Fuel Management: Securing Value Across India’s Coal Supply Chain

For coal-fired power plants, the business of managing coal is complex and crucial to success. Adopting the right fuel management practices can help control value loss.
Coal is the single biggest cost component for thermal power generators, typically accounting for 60 to 70 percent of input costs. And managing coal is complex, with players facing an array of issues across the supply chain—from sourcing to logistics management, bulk handling, yard management, and overall quality management. In emerging markets such as India, the addressable value loss can reach 7 to 12 percent of the total cost of coal across the entire chain.

Managing quality losses across the supply chain is a huge challenge, amplified by improper quality measurement and inefficient policies.

Where is value lost? To begin with, in coal sourcing. Many power companies, unable to fulfill requirements from long-term standard contracts with domestic sources, are relying on alternative routes such as spot and short-term coal contracts or imports. This adds to logistical challenges in the form of capacity constraints (including rail and port) and sizable quantity losses because of poor external infrastructure. In addition, managing quality losses across the supply chain is a huge challenge, amplified by improper quality measurement and inefficient yard and stockpile management practices.

The right suite of fuel management practices can plug the value loss. A.T. Kearney has helped numerous power companies adopt a comprehensive set of best practices across three dimensions: planning and sourcing, coal quality, and logistics and inventory management. In this paper, we discuss how our fuel management framework can ensure an adequate coal supply while minimizing total delivered costs (see figure 1).

Figure 1
A fuel management framework can reduce total coal costs by 7% to 12%¹

¹Indicates cost reduction opportunity on total delivered cost of coal
Note: GCV is gross calorific value; FIFO is first in, first out.
Source: A.T. Kearney analysis
Planning and Sourcing

Given the growing requirement to obtain coal from a variety of sources, identifying the lowest-cost source and the most-optimal blend is essential to plant profitability.

Identifying the most cost-efficient source

Determining the best of a number of potential sourcing options requires understanding and comparing the total delivered cost of coal, comprising FOB port costs, logistics, and other indirect costs such as quality losses. A short supply of domestic coal forces many power plants to explore imports, which requires a deep understanding of global coal markets and identifying opportunities for strategic sourcing. For instance, small and mid-size mines in Indonesia, with low cash costs and higher sulfur content, are good bets from a cost perspective for countries such as India and China. Also, as demand-supply and regulatory scenarios continue to change, power players should develop the flexibility to import and use coal of varying grades and quality and take advantage of emerging opportunities. For example, the potential ban on imports of low-grade coal in China will open up opportunities for other Asian countries to source cheap low-calorific-value coal. Similarly, while Indonesia will continue to be the largest source of imported coal for India’s power players in the next 10 to 15 years, other markets—including South Africa, Australia, and the United States—are emerging as long-term strategic alternatives (see figure 2).

Figure 2

Identifying the most cost-effective source is essential to plant profitability

<table>
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<tr>
<th>Opportunities</th>
<th>Challenges</th>
<th>Implications for Indian power players</th>
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| **Indonesia** | • Well-established trade route; lowest landed cost  
• Coal characteristics suitable for Indian power plant operations; multiple tie-ups and asset investments | • Production in the largest mines has peaked; cash costs are rising  
• Upcoming mines face significant inland logistics challenges and port constraints | • Largest exporter to India; should continue as such for next 10-15 years  
• Logistics infrastructure development is crucial for long-term growth |
| **South Africa** | • GCV-equivalent FOB costs comparable or lower than Indonesia  
• Favorable mining cash costs and export regulation | • Port and inland logistics capacity constraints limit export volume  
• Logistics costs higher than Indonesia | • Selective opportunities during depressed freight or FOB prices if plant boilers are capable of using blended South African coal |
| **Australia** | • GCV-equivalent FOB costs comparable or higher than Indonesia  
• Many large thermal coal mines expected to open; high growth expected in exports  
• Industry-wide focus on reducing cash costs by increasing productivity | • Number of current projects delayed due to viability concerns  
• Port capacity constraints  
• Greater focus on coking coal  
• Mining cash costs have been on the rise in past five years | • Long-term strategic investments if new projects pick up pace and offer attractive mining cash costs |
| **United States** | • Favorable mining cash costs in Powder River Basin, Illinois, and Western Bituminous regions  
• Stagnant domestic demand will free up volume for exports  
• Favorable pricing terms possible with selective investment | • Current political regime and environmental lobby opposed to coal-fired generation  
• High inland logistics cost and absence of well-established trade route and port capacity constraints  
• Potentially higher GCV loss and inventory requirements due to long transit times | • Long-term strategic alternate contingent on emergence of a favorable policy paradigm and resolution of logistics issues |

Notes: GCV is gross calorific value; FOB is free on board (i.e., requiring seller to deliver goods on board vessel designated by buyer).  
Source: A.T. Kearney analysis
A good analytical model assesses all potential cost elements (direct and indirect), **including the impact of a blend change on efficiency.**

Successful negotiations and partnerships with mines require a deep understanding of their business requirements and constraints. Among the main points of negotiation: flexibility in coal quality (including ash and sulfur content), payment terms, contract duration, and volume tie-ups.

