

Coal: A heavy burden on the Indian Railways

Plans to significantly expand coal freight face considerable logistical challenges and may detract from the broader economic contribution of the Indian Railways

Charles Worringham, IEEFA Contributor



Contents

Key Findings.....	3
Executive Summary.....	4
Planned Coal-by-Rail Expansion.....	7
Limitations on Coal-by-Rail Expansion.....	8
Coal India’s Dependence on Road Transport	16
Rail Infrastructure Investment.....	17
Economic Appraisal of New Rail Infrastructure	18
Emphasis on Freight and Revenues over Passenger Services.....	20
Opportunity Cost of Emphasis on Coal Freight and Revenues.....	22
Recommendations.....	24
About IEEFA.....	26
About the Author	26

Figures and Tables

Figure 1: Projections of Coal Transport by Rail in India.....	7
Figure 2: Current and projected (2051) railway capacity utilisation and coal stock declines at power plants supplied by rail (1 Aug - 17 Oct 2023) (by district).....	11
Figure 3: Train Speeds, Jan 2019 - Sep 2023.....	12
Figure 4: Passenger and Freight Loads, Jan 2019 – Sep/Oct 2023.....	13
Figure 5: CIL – Coal Transport Mode, Aug 2020 - Jul 2023.....	16
Figure 6: Ratio of freight to passenger traffic by Railway Zone, Sep 2022 - Aug 2023.....	21
Figure 7: Key Performance Indicators for Railway Divisions	22
Table 1: Trains Required to Supply Power Plants at Different Distances from Mines.....	11

Key Findings

India's plans for expanding coal freight by rail face congestion and logistical challenges, divert resources from vital network upgrades, and impose an opportunity cost on a growing economy.

There are several indications that network congestion is returning to pre-pandemic levels following a temporary, lockdown-related easing.

New rail projects for coal frequently delay urgent network maintenance and upgrades.

Accelerating clean energy and recognising coal's network congestion effects can enable the Indian Railways to better serve a changing economy.



Executive Summary

Indian Railways could better serve the country's changing economy if policymakers focus on accelerating renewable electricity generation rather than expanding the transport of coal by rail. Though profitable, coal freight crowds out passenger services and other goods and is the only commodity for which a substitute exists. Doubling coal freight would exacerbate the network congestion which has led to the slowest passenger train speeds since at least 2015. Prioritising urgent track renewal for fast and reliable passenger services and the carriage of manufactured goods would better serve India's future economy and minimise the stranded asset risk posed by railway coal evacuation projects.

India's power demand is rising more quickly than its renewable capacity additions, accelerating plans to mine, transport and burn up to 65% more thermal coal for electricity generation by 2030. Several planning documents have sought to gauge this demand and identify bottlenecks in moving coal from mines to power plants.

The Indian Railways plays a central role in coal freight and the government expects it to transport almost all the additional production. A range of rail infrastructure projects, including the Eastern Dedicated Freight Corridor, aimed at easing coal evacuation, are recently completed, imminent or ongoing. The authorities are actively considering more such projects.

This report considers factors that may hinder such ambitious coal-by-rail targets, including signs that rail network congestion is back to pre-pandemic levels. Evidence includes:

- Higher freight loads than in 2019, but freight train speeds at similar levels
- Non-suburban passenger bookings at 83% of 2019 levels and lower passenger train speeds
- Passenger train cancellations to prioritise coal during crises
- Increased wagon turnaround times

Coal India Ltd (CIL) is likely to be the largest contributor to new coal production and has the most ambitious goals – floating plans to move an additional 400 million tonnes by rail in just four years. This timeline appears unrealistic, especially since almost all the extra 91 million tonnes that CIL has mined in the last two years moved not by rail but by truck. The company now reports more than 600,000 truck movements each month. Meeting CIL's targets requires a rapid reversal of this trend.

Challenges to the ambitious coal-by-rail targets



India plans to **more than double coal freight** carried by Indian Railways in the next few years.



Integrated Coal Logistics Plan projections suggest coal evacuation projects and freight corridors may still leave the congested railway network **operating over capacity**.



Accelerating renewable energy could prevent **unnecessary rail network congestion** by limiting growth in coal freight - the only bulk freight commodity for which a ready substitute exists.



Prioritising coal freight imposes **opportunity costs** on a changing economy and diverts resources from vital track renewal projects, impacting **overall railway performance**.



Passenger trains experience **reduced speeds, delays** and **cancellations** as coal and other freight take precedence.

Source: IEEFA

The Government of India has set aside record budget allocations (reaching US\$31.5 billion for the fiscal year (FY) 2024) for the Indian Railways to make upgrades, in which coal evacuation features prominently. An analysis of these projects in the recent *Integrated Coal Logistics Plan*¹ includes forecasts that many lines will exceed 100% capacity even after commissioning all the current work. There are calls to urgently add even more infrastructure to support coal movement, including dedicated coal evacuation corridors.

India's Ministry of Statistics and Programme Implementation, however, warns that railway projects are the second-most delayed category of infrastructure, so timely completion is not guaranteed. As detailed in a later section, Railway planning also issues guidelines that appear to exclude the possibility of negative 'network effects', resulting from new coal traffic worsening congestion outside the immediate project area.

Even if the Indian Railways meets the coal transport targets, further special measures may be a requirement. In the past, these have included relaxing maintenance schedules for wagons and, when coal stocks were at critical levels in May 2022, the cancellation of 1,900 passenger train services.

The highly variable freight-to-passenger traffic ratios in India's 16 railway zones illustrate the Indian Railways' emphasis on freight and revenues. These ratios favour freight in the eastern coal-bearing regions and by the priority accorded to freight and revenue indices in the Key Performance

¹ Deloitte Touche Tohmatsu India LLP for Coal India Ltd. [Integrated Coal Logistics Plan for Coal Mines/Blocks, Final Report](#). April 2023.

Indicators (KPIs) issued to the railway zones. Freight KPIs outweigh those for passengers 4-to-1, and safety enhancement makes up just 2% of the total.

The prioritisation of coal freight presents opportunity costs for the Indian Railways and, more broadly, the economy. The Indian Railways is devoting planning and engineering resources to coal evacuation projects when major routes require significant track renewal. Poor track conditions are blamed for service delays and for limiting the speed of the new *Vande Bharat* trains.



The prioritisation of coal freight presents opportunity costs for the Indian Railways and more broadly, the economy.

In an expanding and changing economy, transporting raw materials, refrigerated food and finished goods, and enhanced passenger services require network capacity. These services could face significant constraints as a result of coal freight expansion.

