

Transport Systems:

A Systemic View in the context of Climate Change

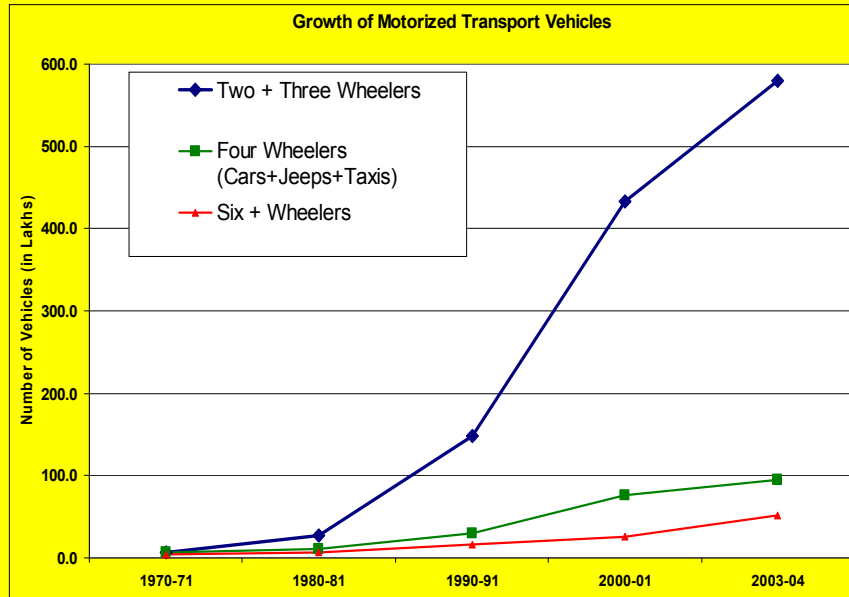
*Climate Change India 2008,
Pune 22-23 April.*

*- Prof. Sanjeev Ghotge,
Senior Fellow, WISE*

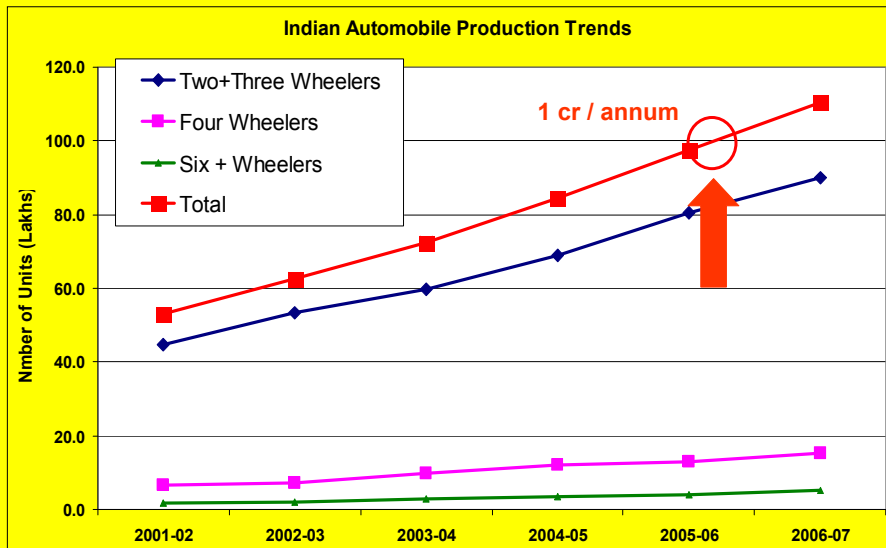
Hierarchy of energy intensity in transport modes

- Shipping
 - Railways
 - Road/Vehicular
 - Aviation
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- These are in **increasing** order of energy intensity in terms of per passenger-km and per tonne-km
 - Energy intensity **directly co-relates** with GHG Emissions

