

Chapter 13. The Transport Sector⁸²

Overview of Greenhouse Gas Emissions from the Transport Sector

265. The transport sector is an important source of greenhouse gas emissions worldwide; however, in South Asia, its contribution to CO₂, the main GHG, has been low relative to other regions of the world. During the period of 2000-2004, the transport sector only accounted for 10 percent of the region's total CO₂ emissions while in the rest of the world it contributed to about 20 percent of total CO₂ emissions⁸³. Given the region's significant population and economic size, this share implies carbon emitted from transport use per person and per unit of economic output is particularly low (Table 13.1). Between 1990 and 2005, the rate of growth of transport CO₂ emissions was the second lowest in the developing world (2.1 percent), after the former Soviet Union. While many of the developing regions have experienced an increase in transport CO₂-emissions in recent years, South Asia has managed to become even less transport-CO₂ intensive (Table 13.2).

Table 13.1 Per Capita and Per Unit of GDP Transport CO₂ Emissions by Region and by South Asian Country, 2005

Region/Country	Per capita CO ₂ emissions (kilograms of CO ₂)	CO ₂ emissions per US\$ of GDP ^a (grams of CO ₂)
World	985	116
OECD North America	4,846	162
OECD Pacific	2,142	84
OECD Europe	1,839	81
Africa	203	88
Latin America	723	102
Middle East	1,502	207
Non-OECD Europe	834	106
Former USSR	980	133
Asia (excluding China)	196	57
China (including Hong Kong)	257	42
<i>South Asia</i>	<i>94</i>	<i>33</i>
Bangladesh	31	17
India	89	29
Nepal	31	22
Pakistan	170	81
Sri Lanka	279	68

Source: International Energy Agency.

a. In 2005 US dollars.

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⁸³ World Resources Institute Climate Analysis Indicators Tool (CAIT) (<http://www.wri.org/project/cait>).

266. **There is some variation in the level of emissions among South Asian countries, with Pakistan and Sri Lanka being the most transport CO₂-intensive.** The average Sri Lankan emits nearly 300 percent more CO₂ from transport than an average person living elsewhere in the region. In Pakistan, producing a given amount of economic output requires more than twice the amount of CO₂ emissions from transport than the region's average. On the other hand, at 6.9 percent, Bangladesh experienced the largest rate of growth in transport CO₂ emissions between 2000 and 2005 (Table 13.2).

267. **When examined in the context of the high levels of economic growth the region has been experiencing, the low intensification rate of transport CO₂ emissions in South Asia as a whole is remarkable.** The economy of the region grew at an impressive 5.3 percent per year between 2000 and 2005, a rate of growth that is second only to that of China (7.5 percent per year). However, while China's rate of CO₂ emissions from transport kept pace with economic growth (growing by 7.3 percent per year), that of South Asia grew at a paltry annual rate of 1.3 percent. This difference may reflect, to some degree, the nature of the respective economic engines fueling the growth in South Asia, and in India in particular, which represents nearly 83 percent of the region's economy. India's economic growth is powered by non-transport-intensive sectors, particularly information technology, biotechnology, and research and development, while China's is driven largely by manufacturing and production of goods for export.

Table 13.2 Growth Rate of Transport CO₂ Emissions by Region and by South Asian Country (1990–2005); (2000–2005)

Region/country	Annual growth rate of transport CO ₂ emissions (%)	
	1990–2005	2000–2005
World	2.22	2.1
OECD North America	1.58	1.4
OECD Pacific	2.39	0.2
OECD Europe	1.58	0.9
Africa	3.59	3.8
Latin America	3.11	1.7
Middle East	4.45	5.6
Non-OECD Europe	1.97	5.7
Former USSR	-0.67	1.9
Asia (excluding China)	4.38	3.2
China (including Hong Kong)	6.46	7.4
<i>South Asia</i>	<i>2.12</i>	<i>1.3</i>
Bangladesh	6.86	6.9
India	1.43	1.2
Nepal	8.20	1.4
Pakistan	4.52	1.0
Sri Lanka	5.85	0.6

Source: International Energy Agency.