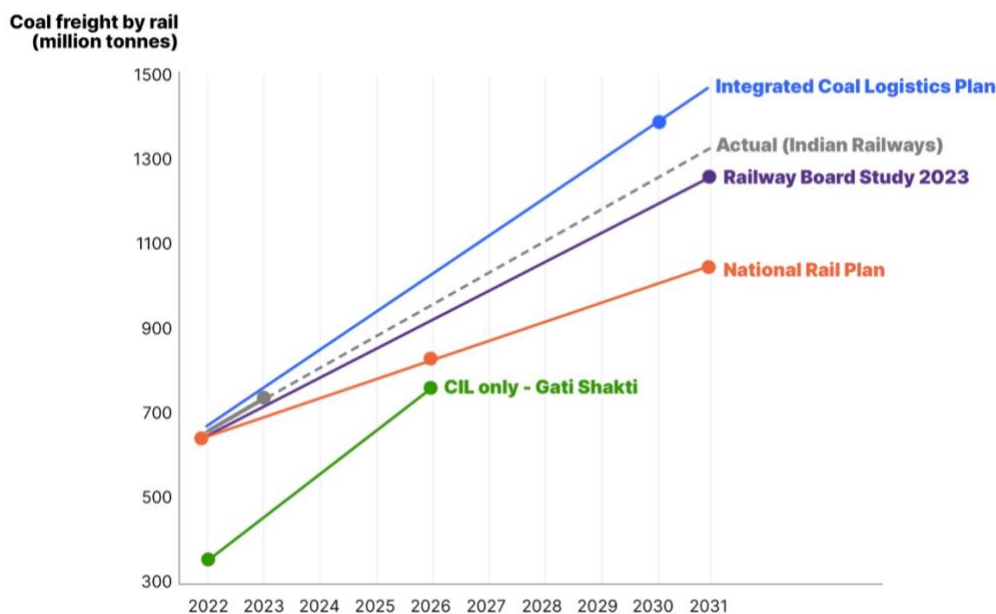
Coal is the only commodity on India's rail system for which a technical substitute is already available. A renewed focus on generating electricity from renewable sources and moving it over wires, rather than in solid form as coal, would give the Indian Railways the breathing space it needs in order to play a broader and more effective role in India's changing economy.

Planned Coal-by-Rail Expansion

Available forecasts point to a substantial growth in the quantity of coal likely to move by rail in the coming years. We present the estimates from the *National Rail Plan* (Scenario 3c, the option suggested as most plausible in the report),² the *Integrated Coal Logistics Plan*,³ a recent *Railway Board Study*⁴ and data for Coal India Ltd (CIL)⁵ in Figure 1, along with a projection from Indian Railways' reports.

These figures include all the coal moved by rail, both imported and domestic (except the domestic coal-only data from CIL). Although one of these forecasts extends to 2051, we include only those for the next eight years, as this period is when most growth is likely to occur and because longer-term projections are far less certain.

Figure 1: Projections of Coal Transport by Rail in India



Source: *Integrated Coal Logistics Plan*, *National Rail Plan (Scenario 3c)*, *Eastern Zonal Conference Report*, *Railway Board Study 2023* (see references 1-4), and *Indian Railways Revenue Freight Traffic Statistics*.⁶

Whichever estimate proves to be closest, all show coal freight transported by rail rising by a minimum of 400 million tonnes in the next eight years, with the most extreme estimate suggesting a

² Ministry of Railways, Government of India. [National Rail Plan \(NRP\) – India, Draft Final Report Volume 1: Report](#). December 2020.

³ Deloitte Touche Tohmatsu India LLP for Coal India Ltd. [Integrated Coal Logistics Plan for Coal Mines/Blocks, Final Report](#). April 2023.

⁴ Times of India. [Why Indian Railways sees need for dedicated coal corridors in line with DFCs to meet India's surging power demand](#). 19 September 2023.

⁵ Ministry of Coal, Government of India. [Eastern Zonal Conference PM Gati Shakti](#). 16 February 2023.

⁶ Ministry of Railways, Government of India. [Revenue Freight Traffic Statistics on Org. Basis, Statements-7A](#).

doubling of coal-by-rail over that period. A recent actual coal transport projection equates to about 75 million tonnes more coal moved each year, or an annual growth rate of about 13%.

The *Railway Board Study 2023* is reported to have raised estimates of India's coal consumption by 2030 to 1,853 million tonnes,⁷ nearly 30% higher than the *National Rail Plan's* forecast. The former General Manager of East Central Railway and Chairman of Rail Division India, Lalit Chandra Trivedi, has questioned the extent of this increase. He suggests that the study takes insufficient account of the new thermal capacity that the Merry-Go-Round loops (MGR – short distance, dedicated loops between pithead and power plant) serve, the transition to clean energy and the need for more multi-modal containerised traffic.⁸ The outlook used in the *Integrated Coal Logistics Plan* is higher still.

In reality, these outlooks are statements of what the Indian Railways may need to carry out in order to match projections of increased supply and demand – not statements on what the Railways can or will be able to carry. As argued below, they may be targets that prove difficult to meet.

Coal is the main, but not the only, freight type for which there are ambitious targets. The *National Rail Plan* outlines a broader expansion of all freight services, anticipating that the 1,512 million tonnes of freight carried in 2022-23 would reach 2,096 million tonnes by 2026 and more than double to 3,167 million tonnes by 2031. From 2021 to 2031, the *National Rail Plan* also forecasts a 46% rise in the number of non-suburban passengers carried daily, from 13 million to 19 million. (The plan does not consider suburban passenger loads as it is primarily longer distance, non-suburban passenger traffic that competes for space with freight.)

Limitations on Coal-by-Rail Expansion

The prospects of meeting these plans hinge on the rail network. In the supply-transport-demand chain, the supply stage does not currently present a limitation. Even setting aside any recourse to importing more coal, India's large open-cast coal mines have proven capable of increasing production at a high rate. In fiscal year (FY) 2023, the combined output of CIL, Singareni Collieries Company Ltd (SCCL) and captive mines reached 893 million tonnes, compared with 778 million tonnes in the previous FY or a 14.8% increase.⁹ This exceeded their despatch levels, which rose at half the rate (7.1%), from 819 million tonnes to 878 million tonnes. CIL and SCCL ended FY2023 with some 9.5 million tonnes higher pithead stocks than the previous year. Coupled with planned new mines and mechanised loading facilities, supply from pit to train does not appear to be a rate-limiting step in the near future.

Demand continues to increase at the other end of the chain, largely on the back of the burgeoning electricity requirement. Roughly 84% of domestic coal despatch went to the nation's power utilities in FY2023, with a further 5.1% delivered to captive power plants. The prioritisation of the electricity

⁷ Times of India. [Why Indian Railways sees need for dedicated coal corridors in line with DFCs to meet India's surging power demand](#). 19 September 2023.

⁸ Trivedi, LC. [Requirements of dedicated freight corridors for coal defies logic](#). September 2023.

⁹ Ministry of Coal, Government of India. [Monthly Statistical Report](#). March 2023.

sector saw the share of coal despatched to all other users fall to 10.7% from 12.7% in the previous FY.⁷

If supply is not in question, continued rapid demand growth for coal beyond the next few years is much less certain as the contribution of renewable energy increases. In turn, the pace of renewable energy growth in coming years will depend on policy initiatives and goals (for example, the recent *G20 New Delhi Leaders' Declaration* calls for tripling renewable energy) and economic forces (with firmed renewable generation costs competitive with thermal power, especially where coal freight costs are high).

There remains, however, a short-term demand increase for thermal coal, which leaves coal transport from mine to power plant as the weakest link in the coal chain in the immediate future. The following sections consider different facets of India's coal logistics.

