Estimating Carbon Emissions from Highway Projects

Narendra Singru

Independent Evaluation Department

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Introduction

Rationale for Measuring Carbon Emissions:

- **ADB's Safeguards Policy Statement requires quantification of emissions linked to development and operations of its projects**
- **Need to develop a mechanism to monitor carbon emissions at project, portfolio, and corporate levels**
- **Developing member countries to identify their nationally appropriate mitigation actions (NAMAs)**

Development of Tools - Independent Evaluation Department's ongoing study on "Reducing Carbon Emissions from Transport Projects"

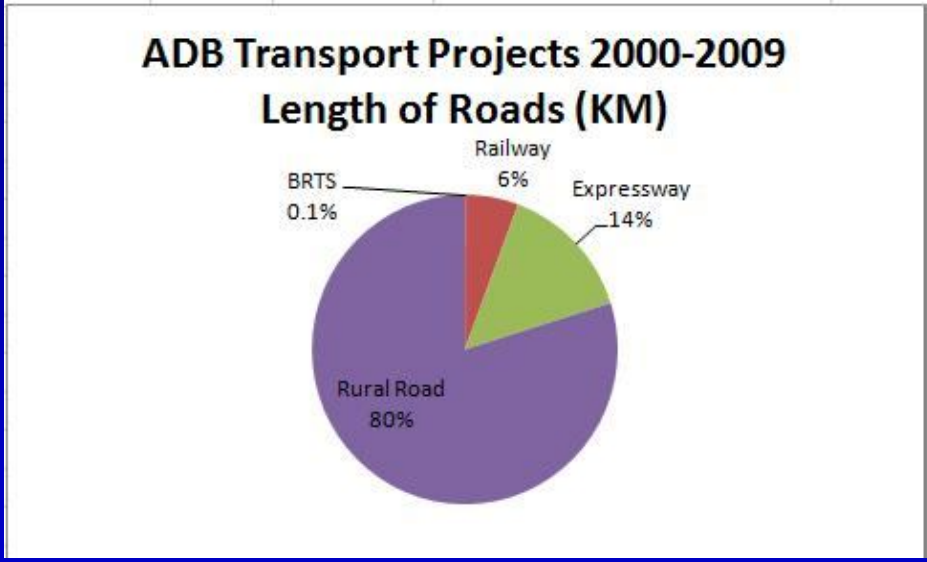
Consultant Team – Institute for Transportation & Development Policy; Clean Air Initiative for Asian Cities

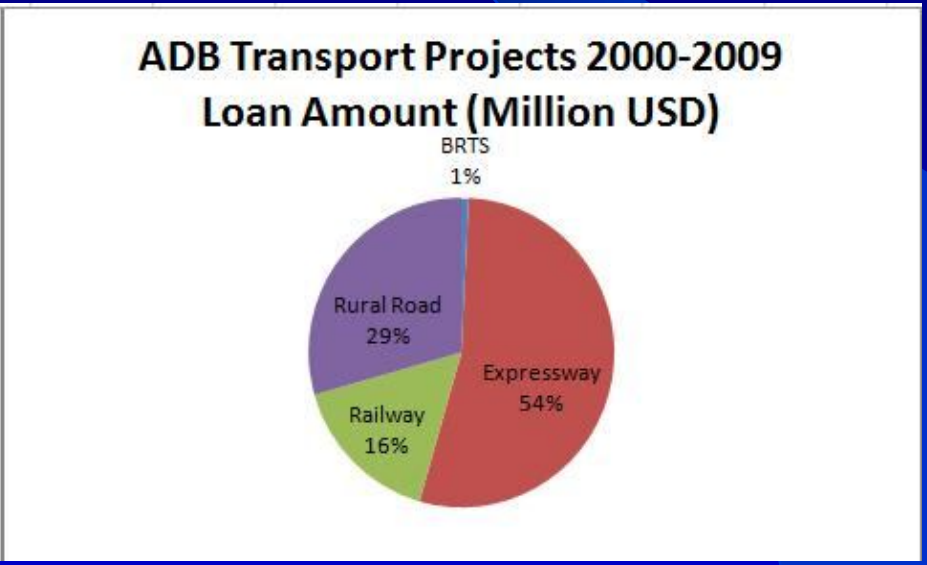
Draft Models Available on ADB Portal –

http://www.adb.org/evaluation/reports/ekb-carbon-emissions-transport.asp

ADB Transport Portfolio 2000-2009 Approvals

- ADB loans aggregate $19 billion approximately





Approach to Carbon Footprint Estimation

- Development of 7 carbon emissions analysis models – based on ASIF (activities, mode share, fuel intensity, fuel choice)
- Analysis of carbon footprint and intensity of savings (based on a business-as-usual [BAU] scenario)
- Intermodal analysis and comparison