Factors Underlying South Asia's Transport Carbon Emissions

268. **The relatively low-carbon intensity of the transport sector reflects unique features of South Asia's urbanization and economy, including its low urbanization rates, low urban and rural mobility rates, and the labor-intensive nature of economic production.** Only about 28 percent of the population resides in the cities of South Asia; of this, 35 percent live in cities with populations less than 100,000 (Toutain and Gopiprasad 2006). Per capita trip rates, even in urban areas, are low. Labor rather than capital and energy remain the dominant input in production. Additionally, high fuel prices in the region may be having a price effect in restraining the transport-related greenhouse gas emissions from the region, but this effect is likely to be small. Rather, it is more likely that wage rates function as the primary constraint in South Asia. For example, the ratio of fuel price to per capita income in India is among the highest in the world – it is six times as high as in China, and over 55 times as high as the OECD average (Muralikrishna 2007).⁸⁴

269. **More specifically, the total amount of CO₂ produced by the transport sector generally depends upon three main factors:** (i) the amount and nature of the demand for vehicular travel; (ii) the energy intensity of the vehicles used to meet that demand; and (iii) the life-cycle carbon content (LCC) of the system used to generate and deliver that energy.⁸⁵ Public policy, intentional or otherwise, can influence many of these factors in significant ways. This section briefly examines these factors in the South Asian context.

Demand for Vehicular Travel

270. **Vehicular travel demand is best understood by subsector: urban passenger travel, interurban passenger travel, and freight transport.** In urban areas, the magnitude and nature of demand for vehicular travel is influenced by the size of the urban population, mobility rates, amount of time people are willing to spend traveling, prevailing speeds on existing transport networks, proportion of desired trips that are walkable, the costs of vehicle movement and storage, and the viability of public transport or non-motorized modes of transport.

271. **In South Asia, the mobility rates, travel speeds, and motorization are low.** According to RITES (1998), there are about 0.51 motorized trips per person in India. Prevailing travel speeds are low, as is the tolerance for long travel times. Gakenheimer and Zegras (2003) report typical speeds for urban buses of 6 to 10 kilometers per hour in many large cities. In city centers, average speeds during peak hours reach 5 to 15 kilometers per hour. The vast availability of the public transport system and low real wages also undermined the practicality of private motorized use. The high level of crowding in urban centers leads as well to a significant number of trips without the use of motorized vehicles. In general, the more centralized the population, the more feasible are walking trips.

⁸⁴ India's and Pakistan's gasoline prices in 2007 (US\$1.01 per liter) were about 15 percent higher than the world average (US\$0.88 per liter).

⁸⁵ This decomposition is a minor modification of the one proposed by Schipper and Marie-Lilieu 1999 as the "ASIF identity".

272. **The motorization rate, while currently low, is expected to rise dramatically in the future.** India's rate of car ownership in 2000 was just 10 vehicles per 1,000 persons, compared to a worldwide average of about 113 vehicles per 1000 persons (WBCSD 2003). Even including two-wheelers, vehicle ownership, although higher than the rates for either Africa or China, is still substantially lower than the worldwide average (WBCSD 2003). Forecasts however suggest a meteoric rise in vehicle ownership. Ownership of light-duty vehicles (cars and light trucks) is predicted to increase by 5.7 to 10 percent (WBCSD 2003; WEO 2007), resulting in car ownership of between 56 million and 115 million in 2030. Including two-wheelers, total vehicle stock under the WEO projection in 2030 at 295 million will overtake that of the United States. These figures predate the announcement of Tata Motors of the distribution of an affordable mini car model known as the "Nano". This likely increase in vehicle penetration, even above those predicted in these early studies, will raise the trajectory of future CO₂ emissions.

273. **Interurban travel tends to be a relatively important source of overall travel demand.** Thus, it is an important submarket for consideration in any strategy aimed at heading off a growth in greenhouse gas emissions from the transport sector as a whole. Intercity passenger transport occurs mostly via bus and rail (99 percent in 2006), and it constitutes a relatively important source of overall travel demand. Based on reported figures from Indian Railways and the domestic airline industry, there were 6.8 billion intercity passenger trips in India in 2006/2007.

274. **Even though air travel mode shares are quite low, the potential growth of this market is of particular concern for CO₂ emissions over the long run.** An analysis of Indian Railways' fuel consumption shows a CO₂ emissions factor of about 9.6 grams of CO₂ per passenger-kilometer in 2006, or about 1 kilogram of CO₂ per passenger trip.⁸⁶ By contrast, CO₂ emissions per passenger-kilometer from air transport in the United States in 2006 were 136 grams.⁸⁷ (India-specific aviation emissions factors were not available for the present report). Assuming these emissions factors are reasonably applicable in India, each air trip that could occur by rail instead of by air would reduce CO₂ emissions by a factor of 14.

