

SUSTAINABLE INFRASTRUCTURE

The Transport Imperative

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Transport Sector: Going Low Carbon

- Passenger Mobility: personal choice
- Freight Transportation: cost competitiveness & Supply chain commitments
- CDM rewards offsets mostly for investors, not much for users
- Apprehensions of stakeholders in business-as-usual carbon based transport infrastructure
 - CO2 reduction strategies not yet clear/backed by clear government policies
 - High cost of clean fuel technologies (large scale Solar, Wind power costly, not yet commercially viable)

Global & Indian Patterns

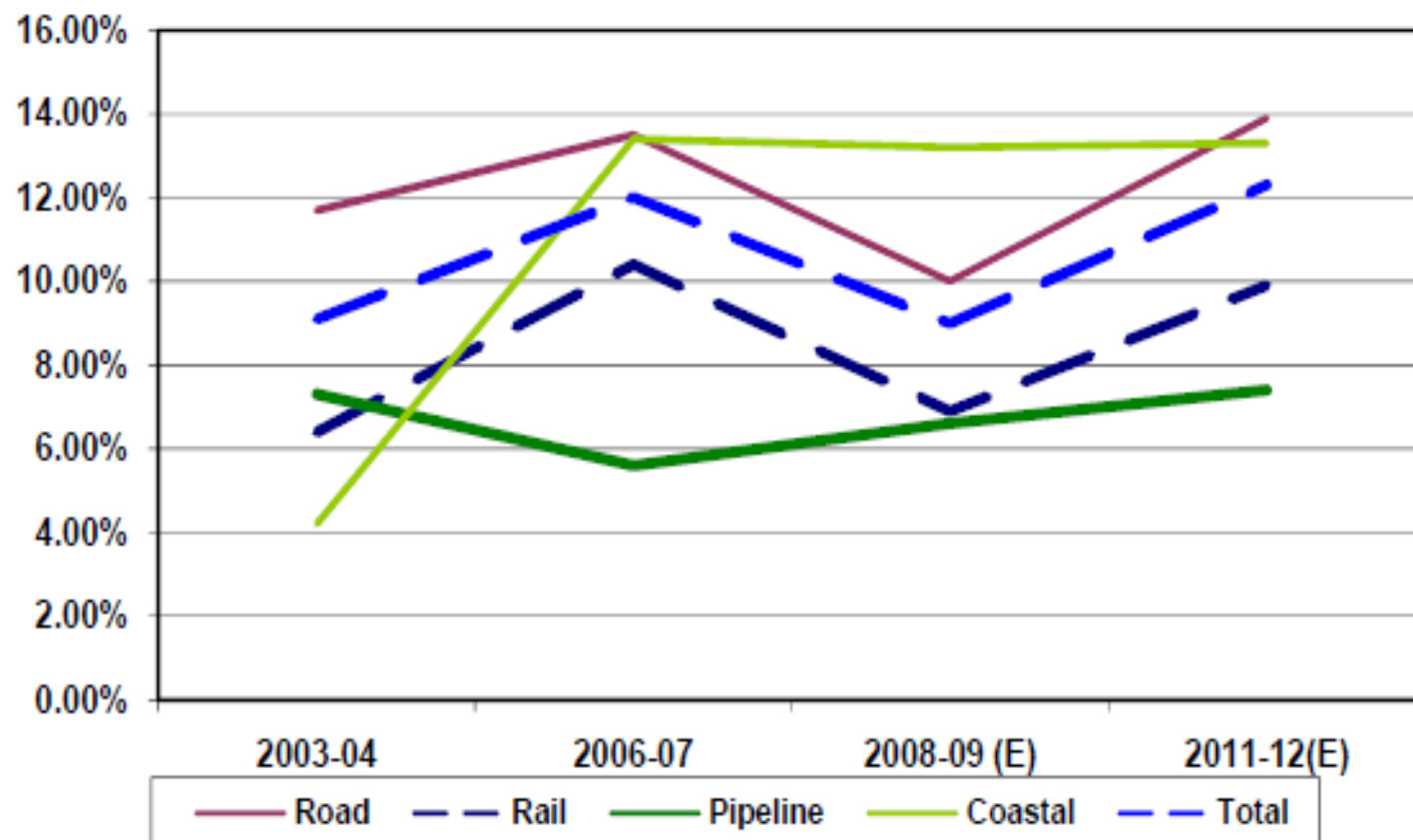
- Transportation market: global shift towards railways
- Rail travel on average 3-10 times less CO2 intensive than road/air
- India: Growth in transport sector vis-à-vis the growth of railways:
 - Railway sector not keeping pace with the overall transport sector even with capacity addition
 - Average growth in freight movement: 9-12%,
 - Growth in rail freight movement: 6-9%
 - Result: Estimated fall in railways' market share from 36% in 1999-2000 to 29% in 2011-12 (though freight movement will increase from 305BTKM to 740 BTKM or +243% for a 20% y-o-y growth, against a total freight increase of 300%, averaging 25% y-o-y)

