

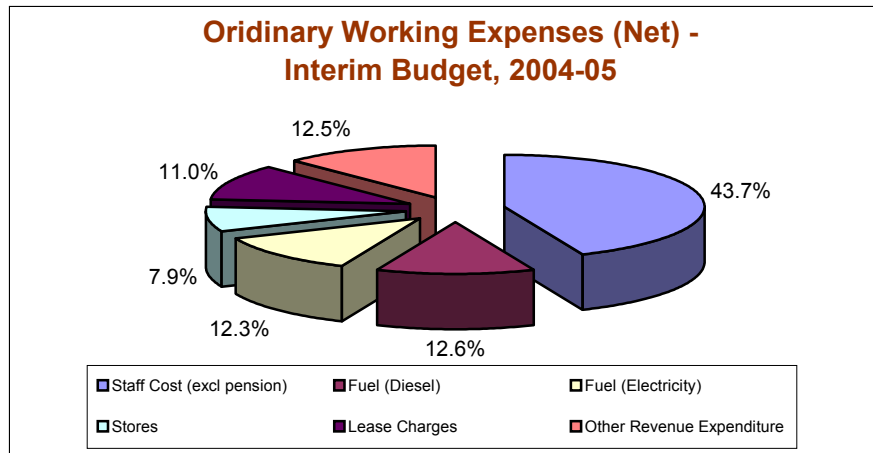
# INDIAN RAILWAYS

## NEED FOR LONG TERM ENERGY PLANNING

### DISCUSSION PAPER

#### **1.0 INTRODUCTION**

1.1 After the staff cost, fuel (diesel & electricity) constitutes the second largest component of Indian Railways ordinary working expenses. As per the Interim Budget 2004-05 staff cost excluding pensions is 43.7% and fuel constitutes 24.9% of which electricity is 12.3% and diesel is 12.6%.



1.2 While lot of attention has been paid to cut down the staff cost and course has been set by manpower planning, rightsizing through benchmarking for more than a decade, no serious discussion has taken place on containing the fuel costs to control operational expenditure.

1.3 This Discussion Paper brings out the trend of fuel cost and traffic hauled by Indian Railways for last 5 years and attempts to project the future scenario for next three years i.e. upto end of X Plan.

## 2.0 TREND ANALYSIS & PROJECTIONS

2.1 Taking the figure from published Annual Statistical Statement the unit price of diesel and electricity for traction has been indicated in Table 2.1 & 2.2.

### Average Unit Cost of Electricity for traction on Indian Railways

Year	Unit Cost of Electricity (KWH) (Rs.)	Increase w.r.t. 1998-1999 (Base 100)	Source A.S.S
1998-99	4.00	100.00	Page - 199
1999-2000	4.13	103.25	Page - 201
2000-01	4.28	107.00	Page - 203
2001-02	4.27	106.75	Page - 203
2002-03	4.29	107.25	From Statistical Branch (under print)
2003-04	4.28	107.00	From Statistical Branch - Final Modification
2004-05	4.28	107.00	Estimated*
2005-06	4.28	107.00	Estimated*
2006-07	4.28	107.00	Estimated*
2007-08	4.28	107.00	Estimated*

\*Projected figures based on Median increase of previous five years.

