Promoting Global Environmental Priorities in the Urban Transport Sector

Experience from World Bank Group—Global Environment Facility Projects

Global Environment Operations
Environment Department
The World Bank

Promoting Global Environmental Priorities in the Urban Transport Sector

Experience from World Bank Group—Global Environment Facility Projects

Global Environment Operations
Environment Department
The World Bank

Printed in the United States of America

This paper was prepared by Rama Chandra Reddy and Sarath Guttikunda, Environment Department, World Bank. It has benefited from review and comments by Sameer Akbar, Steve Gorman, Chandrasekar Govindarajalu, Todd Johnson, Juan Lopez-Silva, and Samuel Wedderburn who was the task manager for the study. Thanks to Esther Monier-Illouz for assistance with editing and processing.

Contents

Abbreviations and acronyms … vii

1 Introduction … 1

2 Issues in urban transport … 3

Environmental priorities in urban transport … 3

World Bank Group priorities in the urban transport sector … 7

Interventions implemented under GEF OP 11 urban transport projects … 10

3 World Bank Group experience in implementing the GEF OP 11 priorities … 13

World Bank Group implementation of transport projects under GEF OP 11 … 13

Monitoring and evaluation of urban transport projects … 16

4 Opportunities for enhancing the environmental impacts of urban transport projects … 17

Freight and long-distance transport … 17

Transport demand management … 18

Market-based mechanisms to reduce emissions … 18

Private sector participation in transport management … 19

Land use planning and modal integration … 19

Transport information systems … 19

References … 21

Boxes

1 Priorities under GEF Operational Program 11 … 3

2 Promoting sustainable transport and better air quality in Santiago … 14

3 A multicity demonstration program for transport in China … 15

4 Decontamination bonds in Santiago … 18

Figures

1 Relationship between poverty reduction, urban transport, improved air quality, and reductions in greenhouse gas (GHG) emissions … 4
2 Burden of disease from urban air pollution by developing region … 6
3 Air quality management model highlighting management options … 7

Tables

1 Greenhouse gas (GHG) emissions of selected transport systems … 5
2 World Bank Group–implemented projects under GEF Operational Program 11 … 9
3 Bus rapid transit interventions and outcome indicators … 10
4 Percentage change in pollutants and road space usage when buses replace other vehicles in the urban transport system … 11

Abbreviations and acronyms

BRT	Bus rapid transit
CAS	Country assistance strategy
CDM	Clean Development Mechanism
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CONAMA	Comisión Nacional del Medio Ambiente
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas
HC	Hydrocarbon
IBRD	International Bank for Reconstruction and Development
IFC	International Finance Corporation
NMT	Nonmotorized transport
N_2O	Nitrous oxide
NO_x	Nitrogen oxides
OP	[GEF] Operational Program
PM_{10}	Particulate matter of size 10 microns or smaller in aerodynamic diameter
$PM_{2.5}$	Particulate matter of size 2.5 microns or smaller in aerodynamic diameter
SO_2	Sulfur dioxide
SO_x	Sulfur oxides

All dollar amounts are U.S. dollars unless otherwise indicated.

1. Introduction

Transport is a key infrastructure sector that acts as a stimulus to economic growth and is an important element of strategies for poverty reduction, regional and national development, and the environmental objective of limiting greenhouse gas (GHG) emissions. Growing energy use by the transport sector is increasingly contributing to climate change and degrading local air quality in developing country cities. The sector already accounts for a large proportion of public investment, and passenger and freight transport is expected to grow 1.5 to 2.0 times faster than gross domestic product (GDP) in most developing countries.

Transport not only plays a key role in the daily functioning of cities but can also be a tool for managing growth. With more than 300 cities in Asia expected to have over 1 million inhabitants by 2025, and many secondary cities growing rapidly, future economic growth will largely be driven by urban economic activity (GEF 2006). A unique opportunity exists to meet the challenge of the exponential growth of developing country cities by moving future development in more sustainable directions through rationalized and accessible transport.

This paper reviews the World Bank Group's experience in implementing urban transport projects under GEF Operational Program 11 (OP 11), on sustainable transport, and outlines the opportunities for improving the effectiveness of these projects. It is addressed to policy makers and professionals of bilateral and multilateral agencies, client country governments, and other stakeholders. The next chapter outlines the environmental issues associated with the transport sector and describes the synergies between GEF OP 11 and the Bank's urban transport priorities. Chapter 3 then examines World Bank Group experience in implementing GEF-supported urban transport projects. Chapter 4 looks at the opportunities for strengthening the World Bank Group's contribution to transport sector initiatives under GEF OP 11.

2. Issues in urban transport

As an implementing agency of the Global Environment Facility (GEF), the World Bank Group actively promotes global environmental priorities in the transport sector under GEF OP 11 (see box 1). That program reflects the growing share of urban transport in GHG emissions and addresses the implications for the global environment.

The World Bank Group assists in developing sustainable transport strategies in partner countries through policy dialogue, technical assistance, loans, and guarantees. In addition, to complement GEF grants, it provides cofinancing for projects that address climate change concerns by promoting low-carbon technologies and by supporting institutional, technical, and financial arrangements that can reduce barriers to the adoption of GHG mitigation measures in the urban transport sector and promote public awareness. Efforts to reduce GHG emissions from the transport sector have positive impacts on poverty reduction, the environment, sustainable transport, and urban development (Karekezi, Majoro, and Johnson 2003).