275. **While the drivers of freight transport demand may indicate the success of other desirable economic or social development policies (such as improved rural accessibility), effective policies to mitigate CO₂ emissions can focus on improving modal competitiveness.** For example, in India, the government is investing in two dedicated, high-speed freight rail corridors to improve rail freight competitiveness, reduce costs, and increase reliability.

Energy Intensity of Vehicles

276. **Energy intensity of the vehicle fleet is largely determined by four factors, each of which can be influenced by public policy.** These factors are: (i) the energy efficiency of newly acquired vehicles entering the fleet; (ii) the maintenance practices employed to minimize energy intensity of vehicles over their lifetimes; (iii) the profile of

⁸⁶ Key author's calculations from data provided on Indian Railways website (http://www.indianrailways.gov.in/deptts/stat-eco/Stat_index-06_07.htm).

⁸⁷ Key author's calculations from National Transportation Statistics (Bureau of Transportation Statistics).

vehicle utilization – which vehicles tend to be used for which purposes, how intensively, and for how long; and (iv) the nature of traffic conditions on the roadways where vehicles are most predominantly used. Regretfully there are too few data on any of these factors in the region to attempt drawing definite conclusions.

277. **Based on available comparable data on energy intensity,⁸⁸ the extensive use of two-wheeler vehicles seems to produce the effect that energy consumption per vehicle-kilometer driven in South Asia is the lowest in the world.** Fuel economy results from in-use fleet sampling showed that the vehicles in Pune, India, are less energy intensive compared to those in Mexico City, Shanghai, and Los Angeles (Table 13.3). This apparent efficiency does not reflect a fundamental technological difference among the regions; rather, it is reflective of the type of vehicle used for travel. About 66 percent of vehicle-kilometers traveled in Pune occurred on two-wheelers, while only 20 percent and 2 percent occurred on two-wheelers in Shanghai and Mexico City, respectively. Passenger cars accounted for 71 percent and 95 percent of vehicle-kilometers traveled in Shanghai and Mexico City, respectively, compared with only 14 percent in Pune.

Table 13.3 CO₂ Emissions Intensity (Grams per Vehicle-Kilometer) in Four Cities

Type of vehicle	Pune	Los Angeles	Mexico	Shanghai
Two-wheeler	44	—	67	71
Three-wheeler	71	—	—	—
Bus	1,288	—	800	1,013
Passenger car	353	—	377	413
Delivery truck	876	—	—	803
All vehicles	125	249	387	400

Source: Key author's calculations from output of International Vehicle Emissions Model (University of California at Riverside College of Engineering Center for Environmental Research and Technology, based on databases compiled by University of California Riverside research team in 2004).

— Not available.

278. The data available on fuel efficiency for new vehicles does not lend itself to international comparisons because of methodological differences. It is known, however, that fuel economy standards (or CO₂ emissions standards) for new vehicles have not yet been adopted by any country in South Asia. They are however under active consideration in India.⁸⁹

279. **While vehicle maintenance is a critical factor in the fuel efficiency of the in-use fleet,⁹⁰ the extent to which such maintenance practices are carried out in South**

⁸⁸ These data may not be a representative sample for the region, but are probably the best evidence available regarding fleet energy intensity.

⁸⁹ The effort is being led by the Petroleum Conservation Research Association (PCRA), but the time frame for development of such standards is unclear.

⁹⁰ A recent study carried out by the Automobile Research Association of India in the Indian vehicle fleet revealed that maintenance seems to improve fuel economy between 2 and 19 percent, depending on the type and model year of the vehicle (Marathe and Chaudhari 2007).

Asia is unknown, and more research is needed. The factors that affect fuel economy that are most often cited include keeping tires adequately inflated and aligned, checking and replacing air filters regularly, changing oil and oil filters regularly, keeping the engine lubed, and avoiding aggressive driving practices, particularly heavy accelerations and breaking. Given the high ratio of fuel prices to per capita income cited earlier, however, it would be expected that such practices are widespread. There are also few data available regarding the profile of vehicle use in South Asia. Specifically, the usage patterns of older vehicles relative to newer vehicles as the vehicle fleet is expanded, and the amount of annual kilometrage older vehicles perform relative to newer vehicles, are of interest.

