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CASE STUDY

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Low Carbon Frameworks: Transport

DELHI PUBLIC TRANSPORT

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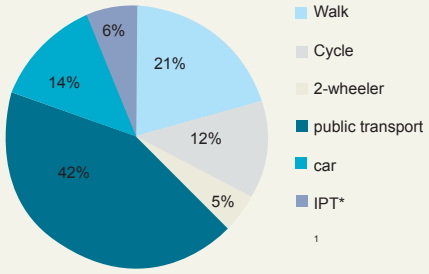
New Delhi is the capital of India and the nucleus of the larger metropolitan area of the National Capital Territory (NCT) of Delhi. NCT Delhi has seen rapid growth in population and economic activity in recent decades. The population stands at 16.8 million (Census of India, 2011). The city has extensive poverty, with as many as 50-60% of the population residing in low-income, poorly serviced, informal or “slum” areas (Tiwari, 2002).

INTRODUCTION

Delhi's urban development has suffered from inconsistent land use policies and poor implementation. The metropole displays highly mixed land use, reflecting its staggered and unplanned development (Tiwari, 2003). Past policies of forcible eviction (continuing into the 2000s) moved poorer residents from central slums to outlying areas or ejected them from the city altogether, whilst uncontrolled development has given rise to a profusion of unofficial residential areas without municipal services (Census of India, 2011; Tiwari, 2003). Peripheral development has increased the urban area of Delhi several-fold in the last few decades, with corresponding increases in average travel time (Badami, 2005). Average trip length is 10.2 km, among the highest in India (Ministry of Urban Development, 2008).



Indicative transport mode share in delhi (ministry of urban development, 2008)

Sources show some disagreement on the split between different transport modes, but indicative values from a recent publication are given in Figure 1. This overview hides considerable variation, however. Notably, the share of walking and cycling is much greater among lower-income households, whilst the use of cars is largely restricted to those with higher incomes (Tiwari, 2001).

Transport planning and expenditure has historically placed disproportionate emphasis on improvements for private motorised vehicles (Tiwari, 2001; DUEIIP, 2001; Govt. of NCT Delhi, 2002; Govt. of NCT Delhi, 2008). Economic growth and rising incomes have increased the demand for mobility which, in the context of these planning priorities, has encouraged a shift from non-motorised and public transport to private motor vehicles. Traffic congestion has increased and average motorised vehicle speeds have declined (Badami, 2005; Tiwari, 2002; Tiwari, 2001), whilst pollution and road fatalities have not been adequately reduced (Govt. of NCT Delhi, 2008; Singh, 2005). Despite extensive existing roadways and significant government investment in their expansion, Delhi has been unable to accommodate the growth in private vehicles on its roads.

However, the socio-economic realities of the city create large numbers of "captive" users of buses, bicycles and walking, despite the low priority afforded to these modes of transport (Tiwari, 2011). Private and city-operated bus services account for the greatest share of transport in Delhi (Tiwari, 2003), but these services are often sub-standard, with poor coordination, inefficient routing, no priority rights of way, poor safety, discomfort and insufficient coverage (DUEIIP, 2001; Bhatia, 2009).

This case study examines two major initiatives to improve Delhi's transport system: the Delhi Metro Rail system and the introduction of a bus rapid transit (BRT) system. It also considers the important role of bicycles and walking in the city.

1. Intermediate public transport' refers to semi-private public transport forms. In the context of Delhi, this is mainly represented by rickshaw taxis (bicycle and motorised).

METRO RAIL SYSTEM

Description

The possible development of a mass transit system in Delhi was first investigated in the 1960s (Randhawa, 2012), but construction of the metro rail system only began in 1998 (Siemiatycki, 2006). The Delhi Metro Rail (DMR) opened in December 2002 with an 8.3 km rail line (Tiwari, 2003), and has since been extended to 190 km with the completion of Phase II in 2011 (DMRC, 2011). Construction of Phase III is now underway, to add a further 103 km (DMRC, 2011). The metro incorporates underground, at-ground and elevated sections.