Network Congestion

A perennial issue for many railway networks globally is congestion. Operators are often under unremitting pressure to increase traffic up to, and sometimes beyond, capacity. India's coal expansion will contribute to even higher congestion unless the Indian Railways commissions all the planned rail infrastructure rapidly and ensures these prove effective at a network as well as a local level. Yet, there are several indications that network congestion is returning to pre-pandemic levels following a temporary, lockdown-related easing. This will significantly constrain the system's ability to absorb a substantial increase in coal traffic. Without significant speed increases, despatching 894 coal rakes a day by 2030, as envisaged in the *Integrated Coal Logistics Plan*, with a turnaround time of 3.9 days,¹⁰ could see up to 1,500 more coal trains operate each day (outward and return trips and loading/unloading). Many more trains are operational than are despatched each day because of the lengthy travel times.

There are expectations that the recently commissioned Eastern Dedicated Freight Corridor (EDFC) will ease some congestion caused by coal freight, especially in Punjab, Haryana and parts of Uttar Pradesh, but it will not fully resolve them. The 140 trains that ran on various sections of the incomplete EDFC, could increase to its daily capacity of 250, thereby reducing travel time.¹¹ Indeed, much higher speeds (35 vs 14 km/hr) have recently been reported.¹² But, the majority of power plants are in regions not served by the EDFC. Further, there remain bottlenecks in routes from the coalfields to the EDFC itself. Moreover, despite commissioning the entire Sonnagar-Dadri section of the EDFC in June 2023, coal stocks at many northern power plants fell considerably until mid-late October, as shown in Figure 2c. Since then (to early December), stocks at north-western power-plant have certainly risen, but coal consumption at these plants has also fallen so the effects of the EDFC have yet to be fully tested.

¹⁰ Deloitte Touche Tohmatsu India LLP for Coal India Ltd. [Integrated Coal Logistics Plan for Coal Mines/Blocks, Final Report](#). April 2023.

¹¹ Business Standard. [Govt completes Eastern Dedicated Freight Corridor, ops begin Nov 1](#). 14 October 2023.

¹² Powerline. [Views of Amrit Lal Meena: "The future of the coal industry is promising"](#). 6 December 2023.

Warnings of coal freight bottlenecks are not new. A 2020 study simulated the Indian rail network using estimates of optimal routes based on the expectation that 900 million tonnes of coal would move by rail in 2030 (less than any of the estimates shown in Figure 1). The authors report that even with a 100 million tonne capacity expansion, there would be an annual under-delivery of 200 million tonnes caused by an overly congested network and that “*present capacity limitations of rail infrastructure in the country are likely to amplify in the future*”.¹³

In addition to delaying trains, excessive congestion can introduce a pernicious feedback loop into any railway system’s operations. Maintaining a constant rate of freight delivery when average speeds decrease requires additional trains to move the same loads in the same period. In turn, this can stretch resources (with rake availability being a frequent issue in previous coal delivery crises) and add to congestion. There is a fine line between maximising and overloading network capacity.

The *National Rail Plan* envisages a far higher utilisation rate of the network by mid-century (Figures 2a and 2b) and outlines several initiatives to cater to the increased traffic. These measures include additional dedicated freight corridors, high-speed rail corridors, enhanced capacity on existing lines, improved signalling, and operational and infrastructure improvements, which we will consider in a later section.



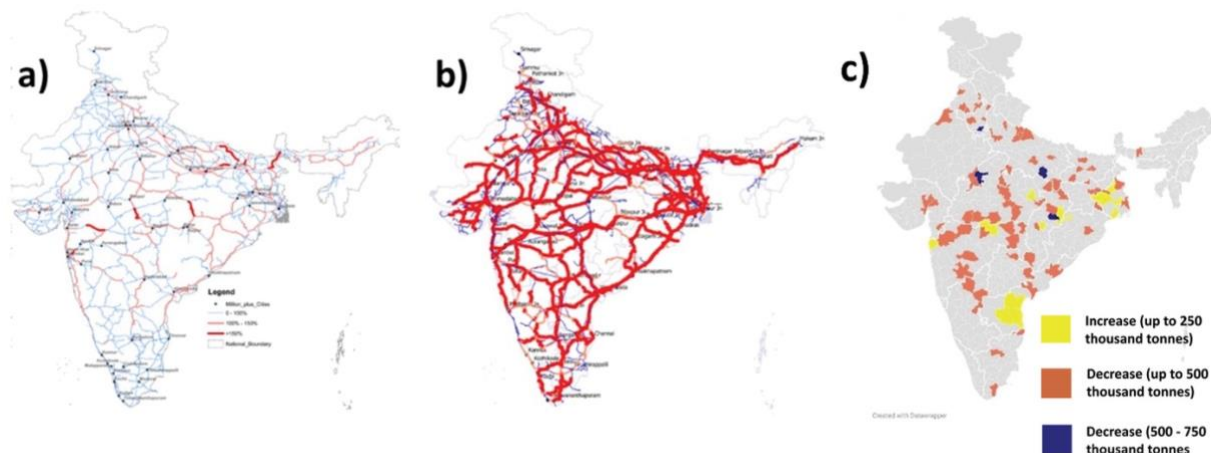
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However, power plant stocks are vulnerable to rail network congestion and capacity limits. Plants supplied by rail can use up stocks rapidly in all parts of the country when power consumption peaks. For example, after nearly six months above 35 million tonnes, stocks declined significantly over 10 weeks from the beginning of August this year and have only recently started to recover.

After declining by 42%, they stabilised at 20.5 million tonnes in mid-October. Figure 2c shows the distribution of these changes for plants supplied by rail. Only a handful of districts (shown in yellow) added to their stocks, while stock declines of up to 500,000 tonnes (orange) were widespread in all parts of the country. A few districts (purple) had even greater declines over this period. Although bad weather caused some production loss, primarily rail dispatch limitations led to this decline. This is because even at the end of August, CIL and SCCL reported having 48.92 million tonnes of vendible stock on hand, far more than required to maintain power plant stocks had the Indian Railways been able to transport it.

¹³ Gupta R et al. *Limited Capacity of Railways for Coal Transportation in India: Evidence from ArcGIS-based Load Flow Study*. *Indian Economic Journal*, 68(4) 675–684. 2020.

Figure 2: Current and projected (2051) railway capacity utilisation and coal stock declines at power plants supplied by rail (1 Aug - 17 Oct 2023) (by district).



Source: a) Current and b) 2051 track utilisation from National Rail Plan.² Broad red lines indicate >150% capacity utilisation. c) IEEFA analysis of CEA Daily Coal Reports, 1 Aug - 17 Oct 2023 (Data from 120 plants supplied by coal and nine supplied by rail-sea or rail-sea-rail, in 87 districts. Districts shown in grey lack thermal power plants or use imported seaborne coal.)

