



Low-carbon and climate-resilient transport infrastructure development Shomik Raj Mehndiratta **Practice Manager, Transport** 



**Climate change is a global challenge that threatens** sustainable development and puts at risk the prosperity and well-being of future generations.

As transport demand increases in the South Asia Region (SAR), due to population and economic growth, the need to provide sustainable and resilient transport services becomes more important than ever.

## The transport sector is the fastest growing in terms of energy consumption

- Urbanization in SAR is on the rise, resulting in a larger problem from urban transport emissions.
- The challenge will be to curb  $\bullet$ emissions, while continuing to grow GDP.
- By 2050, global freight transport CO<sub>2</sub>  $\bullet$ emissions are expected to surpass emissions from passenger vehicles. Trucking is the dominant mode for providing freight services in SAR contributing up to 57 percent of transport-induced GHG emissions in countries like India.

#### **Transport Emissions**



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# Disaster and climate risks are high in SAR, making infrastructure and communities particularly vulnerable

- Flooding, landslides, extreme heat and wildfires are the main risks to be addressed. In specific locations, measures and investments are also critical to increase the adaptive capacity vis-a-vis cyclones, tsunamis along coastal areas, and earthquakes.
- Rapid economic growth and urbanization are accelerating and magnifying the impact of climate change and of these natural disasters.

	Main disaster and climate risks										
	River flood	Urban flood	Coastal flood	Earth quake	Land slides	Volcano	Tsunami	Cyclone	Water scarcity	Extreme heat	Wild fire
Afghanistan											
Bangladesh											
Bhutan											
India											
Maldives											
Nepal											
Pakistan											
Sri Lanka											

Source: ThinkHazard - GFDRR/World Bank (thinkhazard.org)

Resilient infrastructure is not simply about roads or bridges or powerplants alone. It is about the people, the households and the communities for whom this quality infrastructure is a lifeline to better health, better education and better livelihoods -David Malpass, WBG President

# **Economic Loss**

It is estimated that the collective economy of six South Asian countries (Bangladesh, Bhutan, India, the Maldives, Nepal, and Sri Lanka) will lose 1.8 percent of its annual GDP due to climate change by 2050, rising to 8.8 percent by 2100.

# **Transport Infrastructure Loss**

Transport infrastructure incurs losses of US\$15 billion a year on average from natural hazards at the global level, with low- and middle- income countries shouldering about 60 percent of the total amount.



# 1.8%

# Compounding effects

A four-week disruption is, on average, 23 times costlier for households than a two-week disruption.



# **Vulnerable Populations**

Between 1990 and 2019, disasters affected 1.7 billion people and killed around 270,000 in SAR. The WB estimates that 800 million (or 44 %) people in South Asia today live in locations that are or will be moderate or severe climate hotspots by 2050 without action.

# **800Million people**

# 15Billion USD



#### Decarbonizing and climate proofing transport infrastructure against increased incidence of climate shocks produce the co-benefits of more reliable infrastructure with year-round access, cleaner air, green jobs, and reduced traffic congestion

There is thus growing awareness of the need for countries to (a) reduce GHG emissions, the primary cause of climate change, and (b) reduce vulnerabilities of transport systems and its beneficiaries, i.e., respond to the negative impacts of climate change.

The transport sector has thus developed a robust portfolio that tackles both mitigation and adaptation issues—two important elements of the global climate change agenda.

In the WB SAR Approved FY19 and FY 20 Portfolio:

- Mitigation accounted for US\$412Million and \$223Million in co-benefits, representing 24% and 13% of the portfolio respectively (mainly urban projects)
- Adaptation accounted for US\$435Million and \$724Million in co-benefits, representing 25% and 43% of the portfolio respectively (mainly road projects)

Avoid & Shift: Support the development of safe, efficient, and accessible public transport systems that leverage intermodal services and nonmotorized transport that prevent a shift toward private modes.

Avoid strategies aim to reduce the number of kilometers travelled though more efficient urban growth, compact cities, and TOD



*Improve:* Explore eMobility business models in order to support rollout as technology matures.