Table 2.1

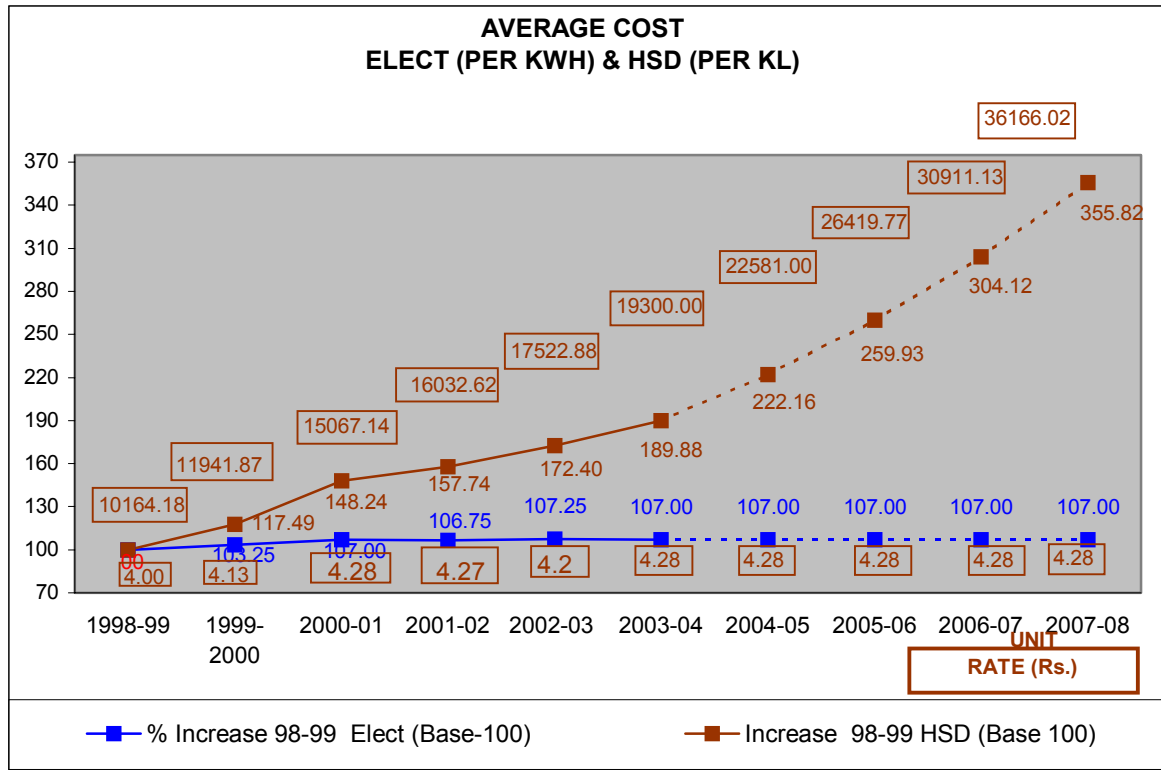
### Average Unit Cost of HSD for traction on Indian Railways

Year	Diesel Oil (HSD) per Kilolitre (Rs.) (6% increase 2004-05 onwards)	Increase w.r.t. 1998-1999 (Base 100)	Diesel Oil (HSD) per Kilolitre (Rs.) (17% increase 2004-05 onwards)	Increase w.r.t. 1998-1999 (Base 100)	Source A.S.S
1998-99	10164.18	100.00	10164.18	100.00	Page - 199
1999-2000	11941.87	117.49	11941.87	117.49	Page - 201
2000-01	15067.14	148.24	15067.14	148.24	Page - 203
2001-02	16032.62	157.74	16032.62	157.74	Page - 203
2002-03	17522.88	172.40	17522.88	172.40	From Statistical Branch - Under Print
2003-04	19300.00	189.88	19300.00	189.88	From Statistical Branch - Final Modification
2004-05	20458.00	201.28	22581.00	222.16	Estimated*
2005-06	21685.48	213.35	26419.77	259.93	Estimated*
2006-07	22986.61	226.15	30911.13	304.12	Estimated*
2007-08	24365.81	239.72	36166.02	355.82	Estimated*

\*Projected figures based on Median increase of previous five years.

**Table 2.2**

In order to analyse the past trend of 5 years and accordingly project the median future trend of unit cost of electricity and diesel the graphical representation of the table above is given below:



2.2 From these table and graph, it is observed that the cost of diesel has been consistently rising. On year-to-year increase basis, the minimum increase has been 9.5% for the years 2000-01 to 2001-02 and the maximum increase 31% during the year 1999-2000 to 2000-01. Median, annual increase over five years has been 17.9%.

2.3 The sharp increases in the global crude oil prices during the last quarter are similar to the sharp increase in the crude oil prices in the Seventies and is likely to lead to sharp increase in the diesel price in the coming year.