The DMR provides a high-specification service, operating between 6:00 and 23:00 with waiting times of between 3 and 12 minutes, depending on the line and time of day (DMRC, 2010a). The system features electronic ticketing, air-conditioned and sound-proofed coaches, and integration with other transport systems, particularly through the establishment of feeder bus routes (Govt. of NCT Delhi, 2008; DMRC, 2011; DMRC, 2010b). Average ridership in 2009-10 was 1.26 million / day (DMRC, 2011).

The DMR has received a great deal of positive media coverage and has received good reviews from its passengers (Siemiatycki, 2006; DMRC, 2011). It is widely cited as an urban transport success story (Jagran Post, 2012; Financial Express, 2011; USAID, 2003). The project is not without its critics, however, who raise concerns regarding the system's true public cost, its equitability in terms of transport provision and land development influences, and its true climate impacts (see below).

Implementation and enablers

The Delhi Metro Rail Corporation (DMRC) was established to build and operate the system, with equal shareholding by the Government of India and the Government of NCT Delhi (Randhawa, 2012). Financing was obtained primarily through international loans (64%), with the balance from equity contributions and loan arrangements with the participating government bodies. A small percentage was to be raised through the development and leasing of government properties provided to DMRC on long-term leases at nominal rents (Randhawa, 2012; Siemiatycki, 2006).

The financial contribution of property development is a noteworthy characteristic of the project and possibly represents an example of value-capture, in which infrastructural developments capture some of the increased property values generated by them (UNEP / GEF, 2011). This appears to have been extremely successful at generating revenue for DMRC, although it is unclear what proportion of this value was generated by the metro as opposed to representing a subsidy through property transfer. In their 2006-7 financial year, DMRC's real estate earnings made up 46% of

total earnings, more than fare-box income, although this has dropped to below 10% since 2009-10 (Tiwari and Goel, 2011; DMRC, 2011). Property-related income thus provided significant support to development costs and still makes up a strong contribution to total revenue (DMRC, 2011; Randhawa, 2012), allowing the DMRC to claim it needs no subsidies. DMRC also benefits from a variety of other financial advantages, including very low-interest loans, extensive exemptions from taxation and low electricity pricing (Tiwari and Goel, 2011; Jain, 2008; Randhawa, 2012). Given this, the DMRC has achieved an operating profit (DMRC, 2011).

Challenges and barriers

Ridership expectations have not been achieved by the DMR, although these continue to grow. Record ridership has only recently exceeded 2 million passengers per day for the entire system, a level that had initially been projected for the 65 km Phase I lines alone (Govt. of NCT Delhi, 2008).

The DMRC has been criticised for an excessive rate of injury and death among construction workers, and for having inadequate mechanisms for ensuring accountability for workers' safety (Azad, 2009).

Effect on emissions of greenhouse gases

DMR received Clean Development Mechanism (CDM) credits of 529,043 tonnes CO_2e per year for transport emissions avoided through its implementation (UNFCCC, 2012). However, this has been critised as not reflective of the true systemic responses to the system, which also include life-cycle emissions of constructing the metro system and rebound effects such a people staying further from work (Randhawa, 2012; Mohan, 2008).

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Other environmental and socio-economic effects

Introduction of the metro has not been accompanied by any reduction in local air pollution (CSE India, Undated).

Randhawa (2012) questions the equity advantages of the metro, arguing that its development has pursued a "gentrification" agenda for the city, displacing and disenfranchising the urban poor through its effects on property and rental prices, slum evictions during construction, disproportionate routing through middle class and commercial areas, and inequitable fare structures. Metro fares are higher than bus fares and do not provide any concessions for less able groups (students, pensioners, etc.), only offering reduced rates for those using smart cards with minimum recharge limits.

There is evidence that the development of the metro has, however, increased cycle rickshaw rentals in the vicinity of stations, generating employment for the poor, often migrant, rickshaw drivers (Kurosaki, 2012).