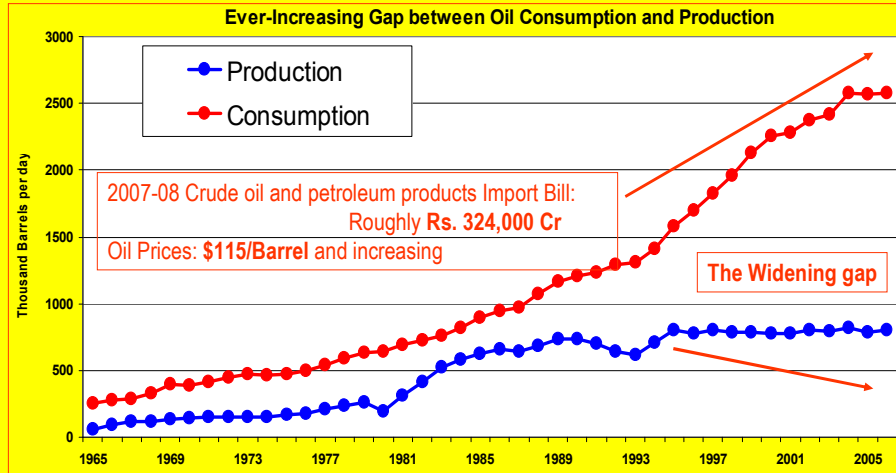
Growth of Motorized Transport Vehicles



Automobile Production Trends



Indian Oil Production and Consumption/Import



IEP indicates roughly **418 Mtoe** as oil need in **2031** with around **90% import** dependency = **2757 Million barrels/ year**; at current prices import bill = **317 Billion USD** or **Rs 12,68,471 Cr**
At double the price, i.e. USD 230/barrel import bill will be **Rs 25.3 Lakh Crore**

World Transport Energy Use, 2000

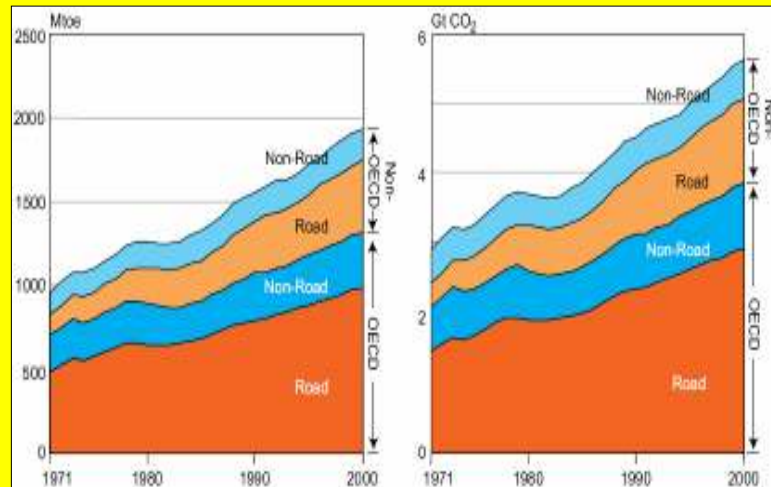
Road Transport – **77.4 %** energy ; (Rail, Aviation, Shipping) – **22.6%**

Table 5.1: World transport energy use in 2000, by mode

Mode	Energy use (EJ)	Share (%)
Light-duty vehicles (LDVs)	34.2	44.5
2-wheelers	1.2	1.6
Heavy freight trucks	12.48	16.2
Medium freight trucks	6.77	8.8
Buses	4.76	6.2
Rail	1.19	1.5
Air	8.95	11.6
Shipping	7.32	9.5
Total	76.87	100

Energy use and Emissions from Transport

Road Emissions are the **most significant factor** within the entire transport sector emissions



GHG Emissions from Vehicles and Trans Modes

Bus and Rail Emissions are roughly **1/6th** of car (gasoline) emissions

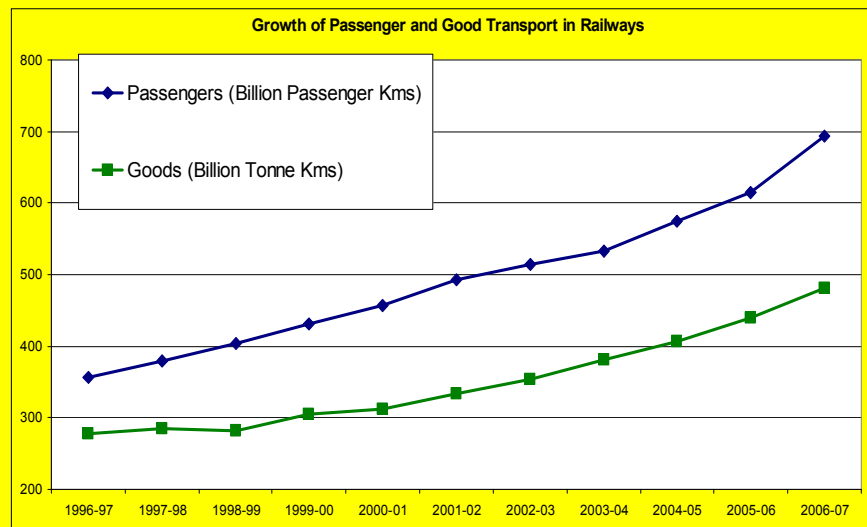
Table 5.4: GHG Emissions from vehicles and transport modes in developing countries