Categorization for Roads Subsector:

(a) expressways are 4 lane inter-city dual carriageways costing more than $1 million per km;

(b) rural roads are 2 lane single carriageways to expand existing capacity in the non-urban context, costing between $0.5 million per km to $1 million per km;

(c) rehabilitated roads are an average of 1.5 lane single carriageways to improve pavement surface, costing less than $0.5 million per km

Business-as-Usual Scenario or No-Project

- Emissions are quantified under the assumption that no major improvement would have happened without the project
- Art. 12 of Kyoto Protocol – certification on the basis of reductions that are additional to any that would occur in the absence of the ….project activity.
- ADB's existing project appraisal including economic analysis uses the no-project scenario as counterfactual for VOCs and VOTs

Monitoring of Carbon Emissions for Road Projects

- Gross Emissions – tons per year; life cycle
- Output Indicator - CO_2 intensity per km of roads constructed
- Mobility Indicators - CO_2 intensity per ton-km (freight) and per passenger-km
- Investment Indicator - CO_2 intensity per $ million spent on road projects
- Comparison with BAU scenario for each of the above indicators

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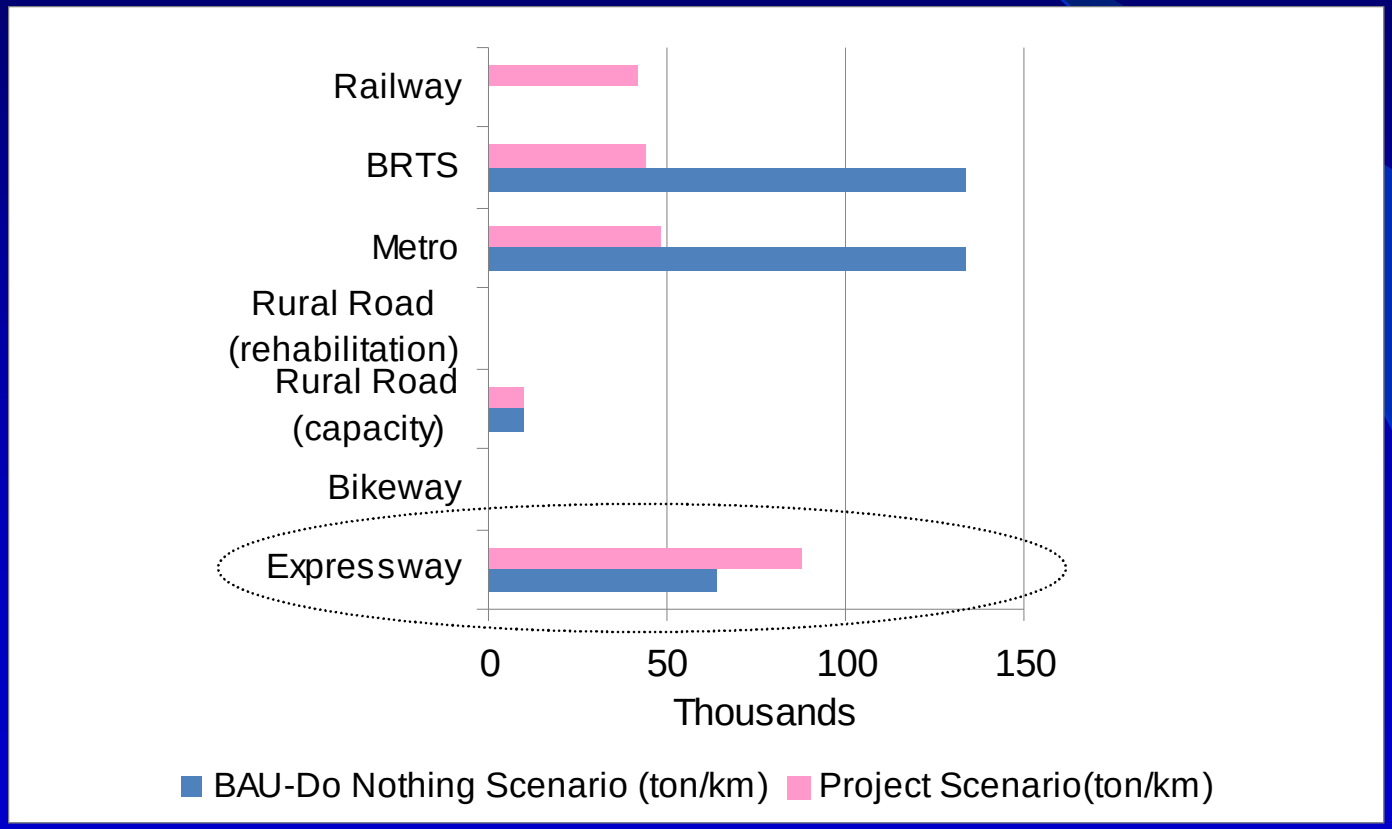
Impact of Expressways on Carbon Emissions - Tons per km Constructed