Table 1: Trains Required to Supply Power Plants at Different Distances from Mines

Plant	State	Capacity (MW)	Weighted distance from mine (km)	Turnaround (days)	Operating trains needed to deliver six rakes/day
Kothagudem V, VI & VIII	Telangana	1,800	59	1.2	7
Gardawarah	Madhya Pradesh	1,600	557	3.0	18
Dadri	Uttar Pradesh	1,820	985	4.6	27
Talwandi Sabo	Punjab	1,980	1,641	6.9	42

Table Source: capacity data – CEA, weighted distance from mine – Integrated Coal Logistics Plan. Turnaround and Operating Trains needed: IEEFA estimates assuming 23km/hr train speed, 12 hours loading and 12 hours unloading.

The supply vulnerability of power plants receiving supplies by rail is no surprise. Still, another aspect of distance is the call that more remote power plants make on railway resources and the implications for network congestion. We illustrate this in the estimates in Table 1 for four power plants of a similar capacity, each requiring between five and seven coal train arrivals daily to operate at a notional 85% capacity. The plants furthest from and closest to the coalfields generate similar quantities of electricity. Still, the former requires more than six times as many trains as the latter – 42, estimated using the stated assumptions – to be operational at any time (outbound and return trips, loading and unloading).

Even without the addition of more coal traffic, network congestion is a chronic problem. The media has periodically reported congestion episodes, such as at Nagpur, affecting container traffic¹⁴ and the Howrah-Chennai line.¹⁵ The latter report quotes a retired Indian Railways Chief Engineer saying that over 10,000km of trunk lines run at 125% capacity when the ideal is about 70%.

Train Speeds

The pandemic and the subsequent lockdowns led to the temporary curtailment of almost all passenger trains, with paradoxical effects on Railway operations. Before the pandemic, maintenance ‘blocks’ (planned time periods when sections of track are off-limits to trains while they undergo maintenance) were frequently insufficient because of the pressure to keep services running. The lockdowns offered an opportunity to catch up on this backlog, putting the network in a better position once services resumed. They also freed up the railway network, enabling freight trains and the few remaining passenger services to travel at record average speeds. Average speeds on the Indian Railways include the time halted at (or outside) stations, so higher averages reflected a combination of faster actual speeds and fewer delays. We show this in Figure 3 for the period between January 2019 and September 2023.

Figure 3: Train Speeds, Jan 2019 - Sep 2023



Source: Indian Railways Monthly Evaluation Reports, Jan 2019 - September 2023.¹⁶

Passenger train average speeds approached 60km/hr at their highest in 2020 when the pandemic led to the cancellation of most passenger services, but declined subsequently. By August 2023, the

¹⁴ Times of India. [Congestion on rail tracks delaying container movement](#). 16 February 2023.

¹⁵ National Herald. [On the wrong track: What ails the Indian Railways?](#). 9 June 2023.

¹⁶ Ministry of Railways, Government of India. [Monthly Evaluation Reports](#).

average speed of passenger trains had dropped to 39.3km/hr and to 38.6km/hr in September – the lowest monthly average reported by the Indian Railways since at least June 2015. Freight train average speeds have been better maintained, reaching a little over 45km/hr at their peak but slowing to 23.3km/hr as of September 2023, compared to their 2019 average of 22.1km/hr.

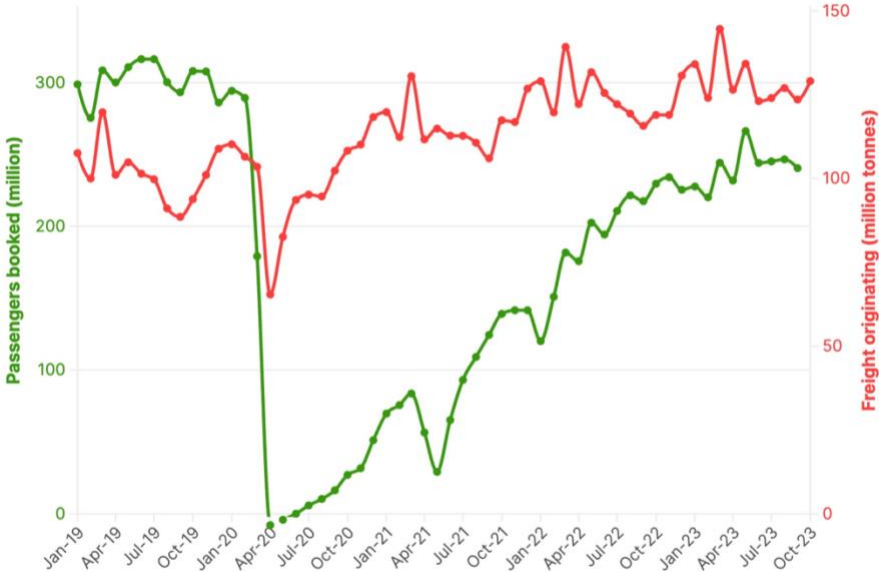
In this connection, it is important to note that the *National Rail Plan’s* preferred Scenario 3c assumes that freight speeds will increase from 25km/hr to 50km/hr by 2051, with a 30km/hr goal by 2026. Therefore, keeping these plans on track requires a rapid reversal of the current trend.

Train Loads

Figure 4 shows passenger and freight loads over the same five-year period. The Indian Railways consistently booked over 300 million non-suburban passengers per month in 2019, before the pandemic. In August 2023, the latest month for which statistics are available, passenger numbers had still not recovered, standing at about 250 million per month (about 83% of their 2019 level).

By contrast, improvements in freight loads have proven to be more sustainable. Originating loads in the 12 months up to August 2023 averaged 127 million tonnes per month, compared to 101 million tonnes in 2019. Over the same period, the proportion of overall freight tonnage made up of coal has barely changed, standing at 48.3% now compared to 48.8% in 2019. This proportion fell to the low forties during the lockdown because of reduced power generation and shows small seasonal fluctuations but is otherwise stable.

Figure 4: Passenger and Freight Loads, Jan 2019 - Sep/Oct 2023



Source: Indian Railways Monthly Evaluation Reports, Jan 2019 - Sep 2023¹⁶, and Revenue Freight Traffic Statistics on Org. Basis. Statement-7A⁶

The reasons for lower passenger numbers are not fully clear, but some structural factors play a role in addition to the possibility of more work-from-home and incomplete resumption of circular migration from rural areas. The Railways also introduced a new timetable following the lockdowns, and to streamline services, it dropped stops at smaller stations, leading to fewer passengers.

It also appears that services have not fully resumed. An indication of this is that in the 12 months leading up to August 2023, the average passenger train engine km per month was still 2.4% below those for 2019 (52.8 million km vs. 54.5 million km).¹⁷

Finally, there are some suggestions that the coach composition of some trains now favours more expensive air-conditioned (AC) class coaches over non-AC and sleeper class coaches. But, other than isolated announcements, e.g., from the Southern Railway¹⁸, there is insufficient data to establish the number of potential passengers deterred by this cost factor.

Punctuality

There has not been a comprehensive public analysis of train punctuality since the Comptroller and Auditor-General (CAG) report of 2021,¹⁹ which examined data up to 2020. At that time, the CAG found “*no perceptible improvement in mobility outcome indicators despite significant investments of ₹2.5 lakh crore [about Rs2.5 trillion or US\$3 billion] for infrastructure during the previous decade (2008-19)*”.