2.4 The electricity prices, however, have been more or less stable during the last 5 years and with the passing of Electricity Act 2003 and beginning of accelerated power reform, it is becoming possible for Indian Railways to secure lower electricity rates in the coming years. It can be observed that in spite of a general inflation of about 5% the unit rate of electricity for traction purposes has remained more or less stable at Rs.4.28 per unit, thus, absorbing the general inflation. With the proactive approach by all Zonal Railways with State Electricity Regulatory Commissions (SERC's) wherever functional and through negotiations with State Electricity Boards wherever SERCs are yet to be set up marginal reduction in electricity tariff have also been achieved. If the past trend and present development in Power & Petroleum sectors are any indication, it would be conservative conclusion with reasonable certainty that for the coming 3 years the electricity tariff is likely to remain stable at the current rate.

However, with the recent announced hike in coal prices by 16.7% the average electricity prices are expected to increase by 10% from the current level of Rs.4.28/Unit. This would result in energy prices reaching a level Rs. 4.70/Unit in the immediate future after which it would again stabilize. Even the increase anticipated in the current year would get partially offset by various initiatives of direct power supply from NTPC and other tariff regulatory measures being adopted.

2.5 The results obtained so far out of initiatives of availing direct power supply from NTPC in Northern Railway and similar future schemes in other Railways coupled with availing of avenues thrown open by New Electricity Act 2003 e.g.

captive generation, open access, further reduction in electricity costs in future would be a reasonable certainty.

2.6 Adoption of technology of regenerative braking through 3-phase technology in electrical loco has further exhibited the potential to realize energy savings of 16% in level section and upto 30% in graded section for freight and coaching services. Induction of 3-phase technology in EMU's in progress and future plan of its adoption for MEMU services would provide energy savings of 10-15% further bringing down the effective unit cost of electricity for traction.

### 3.0 HAULING COST OF TRAFFIC

3.1 From the published Annual Statistical Statements, the total traffic hauled by diesel and electric traction and respective fuel cost are tabulated in Table 3.1.

& 3.2.

<b>Table 3.1</b>							
<b>Data Sheet for Cost of Fuel per Thousand GTKMs</b>							
Year	<b>DIESEL (BG)</b>						
	GTKMs in Thosands (ASS Stt 16)			Cost of Fuel per thousand GTKM for traction			
	Pass	Goods	Total	Total Cost Rs '000' (ASS Stt 30 Col 175)	Fuel Cost in Rs. per Thous. GTKM	% escl. over prev. year	Fuel Cost with base as (1998-99=100)
1998-99	123525675	213223246	336748921	16983516	50.43		100.00
1999-2000	141422572	226163300	367585872	19372503	52.70	4.50	104.50
2000-01	149853881	234550960	384404841	27054271	70.38	33.54	139.55
2001-02	153001261	243657279	396658540	29799836	75.13	6.75	148.96
2002-03 *	158548747	243285938	401834685	32320223	80.43	7.06	159.48
2003-04	Extrapolation based on average escalation of five years $(51.85/4)=12.96$ at same traffic level				90.86	12.96	180.15