**Ensuring an optimal blend**

Most Indian power plants that use multisource coal face a challenge in deciding the right coal blend to feed into the boilers. Arriving at the most cost-efficient and operationally sustainable blend can be a complex exercise that requires the right set of tools and proper execution of blend trials. A good analytical model assesses all potential cost elements (direct and indirect), including the impact of a blend change on efficiency. A.T. Kearney has developed a model that examines factors such as coal cost per ton by grade, boiler efficiency at each input (gross calorific value and total moisture), and other indirect costs, including ash disposal and changes in auxiliary consumption. Trials should complement the analysis by providing the practical inputs to the model, stress-testing key nodes and assumptions, and identifying any operational changes required. Figure 3 shows our recommended three-step approach—planning, execution, analysis—for arriving at the optimal blend.

**Figure 3**

**A three-step approach can help ensure the optimal coal blend**

<table>
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<tr>
<th>Planning</th>
<th>Execution</th>
<th>Analysis</th>
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<tr>
<td>• Develop an analytical tool to estimate the coal cost per unit of generation for different blends</td>
<td>• Ensure all activities are performed per plan; capture all relevant parameters and observations</td>
<td>• Study all trial observations to determine long-term sustainability of the changed blend</td>
</tr>
<tr>
<td>• Design the right trial plan: determine trial sequence, parameters to track, stress tests, and boiler efficiency testing plan</td>
<td>• Smooth rollback to the previous blend if trial reveals negative impact on operational parameters and if generation risks are foreseeable</td>
<td>• Estimate actual changes in boiler efficiency, SCC, and indirect costs to determine cost benefits of the new blend</td>
</tr>
<tr>
<td>• Launch the right communication strategy to “on-board” all stakeholders to execute smooth trials</td>
<td></td>
<td>• Determine necessary adjustments in operational parameters to ensure a more optimal, sustainable changed blend</td>
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**Key enablers**

- Accurate blending (ensure monitoring dashboards, operator training, and uniform coal flow)
- The right quality-measurement practices
- Proper calibration of critical coal-feeding and -handling equipment in plant (such as mill feeders)

Note: SCC is specific coal consumption.
Source: A.T. Kearney analysis
Quality Management

Many Indian power plants underinvest in coal quality management. Most measure quality at the source and at pre-boiler feeding, but with limited or no tracking of gross calorific value (GCV) loss between the two nodes. Further, the data on coal quality is often unreliable. Neglecting quality control can lead to GCV losses as high as 3 to 6 percent, which directly impacts the bottom line (see sidebar: Power Producer Fuels Its Own Success).

Improving quality management requires several moves:

**Tracking and measuring**

With power companies procuring coal from multiple sources and using numerous modes of transportation, quality tracking can be challenging. Accurate tracking requires setting up the right quality measurement processes at key nodes and defining a scientific and consistent method for calculating losses. Based on GCV losses at and between nodes, it is important to roll out focused coal quality management initiatives.

**Sampling and testing**

Without a robust sampling and testing process, data about quality can be misleading and trends inaccurately assessed. Because coal is a heterogeneous product, it is important to have the right infrastructure in place and follow a rigorous sampling process.

**Sampling.** Power plants can ill afford manual collection of samples by a staff that is not qualified to perform the task with the necessary rigor. If possible, plants should install autosamplers for sample collection and provide adequate training for situations when manual sampling is necessary. Furthermore, establishing clear standard operating procedures (SOPs) based on best practices can go a long way toward improving sample collection and preparation.

**Testing.** Laboratory testing faces two common challenges: incorrect testing standards, such as using hard-coal standards for brown coal, and infrastructure constraints that prevent exact replication of the defined testing steps, such as using air-based ovens instead of nitrogen-based ovens for moisture measurement of coal with oxidation tendencies. Both challenges prevent companies from capturing true quality losses and result in inefficient coal consumption and costs.

**Power Producer Fuels Its Own Success**

A large thermal power producer was eager to streamline its fuel management processes and improve costs by addressing several challenges across its supply chain. Fuel costs were high because of suboptimal sourcing and logistics planning, and there was limited understanding about coal quality losses and quality management practices. Inventory levels across nodes were also higher than required.