More recently, a Right to Information request revealed widespread delays in 2022-23,²⁰ with *Duronto* trains having a punctuality rate of only 63.8% and *Shatabdi* trains performing best at 91.8%. The Indian Railways considers a train punctual if it arrives within 15 minutes of its scheduled time, and the overall 83.7% punctuality rate means that roughly 2,000 of the approximately 13,000 daily passenger services run late. In some cases, delays can run into many hours.

Cancellations

Train cancellations occur routinely because of adverse weather, critical maintenance work and other unavoidable factors. Yet, between March and May 2022, the Indian Railways cancelled 1,900 trains to prioritise the movement of coal.²¹ Passenger trains have a hierarchy of priority, starting with the *Rajdhani* trains. Similarly, in terms of freight priority, coal is normally accorded priority ‘C’, behind military traffic, emergency relief goods and foodgrains and levy sugar for the Public Distribution System.

¹⁷ Ministry of Railways, Government of India. [Monthly Evaluation Reports](#).

¹⁸ Southern Railway. [Circular 244/2023-24, Change in Composition of Express Trains](#). 4 July 2023.

¹⁹ Comptroller and Auditor General, Government of India. [Union Government \(Railways\) Compliance Audit, Report No. 22 of 2021](#).

²⁰ The Hindu. [Passenger trains lost over 1 crore minutes in delays in 2022-23, RTI reply states](#). 30 June 2023.

²¹ The Economic Times. [Railways cancelled almost 9,000 train services this year, over 1,900 due to coal movement: RTI](#). 5 June 2022.

The outright cancellation of passenger services to make room for freight is unusual and indicates the urgency accorded to coal supplies in the early months of 2022. The regions most affected were the South-East Central Railway (where there are many large coal mines) and the Northern Railway (where there are many destination powerhouses and track utilisation rates are very high).²²

Congestion remains despite improvements in services, including the advent of the *Vande Bharat* trains, capable of running at 160km/hr, designed for running between 110km/hr and 130km/hr, but in practice, achieving average speeds of 63km/hr and 96km/hr,²³ a limitation largely attributed to inadequate track conditions.

Wagon Turnaround Times

Other less positive signs accompany the success that the Indian Railways has had in moving more freight. The latest data show that wagon turnaround times have been increasing. In the five months up to August 2023, the system-wide time increased by 13.6% from the same period the previous year to an average of 2.34 days.¹² The fact that these times increased in 15 of the 16 railway zones, with the one exception showing no change, indicates the tendency for effects to spread across the network. These statistics refer to all freight wagons, but coal wagon turnaround times are longer, with the recent *Integrated Coal Logistics Plan* citing a value of 3.9 days. Slower turnaround times mean that a larger stock of wagons needs to be operational at any time to deliver the same quantities of freight.

Other Measures to Prioritise Coal

Other than the outright cancellation of passenger services to enable coal freight, the Indian Railways has introduced other measures to keep supplies moving. For example, during the May 2022 crisis, the Indian Railways was reported to have urgently repaired and pressed over 2,000 damaged coal wagons into service.²⁴ In addition, it relaxed the inspection regime for issuing Brake Power Certificates (BPCs) for the most common types of coal wagons in August 2022. The new regulation required a new BPC after 10,000km or 35+5 days (whichever was earlier), replacing the earlier standard of 7,500km or 30+5 days. It subsequently extended the change to 2023.²⁵ While neither measure necessarily poses an acute safety threat, the relaxation of maintenance schedules indicates a system under some stress. Further, the zonal railways now have the authority to reduce permissible free time for loading and unloading coal and iron ore.²⁶

²² The Economic Times. [Passenger trains cancelled to rush in coal rakes](#). 30 Apr 2022.

²³ The Hindu. [23 Vande Bharat trains on tracks, but they fail to live up to the promise of speed](#). 27 June 2023 (updated 29 June).

²⁴ Hindustan Times. [Amid shortage, railways repairs old wagons for faster coal transportation](#). 3 May 2022.

²⁵ Ministry of Railways, Government of India. [Extension of validity of BPC of CC rakes of BOXN/BOXHNL wagons – Special measure \(and Corrigendum\)](#). No. 22/M(N)/951/34 Pt. 2 E 3390305.

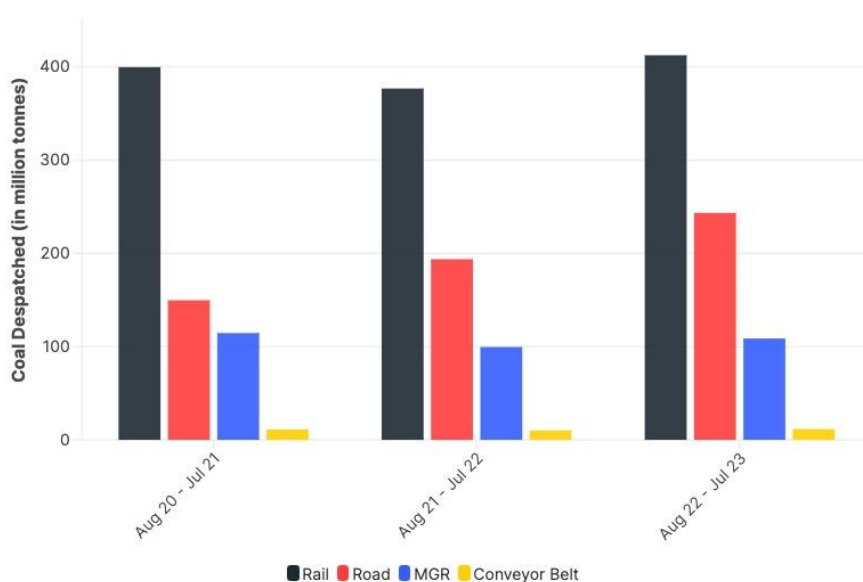
²⁶ Ministry of Railways, Government of India. [Free time for loading and unloading of rakes of Coal and Iron Ore - Power to Zone](#). Circular No.TC-I/2019/201/6-Part(2).

Operational changes include running two or more trains on the empty return run.²⁷ This reduces the number of train movements, but with passing loops often just 750 metres long, the additional length of the train reduces opportunities for faster traffic to overtake. As a result, the Railways restrict this option to routes with adequate passing loops or those where the train speed can remain sufficiently high.

Coal India's Dependence on Road Transport

Given CIL's ambition to more than double its transport of coal by rail in four years, one may expect that there are at least early signs of increased rail use by the company. However, recent data show this is not the case. In fact, virtually all (97.5%) of the additional 91 million tonnes despatched by CIL compared to two years ago have used road transport (Figure 5).

Figure 5: CIL – Coal Transport Mode, Aug 2020 - Jul 2023



Source: IEEFA Analysis of Coal Ministry Monthly Coal Statistics²⁸

This represents a major shift in coal freight mode. CIL reported more than half a million road trips in August 2023 alone (604,862). With an average load of 29.94 tonnes, this totalled 18,109,973 tonnes, or just under a third of that month's despatch. In the last 12 months, rail moved barely more than half of the total coal delivered by CIL (51.7%). Even in the latest reported month (October 2023), the year-on-year despatch growth for CIL was larger for road than for rail (3.99 million tonnes vs 3.76 million tonnes).²⁸

²⁷ The Economic Times. [Railways deploys 86% of its open wagons for coal transportation](#). 5 May 2022.