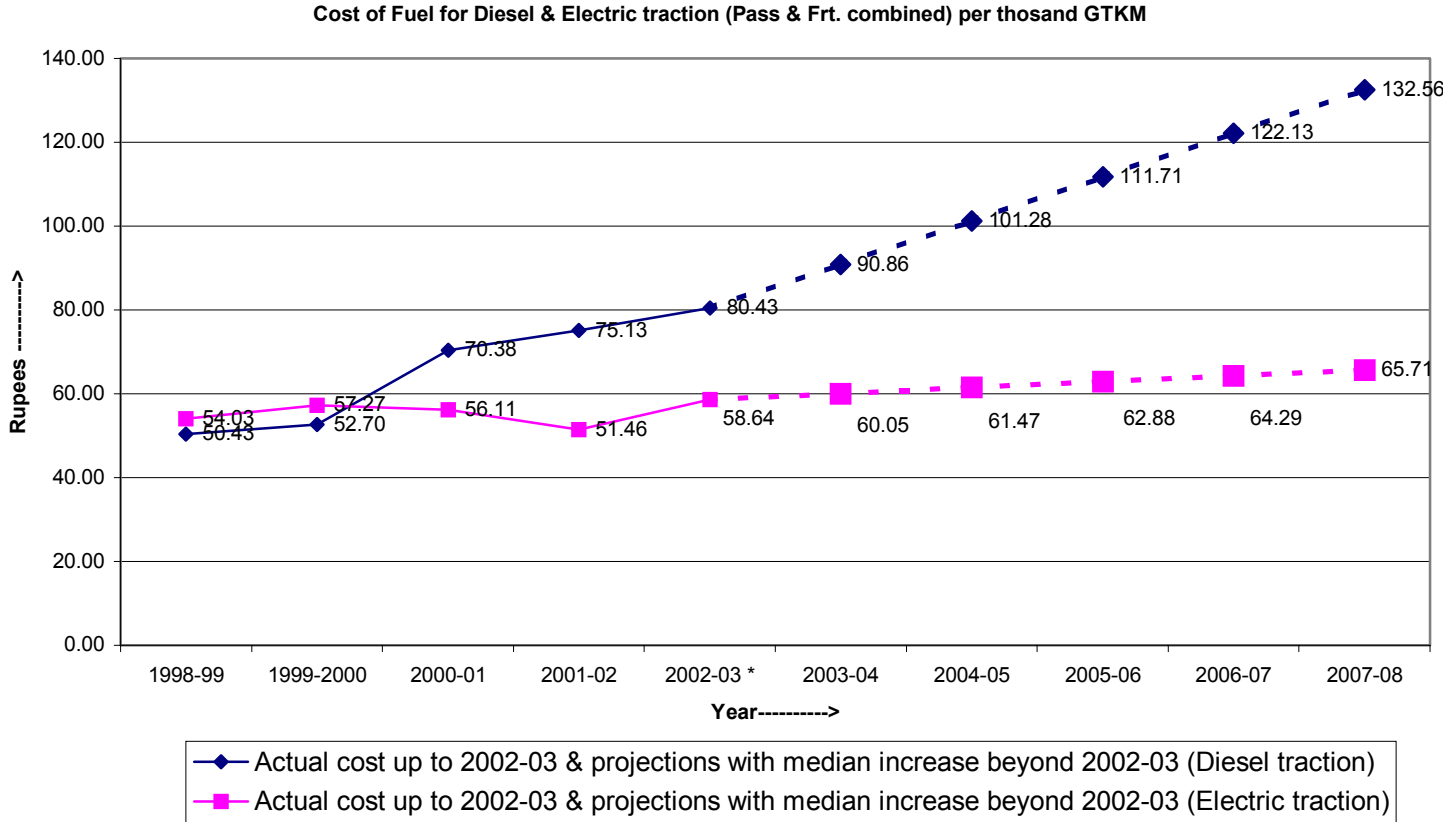
2004-05	101.28	200.82
2005-06	111.71	221.49
2006-07	122.13	242.16
2007-08	132.56	262.84

\* The figures have been taken from statistical branch (under publication)

<b>Table 3.2</b>							
<b>Data Sheet for Cost of Energy per Thousand GTKMs</b>							
<b>Electric (BG)</b>							
Year	GTKMs in Thousands (ASS Stt 16)			Cost of Electric Energy for traction			
	Pass	Goods	Total	Total Cost Rs '000' (ASS Stt 30 Col 178 )	Energy Cost in Rs. per Thousand GTKM	% escl. over prev. year	Energy Cost with base as (1998- 99=100)
1998-99	110903777	327654170	438557947	23693166	54.03	-	100
1999-2000	126916526	358804884	485721410	27819011	57.27	6.01	106.01
2000-01	128770594	363228448	491999042	27606155	56.11	-2.03	103.86
2001-02	137964426	389556004	527520430	27148379	51.46	-8.28	95.26
2002-03 *	147503285	413803830	561307115	32914422	58.64	13.94	108.54
2003-04	Extrapolation based on average escalation of five years (9.64/4=2.41) at same traffic level				60.05	2.41	111.16
2004-05					61.47		113.77
2005-06					62.88		116.39
2006-07					64.29		119.01
2007-08					65.71		121.62

\* The figures have been taken from statistical branch (under publication)

From these figures the unit cost of transport haulage has been worked out and shown in the Table. These figures are shown graphically in graph 3.1.