#### Improvement of Public Transport

Bus supply in India's cities is just a fraction of what they need. The urban travel market is being lost to competing modes. Bus systems have been ignored because attention is usually focused on capital expenditure while buses require a focus on operational sustainability. Currently, the frameworks, organization, traffic congestion, high costs and low fares all discourage investment in new buses. A structured program to support a major expansion of the national urban bus fleet would transform the sector, with great benefits for cities.



#### The Opportunity

#### A program with 150,000 urban bus would lead to

A fleet of 150,000 urban buses can deliver 86 million daily trips or 320 billion passenger kilometres per annum, at a cost lower by 63% than the alternative, **saving INR84,000 cr** per annum.

Over INR59,000 <u>cr</u> per annum in vehicle operating cost savings Postponed infrastructure upgrade (better use of road space) 4,700 million fewer litres of fuel consumed per annum

8,400 fewer lives lost in road accidents per annum

6.5 million tons of CO2 emission avoided per annum 8,900 tons of PM emission avoided per annum

INR105,000 cr in private investments in buses Over 780,000 jobs in the service industry

### **Chennai City Partnership**

• Provides a comprehensive approach to mitigation in the urban context.

This multi-sector project will:

- Focus on the issue of sustainable and integrated service delivery in the city
- Support policy, institutions, investments, and finance
- Place a special emphasis on "integrating" across sectors
- The project will cover urban mobility and spatial development; water and resilience; urban governance and finance, and aims to provide a comprehensive development agenda which tackles both the spatial growth elements of 'avoiding' trips, and improving public transport and NMT to encourage the use of these modes (shift).



### **Karachi Mobility Project**

- Aims to improve mobility, accessibility and safety along selected corridors in Karachi. The project will shift road users from polluting transport modes (e.g. old, poorly maintained buses and motorcycles) to lower carbon modes (e.g. cleaner BRT buses and nonmotorized transport) and ensure better traffic flow.
- The total gross Carbon Dioxide (CO2) emissions over the 20-year evaluation period without the Project are estimated at 2.02 million tons. In the with-Project scenario at 1.42 million tons, a net decrease of CO2 emissions of about 600,000 tons, or 30,000 tons per year.



## **Electric Mobility**

- The National Electric Mobility Mission Plan (NEMMP) 2020 is India's policy for promoting the manufacturing and adoption of EVs in India.
- In initial stages, new technologies need to be tested • through small scale pilots than bigger scale ones. This allows a fine tuning of policies, as well as the institutional build up required to integrate such technologies in the mobility ecosystem.

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- In India we see two wheelers and three wheelers • reaching parity and electric buses not far behind
- Once parity in terms of Total cost of ownership is • reached, scaling up requires access to large scale commercial financing. This is the 10 X to 100 X story [scaling up 10-100 times].

#### **Green Hydrogen**

The race to decarbonization is also requiring a broadening of options. While this decade is likely to be the decade of e-mobility, the surge of interest in hydrogen across countries is likely to lead to a strong role in next decade as a complementary solution. We see this in green states like Kerala, where the drop in green energy prices combined with innovation by KIPT on hydrogen fuel cell (the first hydrogen fuel cell car in India was tested in October

fleet and services.

Similarly, the **Program for Transformative** explore opportunities to investment in battery energy storage for both power system and e-mobility applications.



# In partnership with the IFC, the

supports the development of business models that allow for private participation of EV charging infrastructure, Shift: Focus rail and waterway development efforts on key development corridors.



**Avoid & Improve:** Regionally, focus on avoid-improve strategies for the freight sector through better, fuller trucks.

In the freight sector, avoid strategies refer to initiatives that look at reducing the number of empty trucking trips, while improve refers to upgraded vehicles, technology for more efficient deliveries and vehicle use, and fuel efficiency.

#### **Eastern Dedicated Freight Corridor**

- The Eastern Corridor is 1,840 km long and extends from Ludhiana to Kolkata. The World Bank is supporting the Eastern Dedicated Freight Corridor (EDFC) as a series of projects in which the three sections with a total route length of 1,146 km will be delivered sequentially, but with considerable overlap in their construction schedules.
- A Green House Gas Emission Analysis conducted by DFCCIL for the Eastern DFC Project shows that the Eastern corridor is expected to generate about 10.48 million tons of GHG emissions up to 2041-42, as against 23.29 million of GHG emissions in the absence of EDFC – a 55 percent reduction of GHG emissions.



