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Co-benefits of low carbon passenger transport actions in Indian cities: Case study of Ahmedabad

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ABSTRACT

Rising population, income and urbanization are increasing urban passenger transport demand in India. Energy and emissions intensities associated with conventional transport are no longer sustainable vis-a-vis energy security, air quality and climate change. Cities are seeking transport roadmaps that jointly mitigate these risks. Roadmaps vary across cities, but approach to delineate actions is common: (i) 'representative vision' that articulates long-term goals, (ii) methods for comparative scenarios assessment, and (iii) quantification of co-benefits to prioritize actions. This paper illustrates application of quantitative modeling to assess development and environmental co-benefits for Ahmedabad city. The paper constructs two transport scenarios spanning till 2035. The bifurcating themes are: (i) Business-as-Usual (BAU) and Low Carbon Scenario (LCS). The quantitative assessment using Extended Snapshot (ExSS) Model shows that transport activity shall result in four-fold increase in energy demand under BAU from 2010 to 2035. Three key contributors to CO_2 mitigation under LCS in merit order are: (i) fuel switch, including decarbonized electricity, (ii) modal shift, and (iii) substitution of travel demand. Scenarios analysis shows that LCS improves energy security by reducing oil demand and also delivers air quality co-benefits – reducing 74% NOx and 83% $PM_{2.5}$ from the passenger transport sector compared to BAU in 2035. Finally, the paper argues that cities in developing countries can leverage carbon finance to develop sustainable and low carbon mobility plans that prevent adverse infrastructure and behavioral lock-ins and prompt low carbon development.

Introduction

The transport sector in India contributes 13% of India's GHG emissions (MoEF, 2010). Growing energy use from urban passenger transport is a concern for India which is experiencing increasing population growth, urbanization and rapid economic growth. In the business-as-usual scenario, this demand will be met by oil resulting in challenges of national energy security as well as local issues of air pollution and congestion. India is currently the fourth largest GHG emitter globally (Oliver et al., 2012) and mitigating emissions from energy use is a pressing concern. Urban areas contribute around 60% to the national economy (GoI, 2011a), and are responsible for a significant share of in transport demand and energy consumption.

Studies examining transport energy consumption and CO_2 emissions at the city level for India are limited. Existing studies for Indian cities have focused on social and environmental impacts of transport or assessment of urban transport policies or

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interventions at the city level (Sharma et al., 2014; Khanna et al., 2011; Pucher et al., 2007). To our knowledge, very few studies on long term analysis of sustainable and low carbon policies and options at a local level exist (Li, 2011; Munshi, 2013).

The objective of the paper was to develop a future low carbon mobility scenario for a city. This work is part of a larger study for the city including four sectors – Buildings, Transport, Industry and Power (IIMA, 2010). For the purpose of this paper, we focus on the passenger transport sector. Two scenarios are examined (i) Business-As-Usual (BAU) scenario and (ii) a Low Carbon Scenario (LCS). The scenarios span from 2010 to 2035. We use the Extended Snapshot (ExSS) modeling framework for Ahmedabad city (Gomi et al., 2010). We also attempt to calculate the resulting air quality co-benefits with respect to $PM_{2.5}$ and NOx emissions for the different scenarios.

Urban transport in Indian cities

India is experiencing multiple transitions – population growth, urbanization and increasing per capita incomes. Presently, 33% of India's population lives in urban areas. Four hundred million people will be added to India's cities between 2014 and 2050 taking the share of urban population to 50%. A significant portion of this population will be accommodated in cities with population over one million. By 2030, India will have seven megacities with populations over 10 million (UN, 2014). The growth in number and size of cities along with per capita incomes are expected to drive growth in vehicle ownership and urban passenger travel demand.

Travel demand in cities has been largely met by public transport and non-motorized transport in India (Pucher and Korattyswaroopam, 2004). However, public transport infrastructure has not kept pace with the increasing demand. As a result, the share of public transport and non-motorized transport is decreasing with a corresponding increase in the use of private transport modes. Inadequate infrastructure, population growth, urbanization and increase in incomes have resulted in a significant increase in vehicle ownership and travel demand. Between 1981 and 2007, the number of vehicles in India increased from 5.4 million vehicles to 99.6 million (MoEF, 2010). In 2011, India had over 140 million registered vehicles of which the combined share of two wheelers and four wheelers was 85% (GoI, 2014b).

This has also driven the demand for energy, which is largely met by oil. By 2018, India will surpass Japan as the third largest oil consuming country globally (IEA, 2014). Three quarters of India's oil demand is met through imports (GoI, 2011b) and this is expected to increase further. Greater motorization therefore exacerbates issue of national energy security.

Increase in motorization is leading to other externalities including rising emissions of greenhouse gases, local air pollution, congestion and noise. Between 1985 and 2005, CO_2 emissions from road transport in India grew at an average rate of 5.7% (Garg et al., 2006). Transport sector is increasingly becoming a major contributor to deteriorating air quality in cities. Despite several measures to address local air pollution, the rising trend of air pollution in the Indian cities remains a challenge. Overtime there is a shift in trend as levels of PM_{10} and NOx are increasing in a number of cities (Shukla et al., 2015). In an assessment by the Central Pollution Control Board for 164 cities, over 75% of the cities were found with high or critical levels of PM_{10} (CPCB, 2012) while more than half of the 164 cities had moderate to critical levels of NOx. Figs. 1 and 2 show ambient PM_{10} levels and NOx levels in 35 major cities in 2012 (CPCB, 2014).

Transport interventions and co-benefits

By 2025, 45% of India's population will live in 63 million plus cities (UN, 2014). Growing share of urban population in cities, increase in the size and number of cities and corresponding increase in income levels is expected to transform urban transport significantly in future. The pattern of growth of urban transport in future will have significant bearing on GHG emissions and local impacts including congestion and air pollution (Pathak et al., 2015). Meeting the global 2 °C temperature stabilization targets will require looking at urban transport since this is a growing source of emissions in Indian cities.

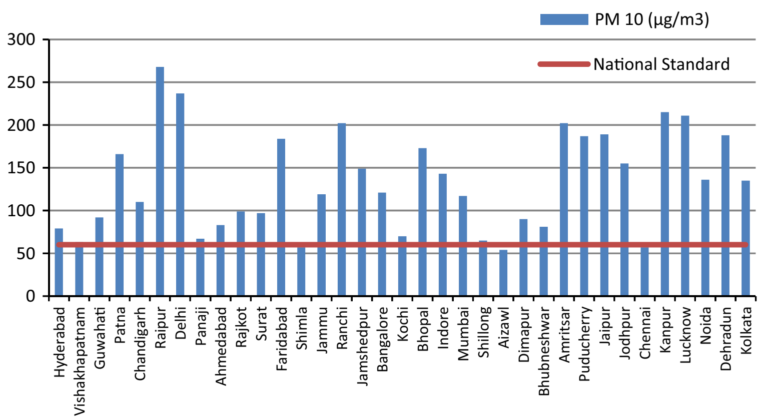

Fig. 1. PM_{10} levels in 35 major Indian cities (μg/m^3). *Source:* CPCB (2014)