This unit cost of transport has also been projected for next 3 years upto end of X Plan based upon median increase. It is evident that the difference in haulage cost by electricity and diesel has been constantly increasing.

3.2 Based upon these figures and projected trends, it would be prudent to study and work out a strategy to set future course for containing the total fuel cost in the endeavour to control the operating expenditure for the financial viability of rail transport.

3.3 It should be realized that at the operating ratio of 92%, Rs.100 will have to be earned for net surplus of Rs.8.00, while any saving in fuel cost would add entirely to surplus.

3.4 With the sharp rise in diesel prices during the last 5 years and a similar anticipation in the coming years, the widening gap in the cost of haulage by electricity and HSD, it is necessary that the choice of fuel/ energy for haulage can no more remain a debate of choice of traction but must take into consideration the related economics of fuel costs and operational requirements.

#### **4.0 ELECTRIFICATION**

4.1 During the previous oil shock PM's directive was received from Cabinet Secretary in December 1980 (Annexure I) to increase the pace of electrification on Indian Railways to 1000 kilometers per year. Though the pace of electrification subsequently picked up but it never reached the target set by Cabinet Sectt. While the maximum electrification achieved so far is 831 RKM in 1990-91, the average rate of electrification since 1980 has been 502 RKM/year only.

4.2 The current abnormal rise in price of crude oil is almost a second oil shock and PM's directive given by Cabinet Secretary earlier once again assumes significance necessitating a re-look at the present status of electrification immediately if the operating expenditure of rail transport is to be kept under control at par with the general rate of inflation.

4.3 With the projected price of diesel oil at Rs.22.58 for 2004-05 and unit cost of electricity at Rs.4.70 (due to announced increase in coal prices by 16%) the breakeven level (BEL) of traffic for electrification as per the standard adopted

currently on Indian Railways comes to 9.39 million GTKM /RKM/year for double line at a cost of Rs.45 lakhs per route kilometer and 5.94 million GTKM/RKM/year for single line at a cost of Rs.35 lakhs per route kilometer (Annexure II). Therefore, at the current price of diesel and electricity itself with a mix of 60:40 for freight and coaching respectively any section having about 2 freight trains and 3 passenger trains each way per day for a double line section and 1 freight and 2 passenger trains each way per day for single line on an average would meet the financial criteria for electrification. With this almost any line would qualify for electrification based on financial justification alone and would give adequate rate of return which would progressively become more attractive in coming years as the gap between unit cost of electricity and diesel further widens.

4.4 It would thus be obvious that unlike the past BEL and the financial return should no longer remain the sole criteria for consideration of taking up electrification of a section and it should be considered on the basis of economy in fuel and traffic considerations to improve the mobility of traffic in any sector or part of the network.

## **5.0 CURRENT STATUS OF ELECTRIFICATION**

5.1 16960 route kilometers on Indian Railways have already been electrified. With the target of 350 route kilometers for the year 2004-05, the major 'B' route between Chennai and Howrah will also be completed. Except for Pune to Renigunta, on Chennai-Bombay route, the entire Golden Quadrilateral and its diagonals would be electrified during 2004-05.

## **6.0 PROPOSED STRATEGY FOR REDUCTION OF FUEL/ENERGY COST OF OPERATION**

### **6.1 Increasing the pace of electrification already approved –**

In view of the facts mentioned above, there is an urgent need to step up the pace of electrification of sections already approved and forming part of golden quadrilateral and its diagonals with the objective of completing the electrification of the golden quadrilateral and its diagonals as the sections covered carry higher density of traffic and also forms the backbone of the rail transport network. In addition the electrification works on sections already approved but subsequently pended or frozen e.g. Khurja-Meerut-Saharanpur, Delhi Sarai Rohilla-Gurgaon, Mughalsarai-Zafrabad should be taken up in right earnest.

### **6.2 Increasing the shelf of projects -**

The sections identified in the blue print for electrification for next 10 years and sections urgently projected by MT along with the list of through put increasing works specified by MT has already been approved by Board. Necessary sanctions, for taking up these approved RE works should be expedited to build up adequate shelf of project for execution of electrification work at a steadily higher pace of approximately 500 RKM/year.