²⁸ Ministry of Coal, Government of India. [Monthly Statistical Reports](#).

This level of road transport is problematic in several ways. While most trips to power plants or sidings are short, others are longer and may use public roads, creating pollution and safety issues. The *Draft Coal Logistics Policy*²⁹ suggested that road haulage of up to 400km is economically viable and noted that the road transport mode leads to nearly three times greater greenhouse emissions than rail (62 vs 22g CO₂/tonne-km).

Given that CIL's dependence on road transport is rapidly increasing while its use of rail, MGR and conveyor belt has remained static, its goal of adding more than 400 million tonnes of coal transport exclusively by rail in the next four years³⁰ appears overly ambitious. CIL operates the largest and most productive open-cast mines in India, and those where the greatest production increases are likely. The Gevra mine in Chhattisgarh, for example, is slated to produce more coal than any other mine in the world by the end of FY2024.³¹ It remains to be seen how quickly CIL's extra production can shift to rail, and even if it can, what the effects will be on the broader railway network.

Rail Infrastructure Investment

There is no doubting the Government of India's intention to boost railway infrastructure. The most recent railway budget outlines record appropriations for the Railways and anticipates record total expenditure by the Indian Railways, reaching approximately US\$31.5 billion this financial year. Major programmes include overhauling railway stations and facilities, new rolling stock, increased rollouts of *Vande Bharat* trains and further development of High-Speed Rail and Dedicated Freight Corridors.

There are projects to increase the capacity of passenger routes, with the *National Rail Plan* anticipating demand growth of six million extra passengers daily in the next decade. The central government has also outlined projects to increase the capacity of the High-Density Network (HDN) and the Highly Utilised Network (HUN).

The greater focus, however, is on freight infrastructure projects, especially coal evacuation. Many such projects completed recently or are in progress. Notable examples include those serving the Mand-Raigarh coalfields (the 124.8km rail line from Kharsia to Dharamjaigarh (part of the Chhattisgarh East Rail Project Phase-I), which has been commissioned, its extension to Korba (Phase II), which has recently received financing, and the Gevra Road-Pendra Road line, which is expected to be completed in December 2024. The latter will take some of the Mand-Raigarh coal traffic as well as expanded production from mines operated by CIL's South-Eastern Coalfields subsidiary, by-passing Bilaspur *en route* to the western and northern power stations.

There have been numerous announcements of such coal evacuation projects, and the *Integrated Coal Logistics Plan*³² summarises these, together with detailed consideration of specific coalfields and railway logistics for eight states.

²⁹ SBI Capital Markets Limited and Primus Partners Private Limited. [Draft Coal Logistics Policy, 2022](#).

³⁰ Ministry of Coal, Government of India. [Eastern Zonal Conference PM Gati Shakti](#). 16 February 2023.

³¹ The Economic Times. [SECL in expansion mode; to make Gevra world's largest coal mine: CMD Prem Mishra](#). 11 June 2023.

³² Deloitte Touche Tohmatsu India LLP for Coal India Ltd. [Integrated Coal Logistics Plan for Coal Mines/Blocks, Final Report](#). April 2023.

Despite this document's 140-page analysis, it leaves several questions unanswered. Prepared by Deloitte Touche Tohmatsu India LLP, it describes the use of "*optimal PLF-Distance model analysis*" to forecast power plant demand and the potential to increase plant load factors, using Maharashtra's coal plants as an example. For reasons the report does not explain, the regression equation on which this example analysis rests uses only a sub-set of Maharashtra's plants. The strong linear relationship calculated from the sub-set in the report entirely disappears after including all the plants it lists. The report's "*optimistic*" scenario uses quite an unrealistic assumption that power plants operate at 95% Plant Load Factor (PLF), and even the "*realistic*" scenario uses an ambitious PLF of 83.5%, nearly 20% higher than current values.

More serious are the report's forecasts that current and in-progress rail projects may be inadequate. In multiple cases, the report predicts that even after the completion of new projects, the capacity utilisation of sectors will rise beyond 100% (e.g. for the critical connection between Gevra and the north and west of India, two adjacent sections will become overloaded – Pendra Road to Anuppur rises from 88% utilisation to 134-138%, and Anuppur-Katni rises from 98% to 143-146%) in line with concerns of network congestion outlined earlier.

The report recommends 39 new projects for the Railways. The flavour of these recommendations comes out with some examples:

- "It is of utmost importance to add a third line (Survey under process) and, in future, a fourth line from Cuttack to Paradeep." [To serve rail-sea routes to Tamil Nadu and beyond]
- "A third line between Korba and Champa is required for future evacuation of coal from Korba CF towards Bilaspur."
- "A 4th line between Pendra Rd to Anuppur & Anuppur to New Katni has to be planned. Nagpur-Wardha line is currently running at 158%."
- "Due to increased supplies from Chhattisgarh to Maharashtra, along with traffic from Odisha and WCL's own traffic, tripling of this line to be expedited."

In response to these recommendations and its own forecasts, the recent *Railway Board Study* is reported as calling for "dedicated coal corridors" linked to the Dedicated Freight Corridors to address the line capacity shortfall,³ in effect acknowledging that current projects will not be enough to move the planned coal volumes.

Economic Appraisal of New Rail Infrastructure

Focusing on current and future rail transport capacity, the *Integrated Coal Logistics Plan* described above does not consider the sources of funds for these potential future projects, their timing or their economic evaluation, simply taking generous estimates of coal demand as a given. The Indian Railways considers economic appraisal of such projects, albeit in a restricted fashion.

Globally, analyses of rail network effects emphasise that changes in one part of the network (such as new lines) may have further ramifications and treat them as potentially positive or negative.³³ By contrast, the Indian Railways provides planners guidelines for the economic appraisal of new projects that assume these effects are mostly or always positive:

“Railway investments can influence the entire railway network and generate network benefits in terms of reduction in environmental impact due to a decrease in emissions, reduction in railway network congestion and improvement in travel time, reliability etc.”³⁴

The guidelines include formulae to estimate network benefits for these components. For the railway network decongestion element, they use estimates of increased speed, shorter leads (distances), and values of passenger time and travel time savings. Where projects are directed towards improving existing traffic flow, their network effects are beneficial and may well include network decongestion remote from the project itself.



It is unclear if this large tranche of new rail projects will in fact hinder train movements elsewhere, even as they ease the movement of coal in the vicinity of the pithead.

But for those which add net new traffic, such as new lines constructed to accommodate enhanced coal production, these assumptions do not hold. Beyond the new line, more trains are being added to the network, increasing congestion. In FY2024 (to August), the average lead for trains supplying thermal power plants was 546km,³⁵ placing the average destination well outside the area of the originating mine where the bulk of projects (new lines, line doublings, etc.) are focused (see also Figure 2c). Consequently, this large tranche of new rail projects may hinder train movements elsewhere, even as they ease coal movement in the pithead’s vicinity.