Table-1 INDIA: Transport Sector Key Statistics

	Units	As of 2007
Length of Roads	Km.	3,516,452
Main Roads	Km.	666,452
Paved Roads	%	47.3
Access to All-Season-Roads	%	61
Road Density	km/1,000 sq. km.	1115
<i>Rail Track Length</i>	<i>Km.</i>	<i>63,327</i>
<i>No. of Ports</i>		<i>197</i>
<i>Airports</i>		<i>60</i>
International		11

(Source: www.worldbank.org)

Growth in freight movement of various modes of transport



Indian Transport Sector

- Large, diverse
- Dominant mode: Roads (80% of passenger traffic, 65% of freight)
- Density of highway network
 - 0.66 km of highway per square km of land
 - US= 0.65, China= 0.16, Brazil= 0.20
- Railways: other large player - about 14m passengers/day
- Supply side problems:
 - Intense competition (private road transport services)
 - Operating inflexibilities
 - Capacity constraints on key routes

Roads

- Annual growth rate (from 1990 base of 80% share of land transport demand):
 - 12% in freight demand
 - 8% in passenger demand
- Demand for rail transport :
 - 1.4% a year for freight
 - 3.6% a year for passenger traffic

(Last 3 years: Growth of 9.4% rail freight, 7.4% rail passenger traffic)

National Highways Projects (31.3.09)

Sl. No.	NHDP Component	Total length	Completed 4 lane	Under implementation	Balance for award of civil works	(km)
1	GQ	5,846	5,721	125	-	
2	NS-EW	7,142	3,436	2,915	791	
3	Port connectivity	380	206	168	6	
4	Other NHs	962	781	161	20	
5	NHDP –III	12,109	787	1,878	9,444	
6	NHDP Phase V	6,500	106	928	5,470	
7	NHDP Phase VII	700	0	19	681	
Total		33,639	11,037	6,194	16,412	

Source : Department of Road Transport & Highways

- 11th Plan: National highways development requirement estimated at \$48.4 billion
- Focus: Integrated development:
 - Continued development of national highways and rural roads
 - Emphasis likely on the development of state highways and district roads

Indian Railways

2000–2005:

Growth in global Rail Freight traffic: 25%

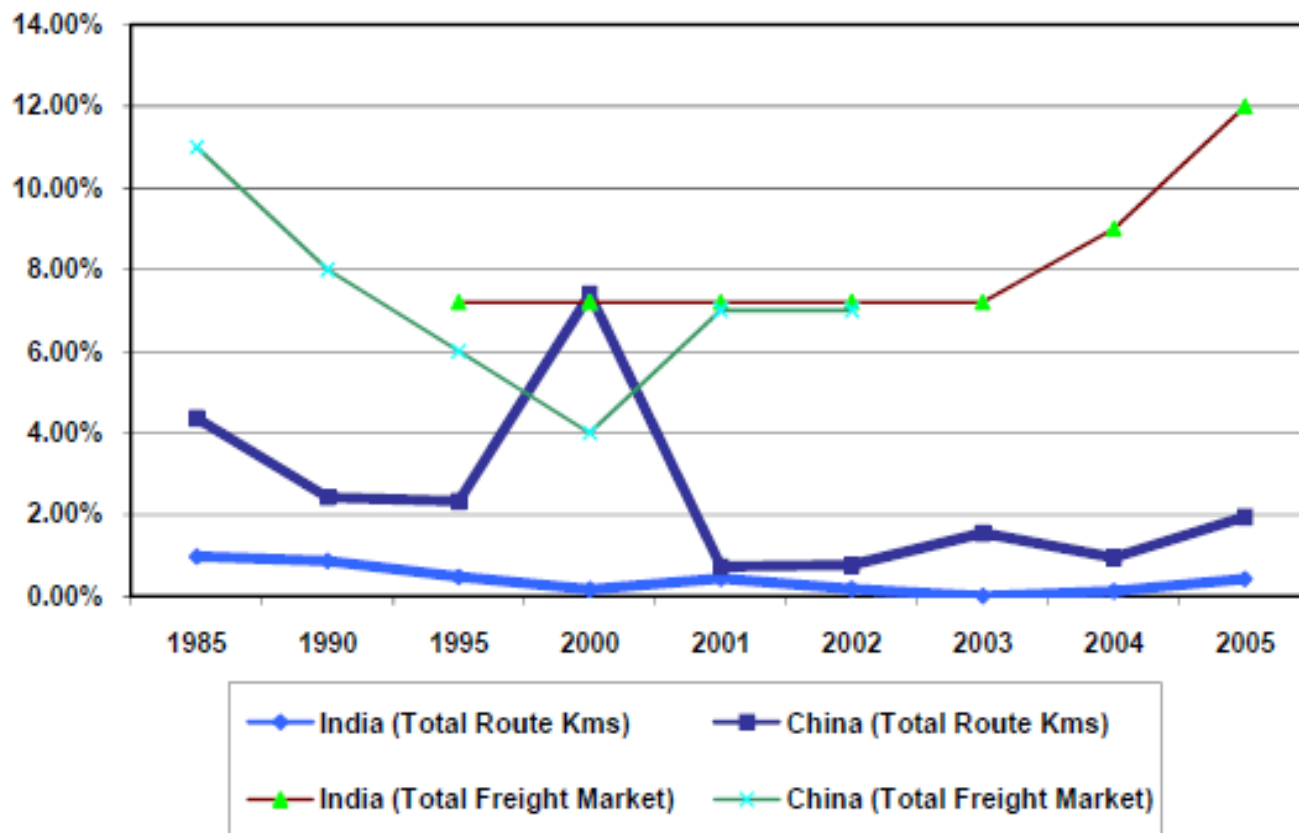
Rail Passenger Traffic: 19%

- Indian Rail market share in 1950-51:
 - 88% (Freight traffic)
 - 68% (Passenger traffic)
- Current market share:
 - 40% (Freight traffic)
 - 20% (Passenger traffic)
- Revenue = 1.75% (approx) of GDP.
- Largest Employer (1.41million)

XIth Plan Projections

- **Freight Traffic to grow at 8-9% p.a.**
- **Passenger Traffic to grow at 6 % p.a.**
- **Projections for 2011-12:**
 - **1100 Million Tonnes of Originating Freight**
 - **705 Billion TKMs**
 - **8400 Million Originating Passengers**
 - **880 billion PKMs**

Growth in Total Route Kms and Total Freight Market



- Railways: any form of primary energy (electricity, coal, diesel)
- Energy efficient: lowest known frictional loss due to rolling of steel on steel
- Road Commercial carriers: low payloads, lower fuel efficiency

Strategy

Objective: Neutrality, eventual Carbon Mitigation Rating for Transport Sector Projects

- Non-fossil fuels → Traction & Operation
- Change in Mode of Transport: light cargo, short haul, heavy haul
- Change in use of Rolling Stock Energy efficiency in commercial hubs (terminals, warehouses, logistics parks): 25% cut in carbon emissions through LEED-rated buildings (carbon credits)
- Energy-efficient technologies
- Reducing transmission loss in electric OHE lines
- Improving fuel management in diesel locomotives
- Other Options: DFC, High speed trains, inter-modal mix