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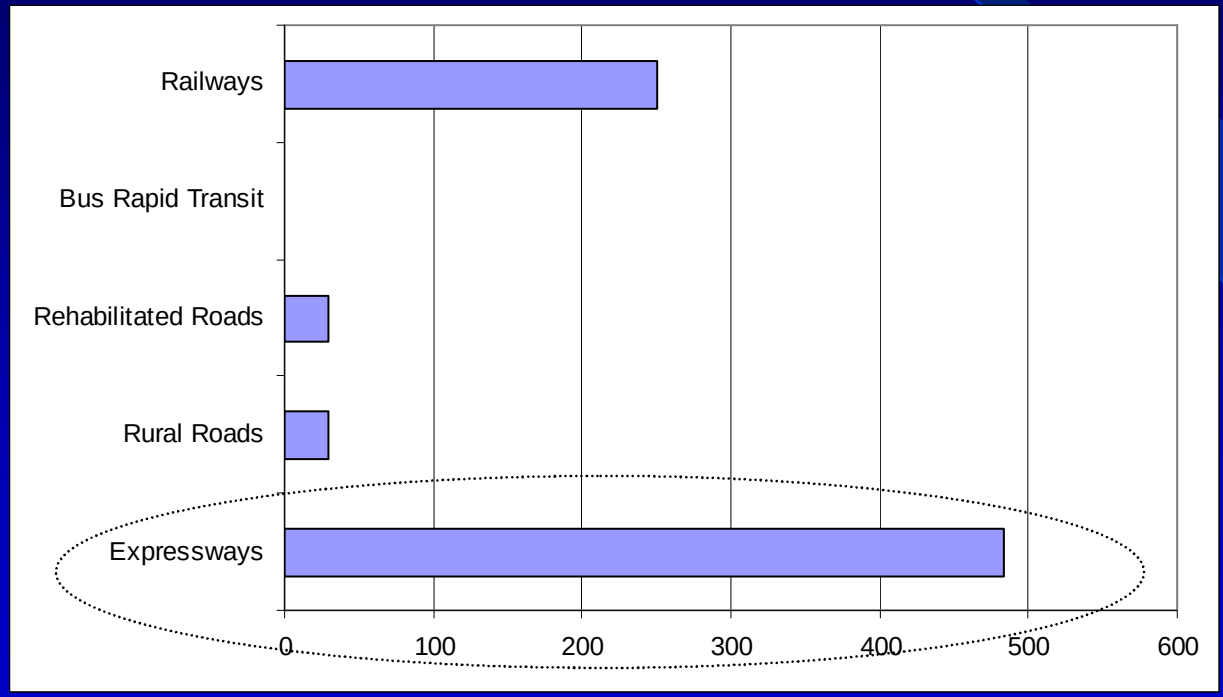
Carbon Footprint

Cumulative CO_2 Construction and Operations Emissions (Million Tons) of ADB-Funded Transport Projects during 2000–2009



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Sensitivity Analysis

Hypothetical Scenario

- If ADB's investment during 2000–2009 on expressways had been reduced by 20% with those funds spent instead building an additional 2,515 km of railway network, it would have reduced ADB's transport sector cumulative CO_2 footprint by approximately 5.7% from the actual emissions pattern
- When compared with a no improvement scenario, this alternative scenario would have reduced transport sector CO_2 emissions by 102 million tons over 20 years compared with BAU