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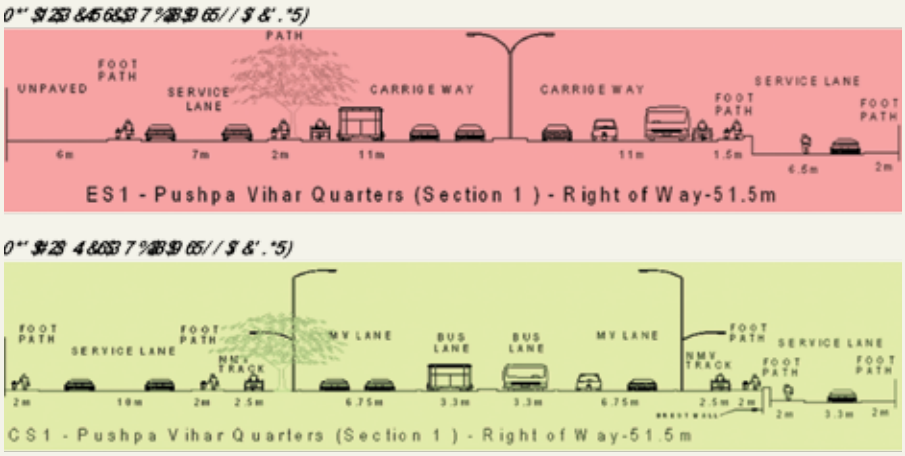
BRT SYSTEM

Description

The Delhi bus rapid transit (BRT) system, managed by the government-owned Delhi Integrated Multi-modal Transport System (DIMTS), opened along a 5.6 km initial corridor in 2008 (DIMTS, 2008; Hidalgo and Pai, 2009). The corridor was designed with segregated single bus lanes running in each direction in the middle of the corridor, with stops located close to intersections, two lanes of mixed traffic on either side, and pedestrian and bicycle ways on the outside (Hidalgo and Pai, 2009), as depicted in Figure 2. The bus route shows peak flows of 120 buses/hour and 6,500 passengers/hour per direction (Hidalgo and Pai, 2009). Prior to the introduction of the BRT system, the absence of segregation in the roadway led to bicycle and motor vehicle occupation of the left-hand lane, frequently forcing buses to drive and stop in the middle lane and essentially creating three lanes of mixed traffic in either direction (Badami, 2005).



BRT corridor design (DIMTS, undated a)

Implementation and enablers

Following studies undertaken in the 1990s that recommended segregated bus lanes, the Government of NCT Delhi established the Delhi Integrated Multi-Modal Transit System Ltd (DIMTS), in a joint venture with the Infrastructure Development Finance Company, and appointed it to oversee the establishment of a BRT system in Delhi. The Indian Institute of Technology Delhi (IIT Delhi) and RITES, a state-owned consultancy, were tasked with design and implementation of the first corridor (DIMTS, undated a; DIMTS, undated b; Hidalgo and Pai, 2009). DIMTS was also tasked with operational and maintenance management along the initial 5.8 km corridor (DIMTS, undated b). The corridor follows an open operation model, however, with Delhi Transport Corporation (DTC) buses, private operators and others (e.g. school buses) making use of the route (Hidalgo and Pai, 2009). The bus operations are therefore financially separate from the infrastructural management, and include buses of the state-owned and subsidised DTC (Tiwari and Goel, 2011).

Challenges and barriers

The BRT project experienced a number of difficulties, including:

- Public resistance to the increased congestion in the remaining two general traffic lanes
- A high number of bus breakdowns, with resulting delays
- Encroachment of private vehicles into bus lanes
- Inadequately informed users
- Pedestrians mingling with vehicular traffic when coming and going from the stations

Media coverage of the BRT was highly negative, focussing on the aggravated congestion experienced by private vehicle users and sensationalising fatal accidents in the corridor (Singh, 2008; Singh, 2010; Roy, 2008; EMBARQ, undated; Hidalgo and Pai, 2009). This reaction occurred despite the minority share of private vehicles in the total corridor traffic (33% of people), and the absence of any identifiable increase in accident rates (Hidalgo and Pai, 2009). Political opposition has criticised the government for the BRT system, and political commitment to the project appears to have faltered (The Hindu, 2012;w Matur and Shukla, 2008; Delhi Greens, 2012). A recent court challenge has led to a High Court order requiring that private vehicles be permitted to use the lanes on a trial basis (Nair, 2012), a move that could conceivably lead to the end of the BRT system.