280. **Finally, the behavior of traffic streams in which vehicles operate also determines the overall fuel intensity of the vehicle fleet.** As is well known, South Asian cities are characterized by high traffic congestion and lower-than-average road conditions, both of which negatively affect fuel intensity. In rural areas, paved roads are more the exception than the rule. Fuel economy is linked both to average speeds and to the relative proportion of acceleration to steady-state driving over a given distance. The more variable the travel speed, the higher the fuel consumption, all else equal. While fuel intensity and CO₂ emissions are lower at higher speeds, simply adopting a policy of facilitating higher-speed travel would induce mode switching and potentially additional trip making as well, thus rendering walking and cycling dangerous; this induced travel could substantially offset any fuel intensity improvements from improved traffic conditions.

Fuel Carbon Content

281. **In the near term, utilization of bio-fuels, particularly ethanol and biodiesel, holds the most promise for affecting life-cycle carbon content of fuels used in the sector.** One set of estimates of emissions factors for Indian production techniques is shown in Table 11.4. The emission factors suggest that a 5 percent ethanol blend into gasoline would reduce CO₂ emissions by about 3 percent, and a 20 percent biodiesel blend would reduce CO₂ emissions by about 11 percent. Current levels of ethanol production in India would be sufficient to cover the needs in the domestic market to achieve the 5 percent ethanol blend proposition (the need has been estimated at only 700 million liters while average output per year is 1.9 billion liters).⁹¹

282. **Whereas India has become one of the world's largest ethanol producers, its production capacity for biodiesel is yet to be developed.** Acknowledging this need, the government of India has pursued an ambitious National Biodiesel Mission since 2003. The objective of this mission is to supply 20 percent of national diesel demand with domestically produced biodiesel, primarily from *Jatropha*. As a desert-blooming plant, *Jatropha* is particularly attractive in that it does not compete with food products, and it can be cultivated on heretofore marginal land. Based on a demonstration phase begun in 2003, it was estimated that production costs of *Jatropha*-based biodiesel would be about US\$0.47 per liter (Gonsalves 2006), though this may have been based on optimistic

⁹¹ This output is almost entirely produced from molasses, a by-product of sugar production; if crop sugar itself were used directly in ethanol production, annual output is estimated to be about 2.3 billion liters (Gonsalves 2006).

assumptions about production costs of *Jatropha* seed oil (Mohan and Kumar 2005). Under a policy established in 2007, state-owned distribution firms are required to purchase biodiesel at a fixed price of about US\$0.68 per liter, but even that seems to be below current production viability (Kukrika 2008).

Table 13.4 Estimates of Life-Cycle Carbon Emissions from Select Conventional Fuels and Biofuels

Fuel	Life-cycle carbon emissions factor (grams/kilometer)
Conventional gasoline	230
Conventional diesel	145
Ethanol (molasses derivative)	75
Biodiesel (<i>Jatropha</i> derivative)	65

Source: Gonsalves 2006.

Future Challenges

283. **While the transport sector has been a relatively small contributor to South Asia’s CO₂ emissions compared to other regions, the rapid pace of urbanization and likely acceleration of motorization trends present a threat to mitigation efforts in the future.** Urbanization, while low compared to other regions, is proceeding at a fast pace, and the mobility demanded by new urban populations serving the new information economy in rapidly transforming cities such as Bangalore, Hyderabad, and Mumbai is indicative of the looming challenge to future mitigation. India has already undertaken substantial steps to respond to the transport demands of urbanization through technological transformation of vehicle fleets in many of its cities, adoption of the National Urban Transport Strategy, propagation of a funding mechanism through the Jawaharlal Nehru National Urban Renewal Mission,⁹² preparation of a nationwide demonstration Sustainable Urban Transport Program, and development of ambitious bio-fuel goals. The motorization in the region has long been predicted and is well documented.

284. **Current policy measures and initiatives, while well-commended, may not be sufficient to address the impending increase in transport carbon emissions.** Whether the various initiatives and measures being put in place by national and local governments will be sufficient to keep transport CO₂ emissions restrained in the future is an open question. The demand for vehicular travel was forecast to be high even before the announcement of plans to build and market small, low-cost cars in India. Even more

⁹² Under this program, the national government provides 35 percent of infrastructure investment funds to cities over 4 million people; 50 percent of such funds to cities over 1 million people; and 80 percent of such funds to certain enumerated cities under 1 million people. In all cases, the cities must undertake certain reforms, develop a city development plan if it does not already have one, and finance the remainder of the investment with a combination of state, city, or outside resources (such as development finance).

aggressive measures than those already under way may not be effective in maintaining low transport emissions if motorization rates accelerate precipitously as a result. The focus would need to be on the energy efficiency of the fleet and integrated planning measures.

