the business. A bulk of the planned capacity additions for the near future is still coal-based. Demand for coal is increasing drastically and Coal India Limited unable to fulfil the increased demand.

As there is a gap in demand of coal and supply by Indian coal companies, so the power companies has to look for imported coal to fulfil their demand. Besides this the Indian coal is of poor quality having high ash content also suggests for a blend with high grade low ash coal. Transportation facilities also suffer a lot as demand and source stations are far situated.

Importing coal will certainly be of help. However, given that Indian domestic coal is sold at government controlled prices, the import option will pump up the power costs and both companies and consumers will have to pay more. Rising costs of imported coal, along with high power tariff, are forcing many companies to surrender their supply contracts. Despite the problems, overseas acquisition need not become the answer to problems Domestic issues must be addressed on a war footing while imports serve as a temporary solution in the interim. So, based on the study a mix of all this various coal sourcing option based on the requirement is the optimal solution for coal.

Coal Logistics plays an imported role in importing coal. Challenges to coal logistics include Port Infrastructures, Railway Infrastructures, and Total Quantity & Quality management and also Cost factor related. As a result of this study we have done, the sourcing of coal from Indonesia is found to be most suitable and the infrastructural development inside the plant are found to be sufficient to handle coal, with some necessary additions for uninterrupted movement of coal and improvement in railway connectivity & congestion. Infrastructural project taken up by the regional railway should be completed at it earliest, which is essential for materializing more coal by rail.

## 6.1 CONCLUSION & RECOMMENDATIONS:

To sum up, in a heavily coal dependent economy like India continuously widening demand - supply gap of coal is a matter of serious concern and steps should be taken for increasing domestic coal production for long term energy security. Solution inter alia lies in accelerated development of captive coal block and for this, outstanding issues must be resolved early. A strong domestic coal production and delivery system would be imperative if the country has to achieve the goal of energy self-sufficiency and long term energy security. An independent coal regulator is required to create confidence in the mind of private investors and to provide them a level playing field. Coal imports are set to increase. This calls for securing coal prospects abroad and development of port capacity with matching inland transport infrastructure.

The coal can be procured from different sources that include domestic as well as international market. E-Auction can meet the demand of smaller plant were demand for coal is small and also in plant were coal is mixed with other source of energy like biogas plant and other fuel based power plant but reliability and cost of E-Auction coal is market driven and required a lot of study of market. The shortage supply of coal from CIL and mining company made fuel linkage; a most reliable sourcing option a risky option now-a-days and also the quantity, quality and timely delivery are some of the concern with fuel linkage.

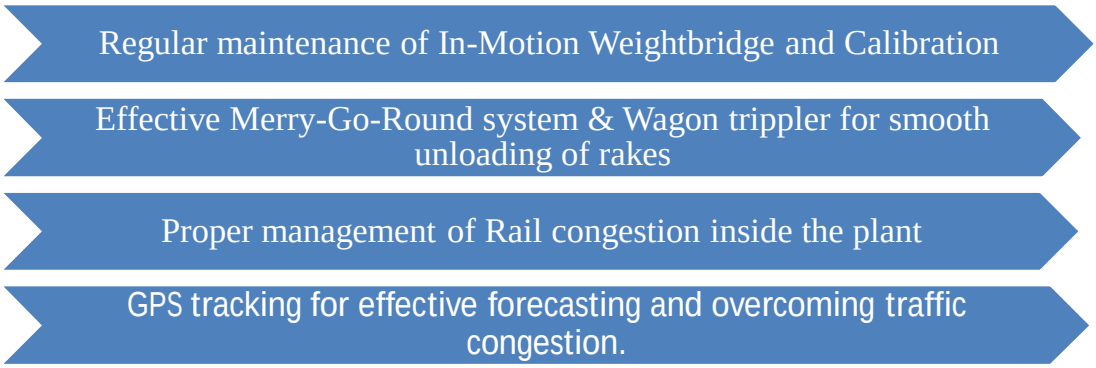
Mining & Acquisition abroad and import is more a regulatory and polices concern. The price of coal from abroad is more or less depend on rules and regulation prevailing in that country and logistics constrains also play a vital and crucial role while opting countries for import of coal from different coal surplus countries. Coal can be procured in three ways from the international market which are