### **Inland Water Transport Project**

- Assam Inland Water Transport Project: aims to (a) improve passenger ferry infrastructure and service in Assam, and (b) improve the institutional capacity and framework for inland water transport in Assam
- Bangladesh Regional Waterway Transport Project: supports Inland Water Transport (IWT) efficiency and safety for passengers and cargo along the Chittagong-Dhaka-Ashuganj Regional Corridor to enhance sector sustainability.
- Capacity Augmentation of the National Waterway: looks to enhance transport efficiency and reliability of National Waterway-1 and augment institutional capacity for the development and management of India's inland waterway transport system in an environmentally sustainable manner.



# 50,000 tons of CO2 equivalent in

Assam IWW

ons of CO2 equivalent in greenhouse gas emissions annually

### **Better, fuller trucks**

- While rail is significantly more carbon-efficient than trucks, the forecasts indicate that in an urbanizing world of increasing incomes, trucking growth will swamp any growth in rail.
- The trucking sector in the region is characterized by being highly fragmented, informal and inefficient. Medium size trucks (seven to ten-ton payloads) are most common in the region, given infrastructure limitations in many countries. Low rates, and the lack of strict inspections discourage the purchase of new trucks.
- If India had China's composition of fleet, the GHG emissions would reduce by 4% and costs would drop by 7%. Similarly, if India had a fleet age comparable to that of the US, GHG emissions would be reduced by 8%. Reducing backhauls would also reduce GHG emissions by 10% and costs by 12%



### Life cycle approach used to mitigate high disasters and climate risks in SAR PILLARS of Resilience



#### Systems Planning

Risks identification; transport development policy and planning addressing identified risks; shifting development away from disaster-prone areas when possible; consideration of integration and redundancy on critical infrastructure.



#### **Engineering and Design**

Improving design standards of transport infrastructure to maintain connectivity and reduce disaster risk; use of innovative materials and design specifications that enhance robustness and flexibility of infrastructure.



#### **Operations and Maintenance**

Developing asset management systems with mapping of transport assets, improving institutional and financial arrangements; integration of climate and disaster risks in the prioritization of infrastructure investments.



#### **Contingency Programming**

Developing policy frameworks, communication protocols, and investments in emergency preparedness and response; alignment of transport systems and flows with local and regional evacuation, and recovery needs.



#### Institutional Capacity and Coordination

Centralizing disaster risk information and data comprehensively; upstream planning of transport systems to reduce the hazard exposure; mitigation of institutional and regulatory challenges, which are cross-cutting in nature, to utilize the life cycle approach effectively.

# SYSTEMS PLANNING Regional Policy Initiatives

- New Climate Adaptation And Resilience For South Asia Project (CARE) aims to enhance regional cooperation to facilitate climate-resilient policy, planning and investments (in Nepal, Bangladesh and Pakistan) with inter alia the creation of a *regional resilience data and analytics service (RDAS)* platform and *decisionsupport systems (DSSs)* to generate, store, analyze and integrate climate specific data in planning stages.
- Coalition for Disaster Resilient Infrastructure (CDRI) is a multi-stakeholder global partnership launched by the India Prime Minister in 2019, which aims to address the challenges of *building resilience into infrastructure systems*. It supports in particular the preparation of National Risk & Resilience Assessments of Critical Infrastructure. WB support provided in India.



# SYSTEMS PLANNING **Risk and Economic Analyses**

- Strengthening Resilient Logistic Infrastructure Study in Bangladesh (GFDRR TF) expected to assess the bottlenecks and improvements required to enhance the resilience of the logistics sector and supply chains to natural disasters and extreme weather.
- Nepal Green and Resilient Transport Strategy for key highway corridors (QII TF):
  - Development of a *comprehensive* • environmental risk management framework with Cost-Benefit Analysis in the transport sector;
  - Preparation of *vulnerability assessments* on the strategic road network with new modeling tool to support decision making.