285. Integrated urban transport planning will be key to achieving sizable mitigation in the transport sector. According to a study carried out by the World Resources Institute's Embarq Center in cooperation with the World Bank during 2007, a policy scenario that emphasized both developing integrated public transport systems – including bus rapid transit and harmonizing transport and land use development – and engaging in rather aggressive transport demand management strategies was found to lead to the lowest level of CO₂ emissions growth through 2030, compared with market-based energy efficiency initiatives and a standards-driven clean two- and three-wheeler scenario. In the integrated urban transport scenario, total transport-related CO₂ emissions were still projected to increase by a factor of nearly 5 (i.e., 39 percent less than the business-as-usual scenario), and per capita transport-related CO₂ emissions by a factor of 3.4, but these increases were the lowest of the scenarios (Box 13.1). The implication is clear. For the short term policies that target fuel efficiency are vital. For the long term integrated transport systems that include bus rapid transport, land-use policies and aggressive demand side management will be needed to curb the growth of transport related emissions. Ultimately new technology will be required to render clean energy transport carriers more economic.

Box 13.1 Scenario Assessment of Future Growth for the Transport Sector in India and the Impact of Nano Distribution on GHG Emissions

The study, carried out by Embarq and the World Bank in 2007, defined four scenarios for potential development and growth of the transport sector. They were the following:

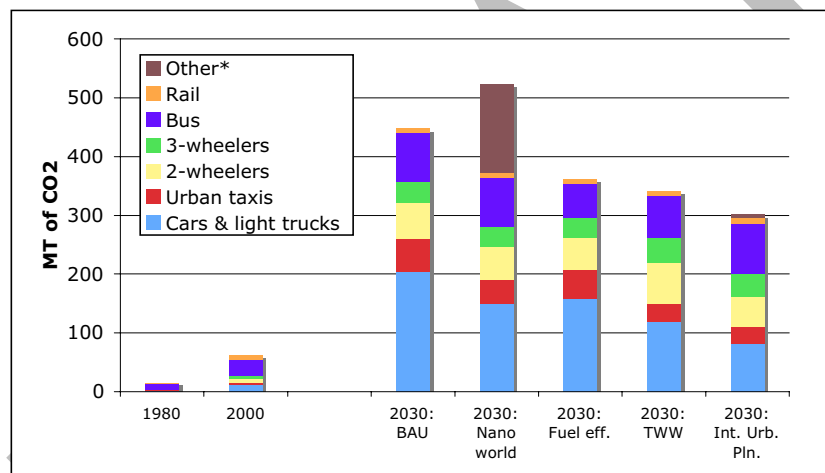
- i. **A baseline scenario (“business-as-usual” or BAU)**, whereby projections of GDP are used to forecast projections of vehicle ownership; vehicle ownership rates at different levels of GDP are assumed to be the same as those observed in the Republic of Korea over the past two decades; two-wheelers ownership rates continue at the same trajectory; and infrastructure (or lack thereof) is not considered a constraint on this level of ownership.
- ii. **An energy efficiency scenario (EF)**, whereby “higher fuel prices and taxes drive consumers to both smaller and more efficient cars”. Those taxes are assumed to be the rates that presently characterize Japanese policy. These prices drive not only choice of cars but also the extent to which they are driven.
- iii. **A clean two- and three-wheeler scenario (“two-wheeler world” or TWW)**, in which Indian policy focuses on developing very clean two-wheelers in recognition of the enormous difficulties in transforming its infrastructure to one that accommodates the large growth in passenger cars assumed under the baseline scenario. Under this scenario, use of public transport grows marginally faster than in the base case, and growth in car ownership grows slower than in the base case.
- iv. **An integrated urban transport planning approach**, in which cities focus on developing integrated public transport systems, including bus rapid transit, coordination with land use development, and engagement in rather aggressive transport demand management strategies.

In response to the announcement of the production of the Nano by Tata Motors, and a competitor by the Renault-Nissan-Bajaj consortium, an additional scenario, “**Nano world**”, was added to the repertoire.