Timeliness of Rail Infrastructure Projects

Railway projects are complex operations that go through multiple stages, each subject to delay, whether from land acquisition challenges, slow approval processes, logistical problems or other factors. In its December 2022 report, the Ministry of Statistics and Programme Implementation examines 1,438 Central Government projects costing over Rs1.5 billion.³⁶ Railway projects ranked as the second most delayed (after the Ministry of Road Transport and Highways projects). Over two-thirds (117 of 173) were delayed with respect to the original timeline, and an additional 23 were delayed even further. The Railways was also reported to have projects with some of the highest cost over-runs.

³³ Landex A. [Network effects in railways](#). *Computers in railways XIII*. WIT Transactions on The Built Environment, Vol 127. 2012.

³⁴ Ministry of Railways, Government of India. [Railway project economic appraisal framework note, 2022](#).

³⁵ Ministry of Railways, Government of India. [Revenue Freight Traffic Statistics on Org. Basis. Statement-7A for August 2023](#).

³⁶ Ministry of Statistics and Programme Implementation, Government of India. [Infrastructure and Project Monitoring Division. 445th Flash Report on Central Sector Projects \(Rs150 crore and above\)](#). December 2022.

If the quantities of coal carried by rail are to approach some of the forecasts, the timely completion of projects is necessary, and even then, the capacity may be insufficient. Recent records do not suggest that on-time completion will likely become the norm for such complex undertakings.

Emphasis on Freight and Revenues over Passenger Services

Railway Zones have Varying Freight-Passenger Ratios

The cross-subsidisation of passenger services by freight revenues is a long-standing issue. Along with pressure to keep its operating ratio (an index of expenses to revenue) below 100%, it explains why the Indian Railways, like many other national railways, places considerable short-term emphasis on the most profitable services.

The balance between the freight and passenger arms is a matter of public policy. It requires, for example, judgments about the indirect economic benefits of passenger movement that do not accrue to the Indian Railways (but may benefit other economic sectors). Societal needs and service obligations also need to be factored in. While these are beyond the scope of this report, it is instructive to consider the extent to which passenger and freight services compete.

Figure 6 depicts this competition spatially. Using monthly Total Train Engine km as an indirect index of freight and passenger train movements, we can estimate the ratio of freight-to-passenger traffic. This shows major regional differences. The coal-bearing regions have ratios exceeding 4:1, indicating much heavier freight traffic – some are closer to parity, and passenger services dominate others. For example, the East Coast Railway exceeds a 5:1 freight-to-passenger ratio, but this balance is almost completely reversed for the Southern Railway, where passenger train engine km exceed those for freight by 4:1. The predominant freight overall is coal, but it is especially dominant in the three railway zones corresponding to India's largest coal mines. This comparison allows the possible impact of increased coal freight to be visualised – with an intensification of the freight-to-passenger ratio in the coal regions and likely spread to the regions with a high density of thermal power plants.

Figure 6: Ratio of freight to passenger traffic by Railway Zone, Sep 2022 - Aug 2023

Freight to Passenger 4.4:1  5:1 Passenger to Freight

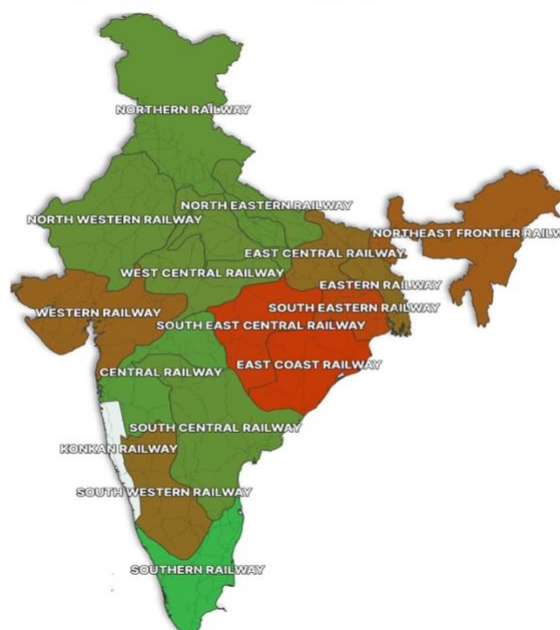


Figure Source: IEEFA calculations from Monthly Evaluation Reports³⁷ based on Total Train Engine km. (Zone map adapted from Nichalp)³⁸

Indian Railways' Key Performance Indicators

A second and very different insight into the passenger-freight balance is apparent in the KPIs issued by the Indian Railways to its 70 divisions. The latest list has 86 items grouped into eight categories, worth a total of 1,000 marks. We summarise these in Figure 7. Items specifically mentioning freight or passenger services are tallied separately and shown in the pie chart (inset).

Marks for freight KPIs outnumber those for passenger services by four to one, and track renewal/maintenance ranks far below the leading categories. Indeed, just three of the many items for freight (*Originating freight loading*, *Net tonne-km (Goods)*, and *Average speed of freight trains*) are accorded more marks than the entire *Track Renewal and Maintenance* category.

Similarly, the *Improvements in Safety Performance* category is worth 20 marks (just 2% of the total), the same as other seemingly less crucial items such as the combination of *Scrap disposal* and *Tender committee cases finalised within 60 days*, which, together, are also worth 20 marks.

³⁷ Ministry of Railways, Government of India. [Monthly Evaluation Reports, September 2022-August 2023](#).

³⁸ Creative Commons license <https://creativecommons.org/licenses/by-sa/3.0/deed.en>

This does not suggest that the railway staff are not diligent in safety, maintenance and operational tasks. However, KPIs are deliberated on by the management and published to influence priorities. They emphasise revenues and freight, and any decisions by the railway staff, for example, to forgo a maintenance block needed for track renewal in order to meet these pressing freight and revenue targets, become more understandable given these stated priorities.

Figure 7: Key Performance Indicators for Railway Divisions

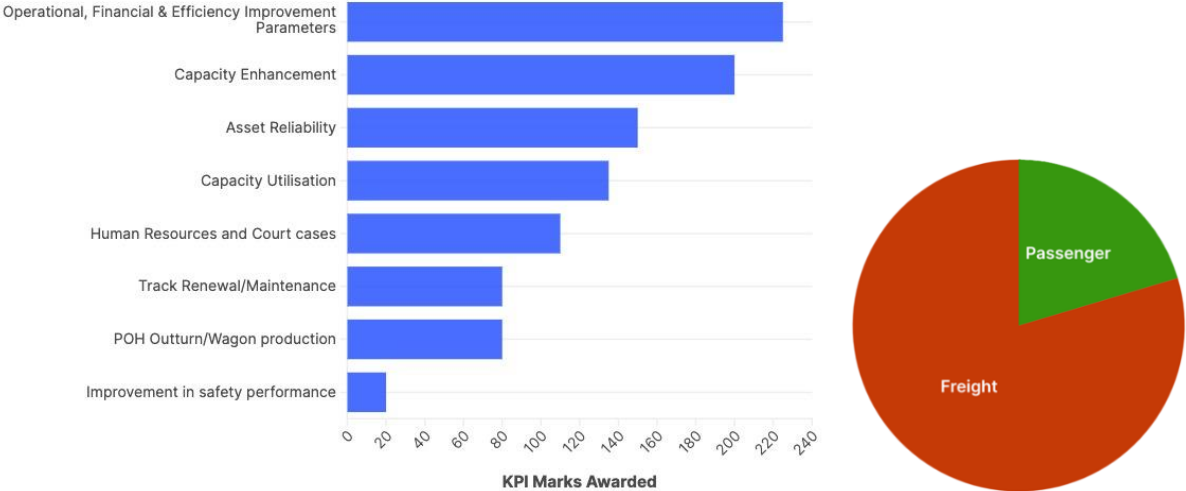


Figure Source: Indian Railways Key Performance Indicators³⁹ (Inset: marks for specific freight and passenger KPIs)