# **ENGINEERING AND DESIGN** *Roads and Bridges*

- \$500 Million Project to Mainstream Resilient and Green Technology for Highways in India (GNHCP) will promote best practices using local and marginal materials, industrial byproducts, and other environmental-friendly solutions for around 800 km of highways in 4 states. Bioengineering guidelines also developed in Nepal in 2018 for slope stabilization works on highway sections (NIRTTP).
- The India Pradhan Mantri Gram Sadak Yojana plan (PMGSY) supported a comprehensive approach to implement climate *resilient designs for rural roads* and pilot creative construction techniques.
- Nepal Bridges Improvement and Maintenance Program (BIMP-II) to upgrade quality of ~ 400 bridges on the Strategic Network with more seismic and multihazard resilient bridge design standards in particular in flood-prone mountainous areas, using *innovative designs including network arch bridges.*













# Resilient Measures





## **ENGINEERING AND DESIGN** *Railways and Waterways*

- Strengthening Climate Resilience of EDFC (GFDRR TF): 2019 study provided a large range of recommendations for improved climate resilience of rail network by adjusting design standards and embedding specific systems in the design for realtime monitoring of track temperatures for example.
- Assam Inland Water Transport Project (AIWTP) finances a cross-river passenger ferry system with resilient measures to cope with increased flooding:
  - Modular floating designs for ferry access points at terminals, modernization of vessels with higher power marine engines to safely navigate the higher velocity current during the flood season.
  - Contingency programming: better practice encouraged by developing and piloting a *river information system and emergency response system* with a new Search and Rescue Unit.



# **OPERATION AND MAINTENANCE**

#### DSS climate data to be integrated into

- existing Bangladesh Road Asset Management System (RAMS) for strategic and rural roads;
- existing Nepal Bridge Management System (BMS) used to prioritize SRN bridge new construction and maintenance works.
- RAMS for strategic roads under development in Nepal (SRCTIP) with integration of DSS climate data and from vulnerability assessment.
- BMS under development in Bangladesh (SupRB) with integration of DSS climate data.

# **CAPACITY BUILDING**

 Knowledge exchanges and training targeting public sector engineers and contractors to plan for, design, build resilient infrastructure.



# Nepal BMS

- + 🗌 Airport
- Road Network
- + 🗹 Strategic Road Network
- + District Road Core Network
- + 🗌 Village Road
- + 🗌 Urban Road

- BMS Map

- 🛨 🗹 Bridge 🛛 🖓
- 🕂 🗹 New Crossing 🛛 🖓
- + 🗹 Bridge monitoring



#### Financing strategies for resilient and green transport



#### Increasing financing needs

The G20 estimates that roads account for more than half of the \$15 trillion investment gap in infrastructure through 2040. While there might be an upfront incremental cost, a multi-year investment in more resilient and cost-efficient infrastructure is on the long term both profitable and crucial as disruptions, disasters and poor maintenance are extremely costly for governments, households and private sector. Cost-benefit analyses are critical to understand how climate policy (or inaction) may impact economic growth and fiscal sustainability.

#### Maximizing finance for resilient transport investments



Along with other measures, using fiscal and economic policy tools and increasing private sector participation must thus be promoted to adapt to climate change and repair damaged infrastructure after a disaster occurred to complement the routine/periodic maintenance costs. Financial protection strategies, including disaster reserve funds, disaster risk financing mechanisms and multi-year insurance programs should be considered. Piloting and scaling up such instruments in SAR – *ex: insurance policies to protect assets for which proper resilient design, construction and maintenance are pre-conditions for insurance payout and reflected into insurance premiums as an incentive* – with the support from the new Global Risk Financing Facility (GRiF) and the WB Disaster Risk Financing and Insurance Program (DRFIP) will help leverage more financing.



#### Unlocking new mechanisms to mitigation finance

While the needs are huge, transport has only been able to access only 4.5% of Clean Development Mechanisms and 12% of Clean Technology Funds. The structure of climate finance does not appear to work for transport. While GEF has provided strategic financing to capacity building opportunities, and GCF has provided support to specific projects; the long term, transformational agenda on mitigation requires additional support to the large agenda.