Tata Motors announced in February of 2008 that it would begin producing and selling a mini-car branded as the “Nano” for the South Asian market. This car would sell for Rs. 100,000—about US \$2,500—per vehicle, making it the least expensive car on the market. Its price point would make it about half as expensive as its nearest competitor, Suzuki’s Maruti 800, currently the top selling car in the Indian market. It has already set the stage for a price war and marketing war in the Indian car market. Renault-Nissan recently announced a partnership with Bajaj to produce a competitor to the Nano—the “ULC”.

The halving of the cost of owning a car will have huge implications on India’s, South Asia’s—and, indeed, the world’s—climate change footprint in the coming years. In fact, the penetration of the Nano into the South Asian vehicle market could swamp the combined effects of any of the measures discussed in this chapter, notwithstanding the relative high fuel economy of the Nano. Indeed, that fuel economy, anticipated to be 22 kilometers per liter (city) and 26 (highway), would presumably be offset somewhat by additional driving that would not have occurred were people driving lower fuel-economy cars.

Forecast of Modal CO₂ Emissions for Adjusted WRI’s Embarq-World Bank India Scenarios



Source: Schipper et al. 2007.

* “Other” refers to small, low-cost car use in the Nano world scenario, and bus rapid transport use in the integrated urban planning scenario.

Opportunities for World Bank Engagement

286. **The World Bank should advocate a multipronged approach**, as summarized in Table 13.5, but its comparative advantage probably lies in providing substantive support for the kinds of policies envisioned in the integrated urban transport planning scenario described earlier. Specifically, its comparative advantage, through technical and financial support, probably fits most squarely with the following types of measures:

- **Support for public transport enhancement and integration.** Public transport must be seen as a viable alternative for different segments of the population,

particularly those who might otherwise use cars or two-wheelers. To engage in such support, the overall emphasis should be on network connectivity and integration; the types of measures that are specifically needed will depend on local circumstances. The World Bank's resources should be used to provide unbiased advice regarding the best way to enhance public transport as a *network* – as opposed to the development of individual services – for a given amount of resources. The Sustainable Urban Transport Project in India, supported by the Global Environment Facility, is an early example of this type of support.⁹³

- **Support for more aggressive transport demand management.** While often politically unpopular, aggressive transport demand management will increasingly be a necessity to grapple with the kinds of challenges South Asian cities will face over the next several decades. Transport demand management measures include strategic use of parking charges and parking management rules to discourage use of private vehicles for commuting to work or school; control of traffic flow in such a way as to prioritize high-occupancy vehicles, particularly public transport; employing congestion charges for particular facilities or in dense traffic zones to keep traffic flowing without inducing additional travel; and vehicle pricing regimes that are oriented toward use rather than fixed periods of ownership, such as pay-as-you-drive vehicle insurance, or annual registration fees linked to recorded kilometrage of vehicles. Because these kinds of measures affect public allocation of road space, they create “winners and losers”, but the latter tend to be more vocal and strident in expressing their opinions to policy makers. The Bank might be able to take better advantage of opportunities for one-time compensation through the use of DPLs and other instruments. Voluntary policies that target fuel efficiency could provide the first stepping stone to pave the way for more robust measures.

- **Improved support and priority placed on long-range urban planning,** particularly integration of land use planning, facility siting, and transport network developments. The Bank would emphasize that the trajectories of vehicle usage patterns, and resulting CO₂ emissions, are set at the time of urbanization, and that subsequent opportunities to reduce CO₂ emissions resulting from such patterns are limited. Engaging such an agenda would mean closer cooperation between the transport and urban sectors than has been World Bank practice in the past, as well as incorporating new areas of focus for each.⁹⁴

- **Improved due diligence** in ensuring that climate change impact assessment be integrated across a range of projects in which the World Bank and its client

⁹³ The total GEF grant proposed for the project is US\$25 million, which will be complemented with a grant of US\$150 million from the government of India, state governments, and implementing agencies, along with a US\$200 million investment loan from the World Bank, implemented over a four-year period, starting from 2009. The project's objectives are (i) to strengthen capacity of the national government, as well as participating states and cities, in planning, financing, operating, and managing sustainable urban transport systems; and (ii) to assist states and cities in preparing and implementing demonstration “green transport” or “GEF-supportable transport” projects (GT projects).

