High Speed Rail in India

Selection of corridors and Impacts on energy and emissions*

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*Emissions throughout this presentation refer to CO₂ emissions from operations only
Ever increasing demand for mobility

GROWTH IN PASSENGER TRANSPORT

• Very fast growth in passenger transport activity

2.5 Mil. Cars (1990) → 15.5 Mil. Cars * (2010)

• Growth drivers: population, economy, urbanization, motorization

286 Rail BPKM (1990) → 1,046 Rail BPKM (2012) **

* Total number of registered cars and jeeps in India; source: Basic Road Statistics, MoRTH; ** Data from the IR

The absolute growth in mobility has been very rapid specifically in the last decade
India’s large urban agglomerations

- Already 8 urban centers have populations greater than 5 million people
- By 2030
  - At least 6 ten million plus cities
  - 6 to 11 five million plus cities

Large passenger mobility can be seen between such large cities across the country

Map based on Census 2011 data
- Top 40 passenger originating cities generate 51% of the total non-suburban traffic
- Delhi, Mumbai and Kolkata alone generate 20% of the total traffic
Originating passengers for the Airlines

• Top 10 passenger originating cities generate 78% of the total traffic
• Delhi, Mumbai and Bangalore generate about 50% of the total traffic
Kochi Air data does not include data from Indian

Identifying urban passenger corridors

- Distinct heavy passenger use corridors emerge
- Capacity constraint of rail would mean traffic will move to air and road

Number of originating passengers:
- > 2 million rail
- 1 to 2 million rail
- > 1 million air

Air data does not include data from Indian
Identification of potential HSR corridors in India

- TERI-ITPS study tried to determine the potential corridors for HSR in India
- There were several overlapping corridors with the Govt. links
- Detailed study on two corridors:
  - **Western Corridor**
    - Ahmedabad – Mumbai – Pune
  - **Southern Corridor**
    - Chennai – Bangalore - Coimbatore

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Map sourced from TERI-ITPS study titled “A Study on the Mid/Long-Term Railway Networks in India Phase II”.
The western corridor - a quick snapshot

The Western Corridor
Ahmedabad – Vadodara – Surat – Mumbai – Pune

Road
- 95 km Ahmedabad-Vadodara Expressway (1.5 hours)
- 93 km Mumbai-Pune Expressway (2 hrs)
- Ahmedabad - Pune corridor coming up connecting Vadodara, Surat and Mumbai

Rail
- Ahmedabad, Vadodara, Surat, Bharuch, Valsad, Borivali, Dadar, Mumbai Central & Pune
- 30 trains runs along the Ahm to Mum, 15 - superfast, 11 - Express, 4 Rajdhani, Shatabdi & Duronto

Air
- All the cities along the corridor are connected by air with center at Mumbai

Section 1: Ahmedabad to Mumbai
Section 2: Mumbai to Pune
The southern corridor - a quick snapshot

The Southern Corridor
Chennai – Bangalore - Coimbatore

Road
- High density passenger network on roads – SRTUs and private operators
- NHAI is expanding the road from 4 to 6 lanes between Chennai and Bangalore – DPR is ready
- Expressway being planned independently between Chennai – Bangalore and Chennai – Coimbatore

Air
- There are about 9 flights daily between Chennai-Bangalore and 3 between Bangalore and Coimbatore
- Since Bangalore airport is 40 km away from the city center it takes approximately the same time between the cities on air as it takes on the road

Rail
- 17 trains between Chennai and Bangalore and 13 trains between Bangalore – Coimbatore (no Shatabdi)

Section 3: Chennai-Bangalore
Section 4: Bangalore-Coimbatore
Section 5: Coimbatore-Chennai

Chennai – Bangalore 327.6 km
Bangalore – Coimbatore 372.0 km
Chennai – Coimbatore 530.0 km
THE AHMEDABAD-MUMBAI SECTION
Ahmedabad-Mumbai
7.94 BPKM in 2011-12

• 58% of the traffic moves on the roads
• Aviation grew at almost 37% (CAGR) between 2008/09 and 2011/12
• Traffic on cars and jeeps have almost caught up with that on the railways
The Ahmedabad-Mumbai corridor

RAIL TRAFFIC

- 6.2 million passengers travelled on reserved rail categories in 2011-12
- Growth of passenger kilometers on various classes (CAGR: 2008/9-2010/11)
  - **Higher** - 7.62%
  - **Middle** - 6.79%
  - **Lower** - 3.85%
- Higher journey classes have higher leads (404km-373km-348km)

Fastest end to end travel time on railways: 6h 25min
The Ahmedabad-Mumbai corridor
RAIL – GLIMPSE AT PASSENGER PROFILES

• Conducted a primary face to face passenger survey on-board trains
• 73% of the respondents were in the ages between 21 and 40 years
• Largely in private services (44%) or self employed (25%)
• Highest share of total respondents in the income band of Rs. 25-50,000

Primary surveys were conducted on day passenger superfast trains that started and terminated between Ahmedabad and Mumbai Central. Sample size: 1461
45% of the respondents were traveling for business or official purposes.
A large number of people were also traveling for social reasons.