### **6.3 Electrification of single line -**

There has been general reluctance to consider single line for electrification on traffic considerations but missing single line links between two major electrified routes on network concept when electrified give a substantial boost to mobility and internal rate of return. This is evident from the recent experience of

electrification of Udhna-Jalgaon section (Report of W. Rly. and DO letter of COM/N. Rly. reflecting increase in throughput, improvement in mobility and savings enclosed at Annexure III) and the past experience of electrification of other connecting single line sections of Renigunta-Gudur in SR (now doubled) and Tundla-Agra-Bayana in NCR. Increase in throughput and reduction of detentions has led to greater mobility and operation flexibility in the electrified network by electrification of these joining sections. In the light of this experience two critical single line sections, linking major electrified routes, i.e. Bina-Kota and Jhansi-Kanpur qualifies for immediate electrification both on consideration of saving in fuel cost as well as for improved network mobility including diversions at the time of break down/accident (recent example of diversion through Patna-Gaya after its electrification due to accident of Rajdhani Express blocking traffic on main line between MGS-PNBE). Out of these two sections, Bina-Kota is already part of Blue print as well as identified sections by MT for urgent requirement. Jhansi-Kanpur section though being constantly projected as essential by GM/NCR has not received necessary approval from Traffic and Planning Dte. It may be worth re-considering the request of GM/NCR.

The other major arterial route, which will be fully doubled by 2004-05 between Itarsi and Allahabad, would also fully qualify for electrification on considerations of savings in fuel costs as well as mobility in the network of NCR and WCR.

## **7.0 JUDICIOUS MIX OF TRACTIONS IN ELECTRIFIED NETWORK**

7.1 At the current cost of diesel and electric haulage on the existing electrified routes avoiding running of diesel under wire is expected to lead to a saving of

more than Rs.100 cr. in fuel cost which may marginally reduce due to increase lie over of locos at point of change of traction. With the electrification investments having been made, running of diesel under wire is financially imprudent and should be reduced to maximum extent.

7.2 The requirement of holding a diesel power every 75 kilometers under disaster management plan by running some nominated diesel trains has to be reviewed by Traffic Directorate. It may be possible to do away with diesel running under wire by earmarking dedicated diesel locomotives for shunting applications and DMT placed suitably in every electrified division so as to meet the requirement of disaster management also. This would, however, require a detailed analysis by Traffic Directorate and if not, the total elimination at least through running diesel under wire can be minimized to great extent to reduce its financial impact substantially through reduction in overall fuel cost.

7.3 The objectives of reducing diesel under wire could also be met by universal dual mode locomotives, which could not only perform shunting in yards in electrified territory without any limitation but also meet requirement of disaster management and eliminate organizational duplication for operation and maintenance. Development of such dual mode locomotives as available in other countries will have to be taken up.

## **8. EMERGING ISSUES**

The current and projected scenario of operational cost input for fuel/energy of Rail transport necessitates the need to adopt appropriate strategy and set the course for containing increase in operational expenditure for

sustained financial viability of Rail transport. As the course for containing the increase in the largest component of cost of human resource is already set, the focus has to shift on the next largest component i.e. cost of fuel energy.

Based on the details as brought out in the discussion paper the issues emerging are as under:

- The gap between unit cost of haulage by fuel and electricity is constantly widening fast.
- The trend in increase of electricity price has been marginal and it is likely to remain stable due to availing of opportunities being thrown open by power reforms.
- Even at the current price levels of fuel/energy the BEL for electrification has reached a level that would financially justify electrification of almost every section on IR.
- With the current status of electrification and the financial viability as per current/projected fuel/energy cost, the factors meriting consideration would be improving network mobility for normal operation and meeting the operational exigencies during breakdown/disaster in the electrified sections.
- It would thus follow that the above can be achieved by setting a course with the pace of electrification pegged at 500 RKM/year in the following manner over and above the sections identified in the Blue Print:

- (i) All electrification works approved but frozen/pended covering important links/routes are taken up in right earnest.
- (ii) Other important links in the electrified territory are considered for approval of electrification.
- (iii) Other major routes e.g. Allahabad-Itarsi, Ahmedabad-Jaipur-Delhi though not featuring in the Blue print must be considered for electrification.