This analysis assumes a 100% shift in traffic from expressways to railways, which could be difficult to achieve in real life

It is intended to bring out the potential impact of expressways/highways

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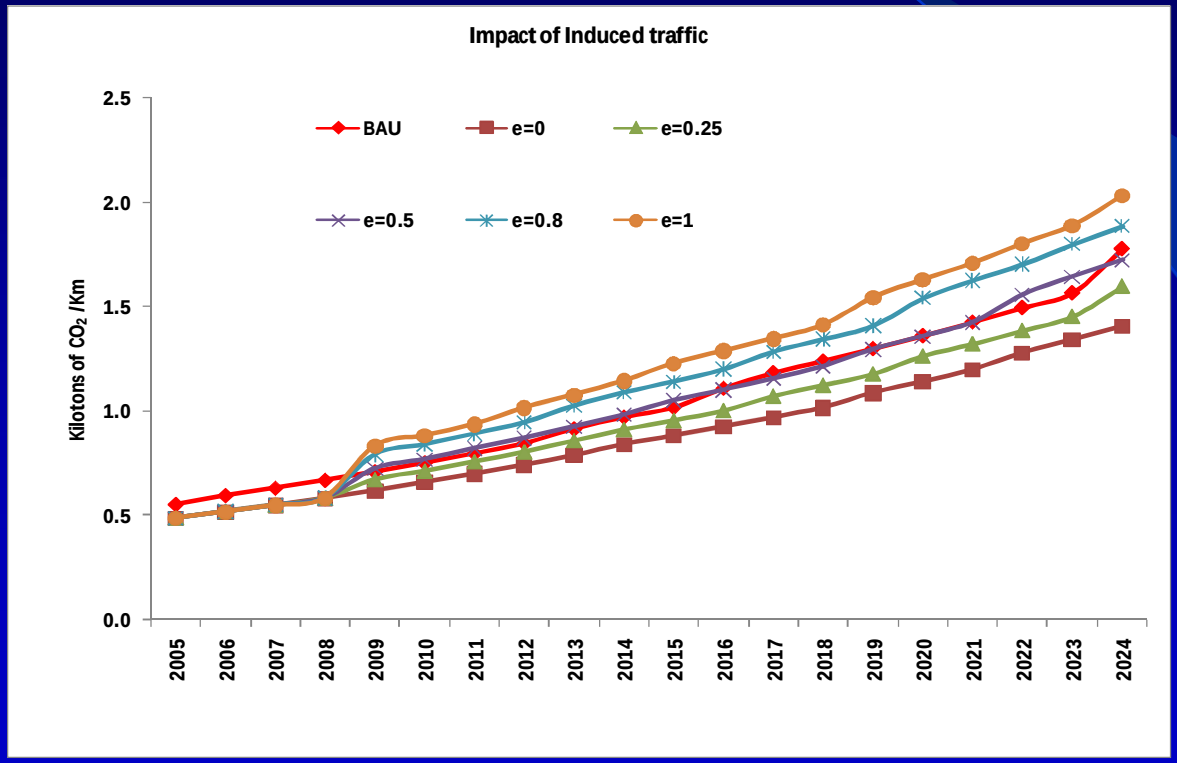
Impact of Induced Traffic

Impact on the CO_2 Emissions of a Road Rehabilitation Project
(Case - Almaty–Bishkek Regional Road Rehabilitation Project)



BAU = business-as-usual, CO_2 = carbon dioxide, km = kilometer, e = elasticity of traffic with regard to road capacity.