The DTC, which provides subsidised services along the BRT route as well as along unsegregated routes throughout the city, enjoys few of the advantages that have been provided to the Delhi Metro Rail Corporation, although both entities are state-owned providers of public transport services (Tiwari and Goel, 2011).

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Effect on emissions of greenhouse gases

No assessments of greenhouse gas emissions or emission reductions were found in the open literature, perhaps due to the limited level of project implementation to date.

Other environmental and socio-economic effects

Public approval ratings were high among bus users (88%) and pedestrians and cyclists (85%). Overall travel times in the corridor were reduced by 19%, balancing a 14% increase in private vehicle travel time with a 35% reduction for the more numerous bus users (Hidalgo and Pai, 2009).

BICYCLES AND PEDESTRIANS

It is noteworthy that non-motorised transport in Delhi continues to play an important role in mobility despite the fact that it has been consistently disregarded in transport planning and infrastructure spending (Tiwari, 2002; Govt. of NCT Delhi, 2008), and despite the particularly high accident risks faced by these users. The persistence of these modes could be indicative of captive users, who cannot afford alternative modes (Tiwari, 2011). Bicycle mode share has nevertheless been declining (Badami, 2005; Ministry of Urban Development, 2008), although total numbers have been buoyed by rising population (Tiwari, 2003). This shift away from bicycle transport would be expected of captive users in times of increasing economic wealth and greater accessibility of cheap vehicles, such as motorised two-wheelers (Badami, 2005).

REFLECTIONS FOR SOUTH AFRICA

The following reflections on the Delhi case study are offered, which are relevant to South Africa:

Expanding the capacity of road infrastructure for private vehicles does not reduce congestion: The Delhi experience suggests that, even with substantial financial investments, the marginal traffic mitigation achieved by roadway expansion can be quickly offset by induced traffic, especially where such expansions result in the neglect of other transport modes.

Implementation of mass transit systems requires strong political commitment: The large investments and development time-frames require political commitment at the highest level and extensive, effective public engagement.

The transport system is subject to tensions and pressures of the broader social-political environment: Interpreting the opposition to the BRT is challenging. However, the brief review presented here suggests that the opinions of the (wealthier) motorists were able to politically outweigh those of the majority of BRT corridor users. In light of the claim that the metro favours the interests of wealthier citizens, the positive media coverage of the metro system's implementation might be another manifestation of this disproportionate influence of wealthier classes.

Potential for cycling and walking: Even the inhabitants of very large cities can gain mobility through non-motorised modes, and these can provide particular benefit to the very poor. However, this might require mixed-use urban development to limit travel distances. Moreover, poorer people who walk and cycle as the most affordable options available to them may shift to motorised vehicles as their income increases, unless transport planning has provided for non-motorised modes which match the convenience, accessibility and experience of private vehicles.

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Case Study: Delhi Public Transport

This is one in a series of case studies produced by WWF South Africa's Low-Carbon Frameworks programme that explores the shift to a low-carbon economy. We seek solutions for emitting fewer greenhouse gas emissions and enabling a flourishing South Africa, which delivers developmental outcomes and social equity.

The programme includes a focus on transport. WWF's transport project aims to provide a platform, expertise and interactive modelling to support labour, business and government in engaging with the challenges implicit in the low-carbon transition. Choices about trade-offs, sequencing of initiatives, and investment will need to be made in setting emission targets for and within the sector, and in determining how to achieve them, while yielding a flourishing economy with equity and developmental benefits. Interventions will need to reduce movement of goods and people; shift to low-carbon modes of transport, from private to public, from road to rail; or improve energy and fuel efficiency. The project builds on previous work on a carbon budget approach to a low-carbon action plan for South Africa, and is grounded in existing initiatives in the transport sector.

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