⁹⁴ As was expressed recently in a Brown Bag roundtable on this subject, this emphasis probably means that staff of both the urban and transport sectors will need to leave their “comfort zones”.

countries are involved, not simply those that target climate change. Such an emphasis has implications for both Bank work and the way it interacts with clients, as follows:

- Upstream strategic evaluation to be given greater priority than downstream, project-by-project evaluations (e.g. alternatives analysis more important than feasibility studies, strategic environmental assessment more important than environmental impact studies, etc.)
- Greater attention to be paid to secondary and cumulative impacts in both environmental and economic analyses of a range of projects, including health, education, urban, social development, and transport projects.

287. **The World Bank should also strengthen its institutional position in the region, beyond the role of simply financing and providing technical assistance to particular projects.** First, it will need to develop the dexterity to not only engage countries on issues related to the demand for vehicular travel, the energy intensity of vehicle fleets, and the fuels available for use in the transport sector, as outlined in this report, but also to understand the best way to engage with governments and other institutions on each of these issues. The Bank should also be prepared to provide expertise and policy clarity to countries throughout the region, not only India. This would involve identifying the resources to allow more concerted engagement in ongoing processes, such as the Clean Air Initiative for Asian Cities, or for organizing events to help disseminate best practice. It will need to engage counterparts at national and sub-national levels, particularly in cities, given that motorization and policies will have their loci primarily at the city level. Again, the GEF Sustainable Urban Transport Project could provide a model for the type of engagement necessary.

Table 13.5 Viable Short- and Medium-Term Policies to Reduce CO₂eq Emissions from Transport in South Asia

	Reduce the demand for vehicular travel	Reduce the energy intensity of the vehicles used	Reduce the life-cycle carbon intensity of the energy sources
<i>Transport sector as a whole</i>	•CO ₂ emissions tax		
	•Transport sector participation in a cap-and-trade regime		
	<ul style="list-style-type: none"> •Shift the lifetime costs of vehicle ownership from time- to use-basis as much as possible •Invest in viable public transport networks, and ensure that they are competitive with private vehicles in terms of frequencies, travel time, and cost (e.g. bus rapid transit, metro, rail, where appropriate) 	<ul style="list-style-type: none"> •Fuel economy or CO₂ emissions standards for vehicles entering fleet beginning with voluntary standards •Develop scrappage programs to target older and inefficient vehicles, and tie these programs into labor market development programs whereby former owners have alternatives to simply buying another vehicle •"Feebates" and other incentive mechanisms to encourage purchase of fuel-efficient cars (such as hybrids) without further incentivizing motorization 	<ul style="list-style-type: none"> •More extensive production and use of biofuels (e.g. <i>Jatropha</i>-based biodiesel, sugar, or woody-biomass-based ethanol)
<i>Urban passenger transport</i>	<ul style="list-style-type: none"> •Coordinate land use with public transport networks by focusing development on corridors and at nodes, and mixing primary land uses where possible; coordinate and think more strategically about facility siting and land use change relative to transport networks; use value capture of the one to help finance the other •Encourage cycling and walking by creating favorable conditions for both. This means focusing on facilities, motorist behavior, and public attitudes •Use network, parking, and vehicle pricing to incentivize travel in vehicles with higher occupancy (i.e. transport demand management) •Where and when appropriate, limit access to key activity centers of city by private vehicles 	<ul style="list-style-type: none"> •Develop production and distribution capability for low-sulfur diesel, so that diesel with advanced exhaust aftertreatment is a viable alternative to compressed natural gas (CNG) •Accelerate transition from 2-stroke to 4-stroke vehicles 	

	Reduce the demand for vehicular travel	Reduce the energy intensity of the vehicles used	Reduce the life-cycle carbon intensity of the energy sources
<i>Non-urban passenger transport</i>	<ul style="list-style-type: none"> •Limit growth of short- and medium- distance air travel by identifying key intercity corridors and developing strategies to strengthen ground transport connections •Consider pricing noncommercial facility use in such a manner as to discourage noncommercial intercity vehicle-kilometers of travel (VKT) growth 		
<i>Freight transport</i>	<ul style="list-style-type: none"> •Multimodal integration •Create logistics management incentives to reduce truck vehicle-kilometers traveled 	<ul style="list-style-type: none"> •Develop and implement fleet maintenance programs •Disseminate best practices on aerodynamic loading and vehicle operations, and incentivize their adoption (e.g. USEPA SmartWay) •Expand rail services through strategic, commodity-targeting-led investments 	<ul style="list-style-type: none"> •Rail electrification where appropriate

Source: Based on Darido 2008.