Opportunity Cost of Emphasis on Coal Freight and Revenues

The dependence of the Railways on coal freight for revenue is widely recognised and has been the subject of substantial analysis, notably the observation that the two are interdependent.⁴⁰ While coal makes up a significant part of the Railways’ earnings, a broader economic perspective suggests that the proliferation of coal evacuation projects may come at the expense of the overall network and broader economy.

In the short-term, the opportunity costs directly affect the Indian Railways itself by diverting resources from essential track renewal and upgrading of the main HDN/HUN lines, along with maintenance of signalling and overhead equipment. These lines carry the bulk of rail traffic. The reluctance to make maintenance blocks available at the expense of train movements, as well as by making funding available, limits the pace of track renewal and associated work. Despite the 2024

³⁹ Ministry of Railways, Government of India. [Key Performance Indicators \(KPIs\) for Divisions, FY2023](#).

⁴⁰ Brookings India. [Indian Railways and coal: An unsustainable interdependency](#). July 2018.

Union budget for the Railways upping track renewal funds to Rs172.97 billion (US\$2.02 billion) -a 12% increase over the previous year- this still falls far short of the need.

While financial allocations reflect priorities, substantial human and physical resources are devoted to expanding coal evacuation and another project that is making the headlines – the Mumbai-Ahmedabad bullet train. These include planning, design, project management, engineering, equipment and materials. The sheer number of projects centred on coal, as well as high-speed rail, reduces the availability of these resources for basic maintenance and upgrade work on the general network.



The dependence of the Railways on coal freight for revenue is widely recognised and has been the subject of substantial analysis

Some experts have been critical of these priorities. For example, a retired Indian Railways Chief Engineer, Alok Verma, has been quoted as saying: *“At the cost of Rs7 lakh crore, [Rs7 trillion or US\$83 billion] we could have upgraded 15,000km of our main trunk routes and removed all bottlenecks. We have chosen to spend thousands of crores on a standalone bullet train, whereas this money could have been used to upgrade thousands of kilometres or track millions of commuters’ use.”*⁴¹

In the longer term, as India’s economy continues to rely on its primary industry (e.g. steel and cement) and places greater weight on the secondary industry (such as domestic manufacturing), its freight needs will keep rising because the primary and secondary industries are associated with large volumes of raw materials, as well as manufactured products. Taking China’s economy as an example, an inverted U-shaped relationship between the turnover of rail freight traffic per person and economic development has been reported, with per capita freight loads rising until quite high per capita GDP levels were reached, along with a more dominant tertiary (services) sector.⁴²

India’s foreseeable freight needs are considerable. Urban growth needs construction materials. Food distribution still lacks adequate cold chains, and there is scope for the Railways to add more ‘reefers’ to transport perishable products as well as expand its bulk transport of foodgrains. The energy transition alone will consume substantial quantities of critical minerals for making panels, batteries, electric vehicles, hydrolysers and other electrical equipment. Other industries will require more distribution capacity for their own inputs and manufactured products, some quite bulky, which are moved most efficiently by train. For example, the Indian Railways has had real success in growing its share of vehicle transport – from 8% to 18% in four years to the end of FY2023. Maruti and Hyundai are reported to have committed to increased rail transport of their vehicles⁴³, and the Railways has increased its fleet of car rakes.

⁴¹ Newsclick. [Railways, Lifeline of India’s Economy, is in ICU](#). 11 June 2023.

⁴² Wang H et al. [The relationship between freight transport and economic development: A case study of China](#). *Research in Transportation Economics*, 85. March 2021.

⁴³ Shipping News. [Top car makers like Maruti and Hyundai bet on rail freight to get emissions on track](#). 20 September 2023.

These demands suggest continued bulk rail freight, and much increased multi-modal container freight will be called on, super-imposed on substantially higher passenger movements.



Unlike almost all other types of rail freight, thermal coal has a substitute in the medium- and long-term: renewable energy generation, storage and transmission supplemented with distributed renewable energy projects and tariff reforms for demand-side management.

Unlike almost all other types of rail freight, thermal coal has a medium- and long-term substitute: renewable energy generation, storage and transmission supplemented with distributed renewable energy projects and tariff reforms for demand-side management. Major coal freight growth may threaten to inhibit the Indian Railways from fully serving other freight and passenger demands and also pose a long-term stranded asset risk. The Railways' coal evacuation infrastructure is being built in some of India's least populated areas. As the demand for coal declines in coming decades, there may not be sufficient volume of new freight in the coal-bearing regions to justify the capital expenditure outlay.

A net zero future necessitates the end of coal as the principal source of power generation in the long term, and in the short- and medium-term, additional coal transport is required only to the extent that renewable energy does not keep pace with rising demand.

Coal has undoubtedly been an important source of revenue for the Indian Railways. However, overly ambitious coal transport goals and expensive infrastructure to accommodate them will further constrain passenger and alternative freight services, and remain a heavy burden on the rail network.

Recommendations

Indian Railways

Railway infrastructure planning should be continuously updated to take account of new renewable generation goals and improved electricity demand outlooks to better forecast actual future coal freight requirements.

To minimise stranded asset risks, all specific potential new railway infrastructure called for in the *Integrated Coal Logistics Plan* should be re-evaluated, using realistic estimates of project completion timelines and probable project costs.

Railway planning, including the economic appraisal of projects, should include all negative as well as positive network effects of infrastructure that serve additional coal freight.

Indian Railways should reconsider the priorities expressed in its Key Performance Indicators for Railway Zones, which disproportionately emphasise revenue and freight items over those for passenger services and safety improvements.

Coal India Limited

Coal India should revisit its ambitions to more than double coal freight in four years and outline more realistic targets and timelines.

Electricity Sector

Renewable generation policies and targets should be enhanced not only for climate and health benefits but also to reduce unnecessary burdens on India's railway network imposed by increasing coal freight.

New renewable energy generation projects should be prioritised and incentivised in regions where thermal power plants have long leads (distances) from India's coal regions. Long leads have a disproportionately negative effect on railway network congestion and make a far larger call on railway resources.

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About the Author

Charles Worringham

Charles Worringham is a former academic and Guest Contributor to IEEFA based in Australia. His previous reports have focussed on land use for renewable energy in India, solar waste compared to waste from thermal power, the potential for agrivoltaics in India, the land use implications of India's ethanol policy, and temperature-related electricity demand patterns.

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