Freight Traffic

Bulk of IR's traffic: overstretched Golden Quadrilateral -Speeds of 26 km/hr
Limited flexibility & capacity constraints will kill the surge

Dedicated Freight Corridor

Estimated Saving of CO2 Emissions

- Through vehicle displacement: 347- 500MT by 2027 (cumulative)
- Through locomotives with regenerative braking: another 3MT
- Through swap/barter strategy: an additional 9MT
- 30% energy requirement from clean power: Swap/barter strategy
- Only fuel efficient 3-phase locos with regenerative braking
- High Speed Regenerative locomotives/kinetic energy harnessing electric locos for energy recovery - supply to grid 10%
- FEMU services for time-sensitive light cargo

MT=Million Tonnes

High-speed trains

- Cost - Resource constraints
- Priority
- Geography: Terrain, curves, inter-city distances

Inter-modal mix:

- Rail bridging: Roadrailleurs, piggy back services
 - Road for short-distance passenger, <500kms
container/freight
-

Indian Railways

- Demand-Supply gap: Quantum jump required
Estimates: Total Investment (2007-2015): \$80 billion (Rs.350,000 crores)

Previous period (2002-2007): \$15 billion

- 1/3 reduction in annual upkeep costs through implementing best-practice procedures (*Source: OECD report on Railways*)
- Projections: →
 - Passenger traffic:
Current 6b to 8.4b (2011-12) to 9.5b (2015) to 14 b (2020)
 - Freight traffic:
Current 700 MT to 1100 MT (2011-12) to 2000 MT (2020)
 - Rolling Stock: Projected Shortfall in XI Plan (2011):
 - Diesel Locos: 700
 - Electric Locos: 700
 - Wheels: 124000

Sources of Financing

Xth Plan (2001-2006) Outlay

SOURCE	Plan Projections	Estimates
Internal Generation + Market Borrowings	\$7b <i>(Rs. 33000 crs)</i>	\$10b <i>(Rs. 45296 crs: 28331+16965)</i>
Budgetary Support	\$6b <i>(Rs. 27600 crs)</i>	\$9b <i>(Rs. 36935 crs)</i>
Total	\$13b <i>(Rs. 60600 crs)</i>	\$19b <i>(Rs. 82232 crs)</i>

Infrastructure—Deficit and Eleventh Plan Physical Targets

Sector	Deficit	Eleventh Plan Targets
Roads/Highways	65590 km of NH comprise only 2% of network; carry 40% of traffic; 12% 4-laned; 50% 2-laned; and 38% single-laned	6-lane 6500 km in GQ; 4-lane 6736 km NS-EW; 4-lane 20000 km; 2-lane 20000 km; 1000 km Expressway
Ports	Inadequate berths and rail/road connectivity	New capacity: 485 m MT in major ports; 345 m MT in minor ports
Airports	Inadequate runways, aircraft handling capacity, parking space and terminal buildings	Modernize 4 metro and 35 non-metro airports; 3 greenfield in NER; 7 other greenfield airports
Railways	Old technology; saturated routes; slow speeds (freight: 22 kmph; passengers: 50 kmph); low payload to tare ratio (2.5)	8132 km new rail; 7148 km gauge conversion; modernize 22 stations; dedicated freight corridors
Power	13.8% peaking deficit; 9.6% energy shortage; 40% transmission and distribution losses; absence of competition	Add 78577 MW; access to all rural households
Irrigation	1123 BCM utilizable water resources; yet near crisis in per capita availability and storage; only 43% of net sown area irrigated	Develop 16 mha major and minor works; 10.25 mha CAD; 2.18 mha flood control
Telecom/IT	Only 18% of market accessed; obsolete hardware; acute human resources' shortages	Reach 600 m subscribers—200 m in rural areas; 20 m broadband; 40 m Internet

Planned Capacity Enhancement

Doubling and Port Connectivity – 6000 Kms.

Dedicated Freight Corridors-11,500 Kms.

Feeder Routes of DFC- 15,000 Kms.

Gauge Conversion- 12,000 Kms.