Large share of rail passengers surveyed were making this journey on a monthly basis and most of them were traveling on work.
The Ahmedabad-Mumbai corridor
BUS TRAFFIC – PASSENGER PROFILES

- About 12 million people travel on intercity buses along this corridor (2011-12)
- Mostly young travelers - 55% respondents between 21 and 30 years
- Greater percentage of respondents were students as compared to the railways
- Respondents had on average, lower incomes than those on the railways

Primary surveys were conducted at bus terminals in Ahmedabad, Vadodara, Surat and Mumbai. Sample size: 712
63% of the respondents were traveling for business or official purposes.
Most of these respondents made trips along this corridor once a week.

High share of bus passengers surveyed along this corridor were young and booked their tickets at the time of journey.
The Ahmedabad-Mumbai corridor

AIR TRAFFIC

- 1.76 mn passengers travelled by air in 2011-12
- Mumbai-Ahmedabad accounts for 80% of the traffic
- Rapid growth of aviation passengers
- New airports in the anvil
- At this rate the mobility on air would exceed the mobility on medium classes of the railways by 2012-13

This growth of passenger traffic driven by growth in air and road traffic is unsustainable in the long run
Rail

- Conducted primary surveys on board trains and on platforms to understand willingness of current passengers to shift to HSR if introduced
- About 98% passengers said that they would be willing to shift to HSR
- But smaller percentage were willing to pay for HSR services

Primary surveys were conducted on day passenger superfast trains that started and terminated between Ahmedabad and Mumbai Central. Sample size: 1461
Road

- Conducted primary surveys at bus terminals to understand willingness of current passengers to shift to HSR if introduced
- About 69% passengers traveling on luxury bus classes said they would shift to HSR and pay
- From the Japanese experience of the Shinkansen, about 15% of car users was assumed to shift to HSR
The Ahmedabad-Mumbai corridor
MODAL SHIFT TO HSR

Air

- International experience show HSR passengers prefer to travel by HSR for journeys with travel time less than 3 hours

![Graph showing the relationship between rail speed and market share.](source)

- About 80% of the passengers between Ahmedabad and Mumbai can be expected to shift to HSR

Based on these assumptions an alternate scenario was built to evaluate the impact of HSR along this corridor
The Ahmedabad-Mumbai corridor

TRAFFIC TRENDS WITH INTRODUCTION OF HSR

- After 15 year of operations likely shares of traffic on this corridor would be
  - 46% on HSR
  - 40% on roads (car: 24%, bus: 16%)
  - 4% on air and 10% on conventional rail
This scenario results in an annual average savings of about 3.5 PJ over a 15 year period.

By 2035-36, HSR services would carry about 46% of the total traffic by consuming only 16% of the energy.

Road transport would still continue to consume the largest share of energy.
The Ahmedabad-Mumbai corridor
EMISSIONS TRENDS WITH INTRODUCTION OF HSR

- A 10% reduction of emissions per annum over BAU
- Annual average emissions reduction of about 81,040 tCO₂ over a 15 year period
- Impact on emissions due to HSR is dampened due to heavy coal based energy generation – need to move towards non-fossil fuel energy sources
HOW DO THESE IMPACTS VARY ACROSS OTHER SECTIONS?
Traffic shares
VARIOUS SECTIONS in 2011-12

Mumbai-Pune: 6.41 BPKM
Chennai-Bangalore: 3.99 BPKM
Bangalore-Coimbatore: 1.35 BPKM
Coimbatore-Chennai: 4.57 BPKM
Changing shares of traffic

COMPARING DIFFERENT SECTIONS

Not many car users are expected to shift, mostly bus users.

Large shift from bus and conventional rail.

Bus shares could go down from the present 72 per cent to as low as 10 per cent.

HSR shares could grow to as high as 52 per cent on account of conventional railways.
Energy use patterns
COMPARING DIFFERENT SECTIONS

Energy requirements by different modes with HSR Mumbai-Pune (MJ)

Trend of energy use on different modes Bangalore-Chennai (HSR) (MJ)

Trend of energy use on different modes Bangalore-Coimbatore (HSR) (MJ)

Trend of energy use on different modes Chennai-Coimbatore (HSR) (MJ)
Emissions patterns
COMPARING DIFFERENT SECTIONS

Where large shifts are expected from conventional rail and buses, there is a decline in the emissions benefits of HSR.
1. High Speed Rail is one of the solutions to meet the rapidly increasing demands for mobility along these corridors.

2. It will also help in achieving energy savings - however the level of savings would depend on the nature of modal shifts.

3. Introduction of HSR may not result in decreased emissions in all cases.

4. Electricity generation from dirty fuels like coal could reduce the overall benefits of HSR - need to move to renewables.

5. The selection of HSR corridors should be done on a case by case basis after thoroughly understanding the traffic patterns along each section.
THANK YOU