	Load factor (average occupancy)	CO ₂ -eq emissions per passenger-km (full energy cycle)
Car (gasoline)	2.5	130-170
Car (diesel)	2.5	85-120
Car (natural gas)	2.5	100-135
Car (electric) ^{a)}	2.0	30-100
Scooter (two-stroke)	1.5	60-90
Scooter (four-stroke)	1.5	40-60
Minibus (gasoline)	12.0	50-70
Minibus (diesel)	12.0	40-60
Bus (diesel)	40.0	20-30
Bus (natural gas)	40.0	25-35
Bus (hydrogen fuel cell) ^{b)}	40.0	15-25
Rail Transit ^{c)}	75% full	20-50

New Directions for Road/Vehicular Transport

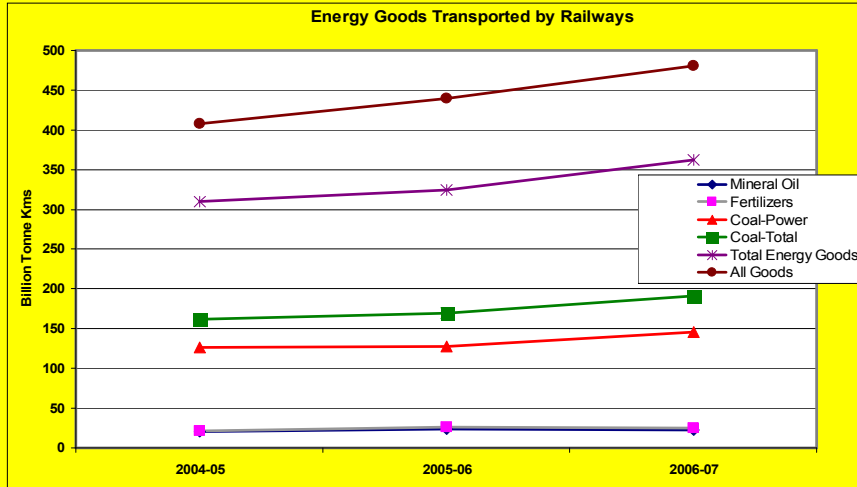
- Reduce dependence on road transport
- Inter-modal shift from road to railways
- Savings on road infrastructure
- Due to peaking of oil, reduction is imperative
- Savings on Oil import bill
- Improved public health and reduced accidents

Passenger and Goods Transport in Railways

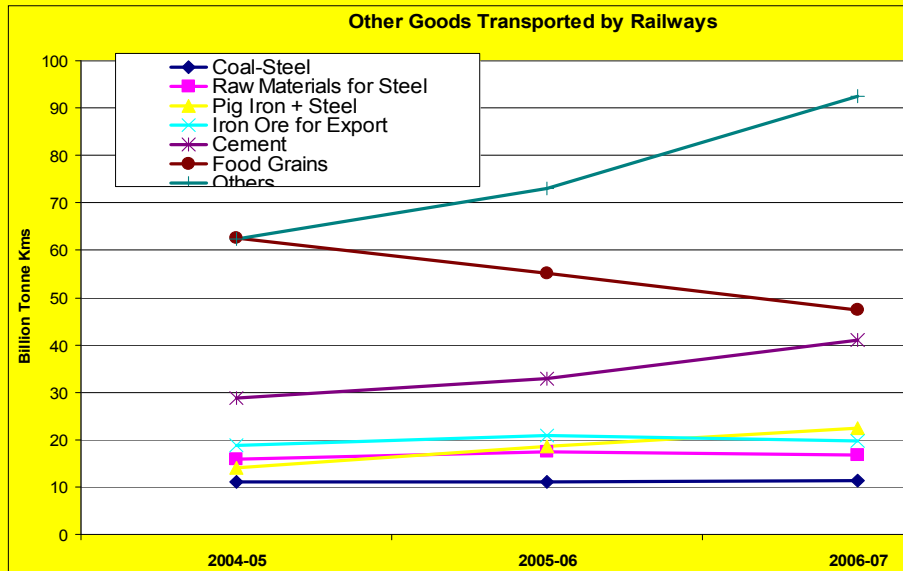


Energy Goods Transported by Rail

Energy goods account for 50% of all goods transport
 Coal Transport – 40% of all goods transport