- Spot Market
- Long term bilateral Contract
- Acquisition of own mine

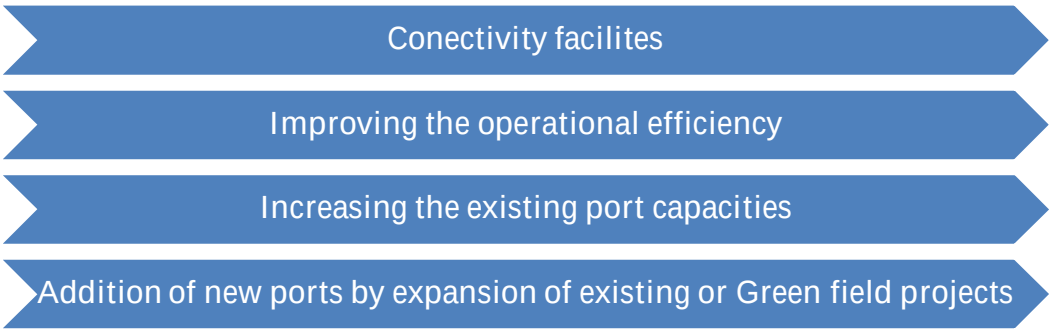
As the spot market prices are fluctuating every month and we won't have the assurance of quantity, so spot market is suitable for small volume, and it suits for the small power plant.
Long term bilateral contract will give the assurance about the quantity and quality, but the prices have to be renegotiated, when there is a huge difference in the market price.

After studying the bottlenecks and challenges of the Railways & Port infrastructure in India, the following recommendation and remedies were written down to curb the shortfall of the Railways & Port infrastructure.

### Recommendations for Railway Infrastructure




### Recommendations for Port Infrastructure




## 6.2 LIMITATIONS OF REPORT:

There can be some limitations of the research report that can come as a hindrance on the securing the aforesaid target of securing fuel supply. These are:

- A detailed cost analysis of the coal prices can be cited as a limitation because landed cost of coal and various pricing heads affect the final price of coal.
- African countries like Botswana, Mozambique are considered as under-developed countries and thus the regulations as well policies are not clear.
- Socio Economic and Political factors have not been discussed in detail in the report which can affect coal imports from these countries.
- Availability of big size coal carrying ships can also affect the coal trade.
- Natural calamities like earthquake, floods etc can affect coal production in these countries.

## 6.3 FUTURE SCOPE OF PROJECT:

As per analysis, Coal will be the main stay of energy for India for the next to 15-20 years. So securing the coal supply is the most crucial factor at this point of time. If one thinks on a long term scenario, this project has a wider scope of fulfilling the fuel shortage especially coal for any Indian Thermal Power Plant. This project can be further used to do a detailed analysis for various countries of the world having sufficient amount of coal reserves.

Moreover this report can be extended in studying the effect of coal import on the company's financial condition and thereby making it more competitive in the current power sector scenario.

### 6.3.1 FUTURE SCENARIO OF COAL TRANSPORTATION BY RAILWAY IN THE REGION:

As Indian railway is taking up many projects to increase its goods carrying capacity the movement of goods and passenger trains will increase. Odisha being the hub of power industry with around 65billon tons of coal reserve is going to be the hub for other heavy industries. These industries require raw materials in large volumes, which could be transported by high capacity vehicles or other means of transportation like railways and the inland waterways. But for rapid growth and development railway is the only mean. So railway is investing on many projects in this area.

Some of the projects which would prove fruitful For Sterlite Energy and Vedanta Aluminium Ltd and would enhance connectivity of the plant and would help logistic department to handle more rakes and would provide delivery of available material to plant for sustainable plant operation are:-

1. Sambhalpur-Rengali-Jharsuguda Doubling (Expected to be completed in this FY2012-2013.
2. Sambhalpur –Taclcher Doubling
3. Brundamal- Jharsuguda fly-over
4. For Sterlite Energy the project of connecting it with Dhutra line is of utmost important. As it would triple the rake handling capacity of the unloading plant.

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