Asset Renewal/Upgradation—all High-density Routes

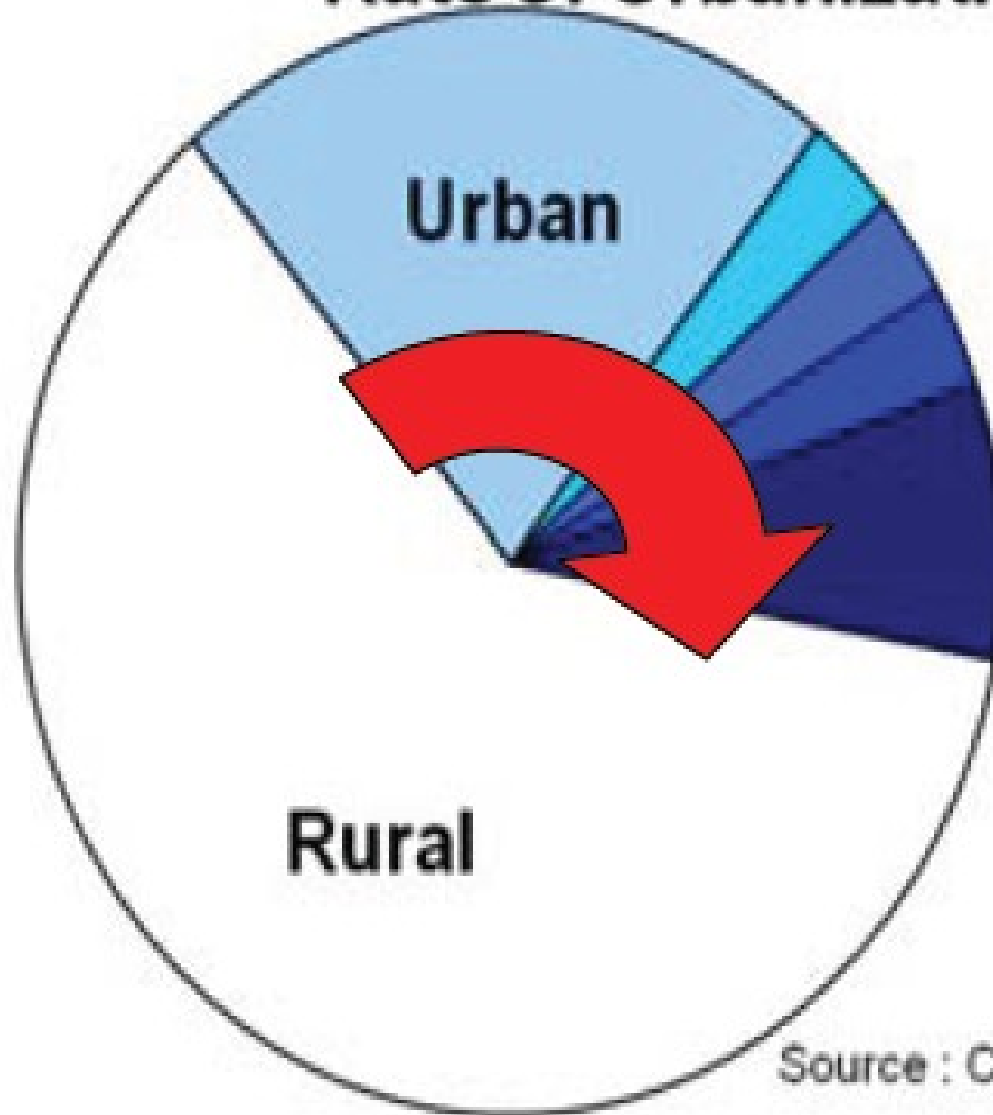
Modernization of Passenger & Freight Terminals

Augmentation Of Manufacturing Capacity Of Rolling Stock.