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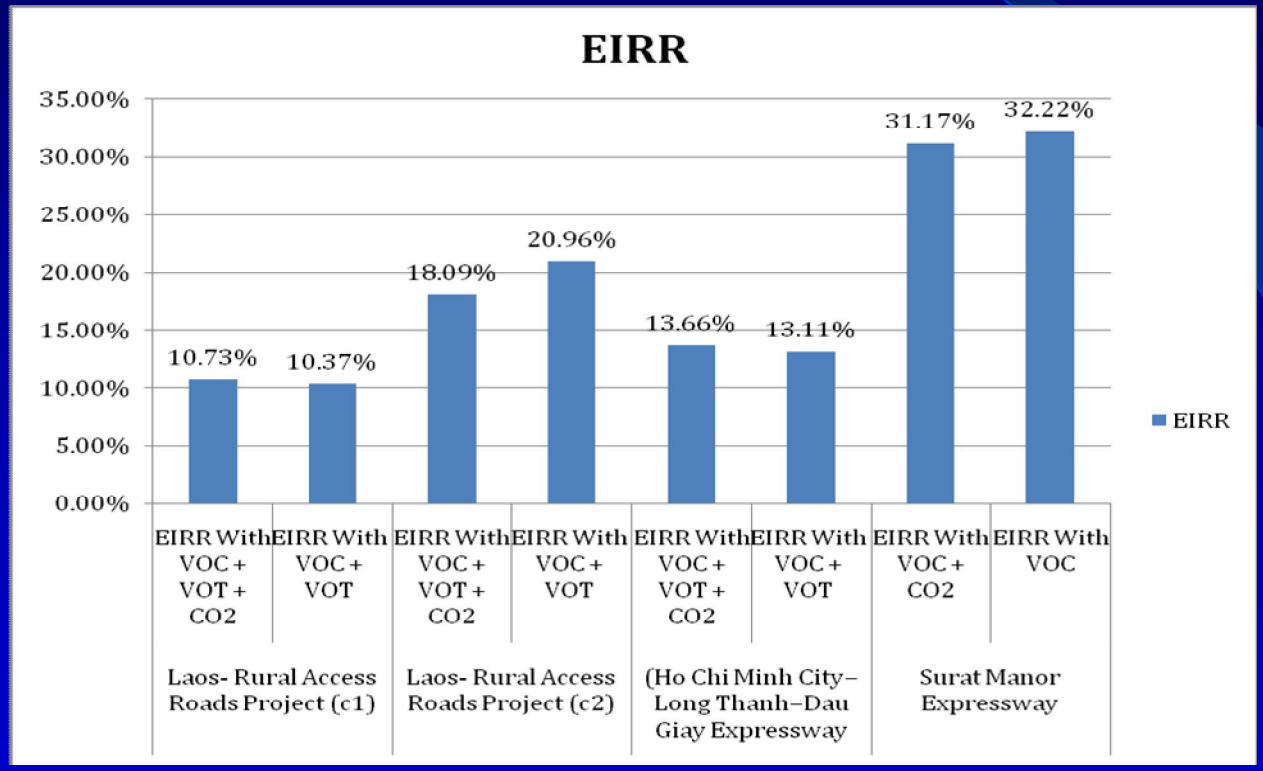
Key Findings

- Expressways tend to improve the efficiency of travel - emission rates per vehicle-km are lower for expressways
- But induced traffic leads to higher emissions per km as compared with other roads/modes
- Periodic road maintenance can significantly reduce carbon emissions
- Carbon intensity of road freight operations is more than that of rail freight
- Given the continued high rate of economic growth, we need (i) smart traffic management; and (b) integrated transport supply and demand management

Implications for ADB's Economic Analyses - Impact of CO_2 Emissions on EIRR



CO_2 = carbon dioxide, EIRR = economic internal rate of return, VOC = vehicle operating cost, VOT = value of time.

Data Requirements for Measuring Carbon Emissions from Road Projects

- Basic project data

For Construction Emissions

- Construction materials used - cement, steel, and bitumen

For Operations Emissions

- Traffic data – baseline traffic volumes, trip lengths, traffic composition, occupancy, induced traffic elasticity, fuel split of vehicles
- CO_2 emission intensity factor in kilogram per liter for different modes depending on gasoline and diesel fuel split
- Volume to capacity (V/C) saturation limit on the project road
- Upstream emission factor to account for fuel manufacture

Measurement of Air Pollution

- Input emission factors for Particulate Matter (g/km) and NOx (g/km)

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Issues for Discussion

- Use of carbon emissions in project appraisal – economic and environment assessments
- How can the BAU scenario be improved?
- Can the existing tools be further improved?

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- Given the continued economic growth, roads will remain a top priority among ADB's developing member countries. How can we do roads better?
- Counter-argument : economic growth can be 'decoupled' from road capacity enhancement

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For feedback or more information contact:

Narendra Singru

Independent Evaluation Department, ADB

nsingru@adb.org