# Strategy Moving Forward

# Focus for our work

#### Mitigation

- Cities: Combining land, and multimodal transit, walking and cycling, and transport demand management policies
- Freight: Multimodal & Better Fuller Trucks

#### **Adaptation**

- Technologies: Promoting efficient systems for enhanced planning and maintenance (data systems utilizing satellite technology, emergency response systems, RAMS) & innovative, cost-effective and resilient techniques
- More agile coordination mechanisms in urban and coastal areas

# What's often missed

#### Mitigation

• Freight: In SAR, truck is and will continue to dominate the freight market, and with current market inefficiencies will drive a large share of the growth in emissions

#### **Adaptation**

- Network Level Thinking: Importance to increase the adaptive capacity of communities and businesses to withstand disasters through network level analysis, increased redundancy, and more systemic planning
- long-term resilience

# **Unlocking financing**

While we continue to work more and more in both mitigation and adaptation, our efforts are small compared to the combined joint effort needed to finance low-carbon and climate-resilient in the region

Climate smart strategic maintenance required to achieve





WorldBankSouthAsia

WorldBankSasia

worldbank.org/sar



# Impacts of COVID-19 pandemic

- This health crisis will create, at least in the short term, a particularly difficult environment with a need to push for more resilient, sustainable and climate-friendly solutions
- The crisis has affected transport services both from the demand and supply sides. Reliability and efficiency of transport networks and logistics services have significantly decreased. Public transport has rapidly become associated with the potential spread of the virus.
- It is critical that transport stakeholders find solutions to enhance the resilience of transport networks and reenergize the construction sector while considering adequate safety and hygiene measures to ensure that connectivity and transport services can be sustained in a resilient manner on critical links.



#### **Compact cities & Public Transport**

- Urbanization in SAR is on the rise. Due to its high use of public transportation options and NMT, many SAR cities account for relatively low emissions per capita. However, these sustainable rates of modal share are beginning to shift.
- History shows that, once a city is built, it is nearly impossible to change its spatial organization for decades or even centuries.
- Therefore, key to sustainable and efficient growth of cities should be first focus on providing safe, reliable, intermodal public transport, to stop the loss of mode share -and when possible for drivers to leave their cars behind and turn to public transit



# Low Carbon Pathways for Urban Mobility in India

 Model for 108 Indian cities with a population size of half a million+ to determine the impact of alternate government programs and policies y urban mobility and GHG emissions.

#### Lowest emissions result from:

- The investments are redeployed across a combination of modes rather than on a single mode;
- Investments are made beyond the Tier I & II cities, especially in Tier III cities;
- Policies can be initiated for arresting sprawl and catalyzing compact cities
- The new trends in favor of shared mobility can be channelized towards higher occupancy vehicles
- The electric mobility strategy for the country is conceived within the framework of the urban mobility strategy; and with a shift to a cleaner electric grid.



### **Intermodal Station Development**

#### Support:

- Encourage multimodal transport by facilitating transfers
- Reduce congestion: Better accessibility & improved facilities drive a shift from private modes
- City transformation: Integrated TOD & commercial development to create a hub of economic activity in cities

#### Through the:

Creation of a National Scheme and Frameworks for the evaluation, designing, development of IMS, paired with a sustainable financing facility can have a transformative effect in urban mobility in India



#### Building resilient transport infrastructure, systems and services in South Asia **CHARACTERISTICS of Resilience – The 4R's**





# **ENGINEERING AND DESIGN** *Roads and Bridges*

- The Afghanistan Rural Access Project (with CERC component) helped to identify locations where natural hazards threaten the all-seasonality of the road network, and to implement design strengthening and maintenance improvements to mitigate risks, in particular avalanches. Civil works financed included 33 emergency maintenance subprojects and 9 post-disaster road subprojects.
- First phase of the Sri Lanka Climate Resilience Multi-phase Programmatic
  Approach in collaboration with the urban team will build upon the results of the closing climate resilient project (roads and bridges rehabilitated / slope stabilization works completed / capacity building) by helping to reduce flood risks in the Kelani and Mundeni basins with reinforced road drainage and structures.