A.T. Kearney worked with the company to design best-in-class fuel processes and implement focused initiatives to unlock value. For example, by devising improved quality management practices, the company saw a bottom-line impact of $25 million (more than 2 percent quality loss reduction). Improving logistics planning and aligning inventory targets created a working-capital impact of $10 million (about 30 percent less inventory across nodes). Additional benefits are being realized through a structured process for blend optimization and a plan to source coal from alternate mines.
Yard and stockpile management

In India’s coal yards, the focus is typically on timely delivery to the downstream node (for example, delivery to bunkers) and timely discharge of coal at the yard. These activities often take attention away from other important considerations, such as proper yard layout that enables first in, first out (FIFO) operations and optimal use of equipment and available yard space. Also, efforts to control spontaneous combustion, the primary reason for GCV loss, are mostly retro-active, not well-planned, and marred by misconceptions about combustion control practices.

Typical stockpiles can be divided into three zones, with the mid and inner cores most prone to combustion.

The first step to follow FIFO methods and address GCV losses is to define proper yard layout. This requires considering the quantum of each grade of coal used, the inventory holding period, and optimum infrastructure usage. Support for this comes from a coal pile age-monitoring tool that screens stack-wise coal age and facilitates FIFO operations, providing guidance on which stack to use for delivery and where to stack fresh coal.

Next is implementing the right stockpile management practices. Typical stockpiles can be divided into three zones, with the mid and inner cores most prone to combustion (see figure 4). For the inner core, it is important to ensure compaction at the time of stacking to reduce and remove air pockets. Active management of hot spots is also vital, especially for the mid core, and involves using thermal probes to identify hot spots and then spreading that section using a poclain to cool it. In the absence of thermal probes, a crude but effective way to detect hot spots is to isolate smoke and oxidation zones early and then cool that section by spreading the coal and compacting it back in the stack. Sprinkling stacks for dust suppression should be done in a controlled manner to avoid energy losses from allowing excess moisture in. Other useful practices include leveling stockpiles to remove air channels, orienting stacks so the wind moves along the stack length, and installing wind breakers.

Figure 4

Typical coal stockpiles have three zones

Note: GCV is gross calorific value.
Source: A.T. Kearney analysis
Logistics and Inventory Management

Coal logistics and inventory planning can be a complex, costly, and unreliable process. Many companies rely on experience-based logistics planning, which can lead to suboptimal decision making. Further, significant quantity losses can occur across the value chain, including handling losses and pilferage. In addition, inventory targets at nodes are either not synced with the logistics plan or do not reflect the right balance between the risk of stock-outs and the cost of working capital. With this in mind, we have outlined three practices to optimize coal logistics and inventory planning:

**Scientific modeling of the supply chain**

Indirect costs such as penalties, vessel demurrages, dead freight, and handling losses need to be accurately factored into an analytical model. The model is then used to assess appropriate network options, including evaluating whether fundamental changes to the network can provide benefits (for example, use of ports versus rail versus road). We have developed supply chain models for a number of organizations to reduce costs while maintaining or improving service levels.

**Optimal infrastructure**

Most quantity losses occur for three reasons:

- Handling losses during discharge of coal resulting from manual loading operations instead of mechanical, incomplete bottom cargo clearance, and high volumes of coal dust at the time of discharge
- Windage losses during storage because of a lack of wind breakers, stacks not oriented for wind to move along their length, and improper sprinkling and dust-suppressing practices
- Pilferage during long-distance road or rail transportation (control being limited by the high costs of monitoring pilferage)

Building a completely mechanized process to control losses requires infrastructure investments at multiple stages, such as a closed conveyor, wagon tippler, and stackers and reclaimers. Despite the initial costs, these investments offer an attractive return. Additionally, defining clear SOPs for coal-handling processes, training on-the-ground staff, and using coal binders to manage coal fines can help prune losses. Tracking and monitoring node quantity losses throughout the supply chain is essential.

**Setting inventory targets in sync with an optimized logistics plan**

The right inventory level at each node is determined by allowing for expected lead times and supply chain variations while ensuring acceptable service levels that prevent stock-outs. Reducing safety stock is essential to optimal inventory levels, and is achieved by reducing demand variation and lead times. Accurate demand forecasting, in the form of a rolling logistics plan, can reduce variation between forecasted and actual coal use. Lead times can be shortened through faster shipping options and minimizing pre-berthing delays.

Inventory levels can be further reduced by employing a multi-nodal network with parallel inventory stock points (by √n, for n number of nodes). Safety stock should be maximized at the node that has minimum quality and quantity losses to reduce value loss.
Capturing Lost Value

Fuel is a thermal power plant’s most important input. Forward-thinking players know that paying attention to managing their fuel can have an immediate impact and create growing advantage. Armed with our fuel-management framework and the practices discussed here, power generators can ensure that coal is available in the right quantity, right quality, and at the right cost.

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