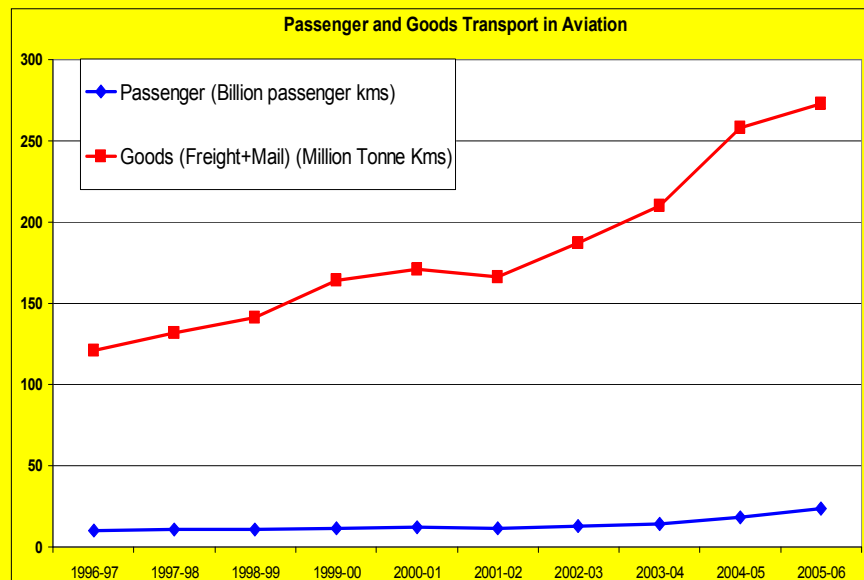
Other Goods Transported by Rail



New Directions for Railways

- Roll-on Roll-off (Ro-Ro)
- Railways powered by Renewable Electricity as far as possible
- Decarbonizing the fuels in economy will free up nearly 50% of goods transport capacity in railways
- Decarbonizing the materials sector will free up nearly 23% of goods transport capacity in railways

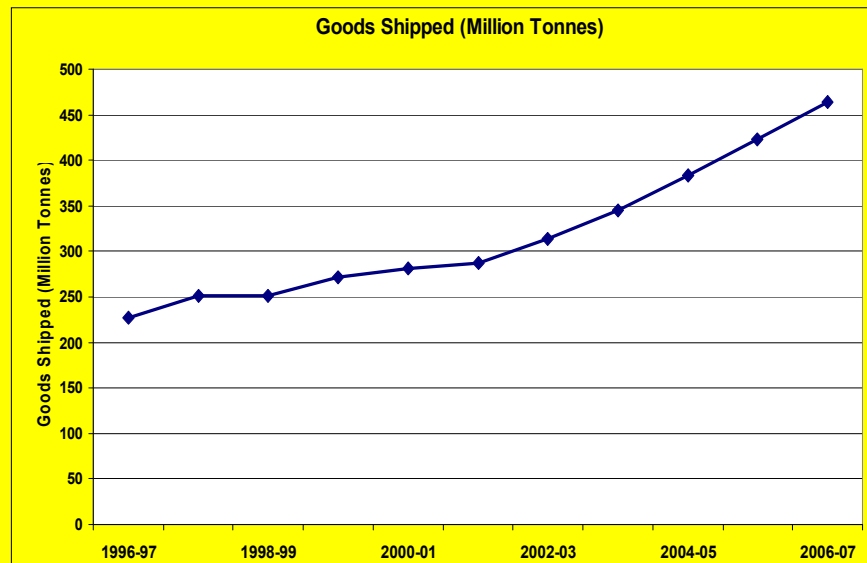
Passenger and Goods Transport in Aviation



New Directions for Aviation

- Aviation Emissions being **high altitude** are more damaging than ground level emissions
- **Reduce** passenger air travel through disincentives
- Due to **peaking of oil**, reduction is imperative
- Reduction in **bill** for Aviation Turbine Fuel
- Reduce **unnecessary goods** transport by air except mail
- Reduce long term investment in **expensive aviation infrastructure** which creates technological lock in

Goods Transport in Shipping



New Directions for Shipping

- **Sea Level Rise** necessitates **review** of existing and future planned Port Development
- Reduction in international trade due to peak oil and economic contraction also requires review of port development to prevent technological lock-in
- Consequences for energy security: fuel supply risk
- **Inter-modal shift** to railways
- Develop in-land shipping wherever possible

Way Forward

- Massive **use of railways** for goods and passenger transport powered by renewable electricity
- Mass **public transportation options** for urban areas
- Heavy reliance on **non-motorized transport**
- **True social and environmental pricing** of conventional fuels
- **Higher taxes and disincentives** for private personal transport