Railways – An International Comparison

Country	Year	Total Route km	Route km Electrified	Total Locomotives	Passenger Coaches	Freight Wagons	Passengers (000)	Passenger-Kilometers (000,000)	Average Km per Passenger	Freight Tons (000,000)	Freight Ton-km (000,000)	Average Km per Ton	Passenger Revenue (2000 Constant US\$ 000,000)	Freight Revenue (2000 Constant US\$ 000,000)	Staff (across all functions)
Asia															
India	2005	63465	17495	7910	37119	222379	5378000	575702	107	602	407398	677	2706	5311	1422200
China	2005	62200	19400	16453	40328	541824	1106510	583320	527	2309	1934612	838	6578	16493	1665588
Japan	2005	20052	12217	1200	24997	9000	8683900	245957	28	37	22632	612			135600
Russia	2005	85245		12213			1338723	172217	129	1281	1858100	1451	1456	9425	1161900
Europe															
UK	2005	15810	5205	410	10746		1082000	43200	40	104	22110	213			
France	2005	29286	14765	4588	15879	35456	962700	76159	79	130	41898	322			167200
Germany	2005	34218	19350	4787	20305	156751	1785400	72554	41	275	88022	320			224600
Africa															
South Africa	2005	20247	10450	2646	3251	94210	3100	991	320	182	109721	603	31	1702	32516
Americas															
USA: All Class I Railways	2005	153787	0	23198		1290000				1723	2478914	1439		41129	162438
Canada: Canadian National	2005	31894		2073		96153				213	262589	1233		3682	22246

Rate of Urbanization (1971-2011)



1971 : 20%

1981 : 23%

1991 : 26%

2001 : 28%

2011 : 41%

Rural

Urban

Source : Census of India

E&Y

% Growth in Infrastructure Services/Production

Item	2006-07	2007-08	H1 08-09*	H2 08-09*	2008-09*
Crude petroleum	5.6	0.4	-0.8	-2.9	-1.8
Petroleum refinery	12.6	6.5	4.5	1.5	3.0
Natural gas	-1.4	2.1	4.8	-1.6	1.4
Coal	5.9	6.0	7.9	8.3	8.1
Electricity generated	7.3	6.3	2.6	2.9	2.7
Railway freight	9.2	9.0	8.5	-1.5	4.9
Port cargo	9.5	12.0	7.2	-3.3	2.1
Air export cargo	3.6	7.5	8.0	-1.8	3.4
Air import cargo	19.4	19.7	5.9	-16.6	-5.7
Air passenger traffic (inter)	12.1	11.9	7.2	0.8	3.8
Air passenger traffic (dom.)	34.0	20.6	-7.5	-16.5	-12.1
Cell phone connections-telecom	85.4	38.3			44.8

Source : Ministry of Statistics and Programme Implementation

India: Requirements

Table 1 - Current Overall Target and its Composition (at 2005/06 prices)

Sector	Amount	
	USD billion*	INR Crores
Power	130	616,500
Railways	66	300,000
National Highways	49	220,000
Civil aviation	9	40,000
Ports	11	50,000
Sub Total	265	1,226,500
Residual sectors	55	223,500
Total	320	1,450,000

*Assuming exchange rate of INR 45.30 to one USD

Note: There is no formal consensus on what constitutes infrastructure. Therefore, the scope of 'Residual Sectors' varies depending on what definition of infrastructure is adopted. A conservative definition of infrastructure would imply that Residual Sectors include telecom, SEZs, supporting urban infrastructure, water and sanitation, state and rural roads, logistics, pipelines etc.

REQUIREMENTS (*contd*)

- Maintaining GDP Growth Rate at 9% (2007-11), entails 6% increase in total investment
- Next 5 yrs: Required increase in Fixed Capital Formation in infrastructure for 8%+ GDP= 8–9% (twice the current rate)
 - GDP= \$775 billion
 - 4.6% of GDP (2002-07) → 8% of GDP (\$320 billion!)
- Implications for the Public Sector

REQUIREMENTS (*contd*)

- Estimated non-Railway investment requirements by 2012:
 - \$ 49 billion - National Highways
 - \$ 9 billion - Airports
 - \$ 11 billion - Ports
 - \$120 billion - Energy
- India can absorb \$ 150 billion FDI in infrastructure sector alone

INVESTMENT TODAY

- Investment Plan for total estimated investment of USD 320-350b (2007-12)
 - Internal resources 70%
 - External funding (WB/ADB/Bilateral) 10%
 - Private investment 20%
- PPI as percentage of GDP < 1%
- Last few years: \$6-8b, Aim = \$15b