BOX 1

Priorities under GEF Operational Program 11

GEF Operational Program 11 (OP 11), initiated in 1999 as one of four operational programs within the GEF climate change focal area, supports global environmental priorities in the urban transport sector. GEF grants under this program promote the implementation of low-carbon technologies, modal shifts to less polluting forms of transport, and interventions related to bus rapid transit systems, nonmotorized transport, traffic management, and land use planning (GEF 2004). GEF grant financing plays a crucial role in overcoming barriers to the adoption of climate-friendly development, transport policies and technologies in the urban transport sector.

The GEF grants cover the incremental costs associated with awareness generation, policy adjustments, regulatory initiatives, and climate-friendly technology options, through enabling activities, medium-size projects, and full-size projects.

Environmental priorities in urban transport

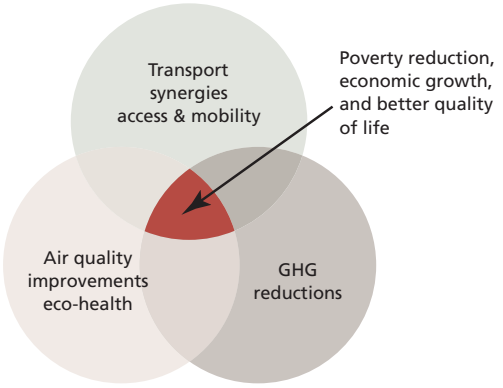
Population growth, urbanization, and industrial activity are the main drivers for the growth of the transport sector (World Bank 2002a). Within the sector, urban transport is a rapidly expanding subsector in most countries. Studies by Naess (1996) and by Newman and Kenworthy (1998) show a strong correlation between urban development and per capita energy use in transport. In addition to the transport sector's linkages to infrastructure and energy, there is increasing evidence showing that it can contribute directly to poverty reduction, independent of the growth channel.

Urban transport and poverty reduction

Three common problems confronting the poor with respect to transport are access to public transit, affordability, and safety. The high cost of motorized transport in relation to cash income means that small changes in fare and service levels can

restrict the mobility choices of the urban poor, who commute long distances to work, often using more than one mode of transport. In addition, in a number of developing countries accident rates related to transport are extremely high, while rising vehicular emissions and fugitive dust from unpaved roads pose increasing risks to human and environmental health. The poor often bear the greatest burden from these risks. Understanding the linkages among transport, health, air quality, GHG emissions, and poverty (illustrated in figure 1) is important in assessing the contribution of transport to poverty reduction.

Figure 1. Relationship between poverty reduction, urban transport, improved air quality, and reductions in greenhouse gas (GHG) emissions



Transport sector and GHG emissions

In urban metropolitan areas the transport sector is estimated to account for a third or more of total emissions of the greenhouse gases with the greatest significance for climate change: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). For example, in Lima transport accounts for about 37 percent of CO_2 emissions, and in 2000 the sector was estimated to contribute 4.68 million tons of the city's CO_2 emissions (GEF 2003a). In Santiago emissions of CO_2 from the transport system in 1994 were estimated at 4.2 million tons, about 68 percent of which was attributed to cars, taxis, and light trucks (GEF 2003b). In Mexico GHG emissions from transport accounted for an estimated 19.6 million tons of CO_2 in 1998 (World Bank 2002b).

The growing energy needs that countries face in the transport sector, especially in urban transport in developing countries, present major challenges in terms of energy security and the environmental externalities associated with GHG emissions, which are growing at a faster rate than is population. The growth of secondary cities and urban sprawl contribute to the pressure on existing urban transport networks. A moderate increase in per capita vehicle ownership could lead to a long commute time, changes in land use, and more transport-related air pollution. The trend toward increased motorization, in all its forms, leads to longer travel times for surface public transport (buses)—which in turn induces more auto and taxi use—and to poor traffic safety, the economic inefficiency of increased fuel use, and degradation of the urban quality of life

Studies show that large GHG benefits could be achieved through a shift from small and private vehicles to large-capacity vehicles for personal transportation. This modal shift is expected to avoid the GHG emissions that would have resulted from the small vehicles. To illustrate, a shift to public transportation is expected to reduce CO2 emissions in the Greater Santiago region by 9.6 percent, while emissions of particulate matter (PM10 and PM2.5)[1] would drop by 8 percent, assuming the implementation of urban land use policies regarding housing and commercial real estate development, along with transportation planning to avoid congestion (GEF 2003b; World Bank 2003c). Table 1 presents GHG emissions for various transportation modes; articulated buses produce the least GHG emissions per passenger-kilometer and are cost-effective public transportation options.

Table 1. Greenhouse gas (GHG) emissions of selected transport systems

Mode of transport	Maximum capacity (passengers per vehicle)	Average capacity (passengers per vehicle)	GHG emissions per vehicle-kilometer	GHG emissions per average passenger-kilometer
Gasoline scooter (two-stroke)	2	1.2	118	98
Gasoline scooter (four-stroke)	2	1.2	70	64
Gasoline car	5	1.2	293	244
Diesel car	5	1.2	172	143
Diesel minibus	20	15	750	50
Diesel bus	80	65	963	15
Compressed natural gas bus	80	65	1,050	16
Diesel articulated bus	80	65	1,000	7

Source: Hook and Wright 2002.

Urban transport and local air quality

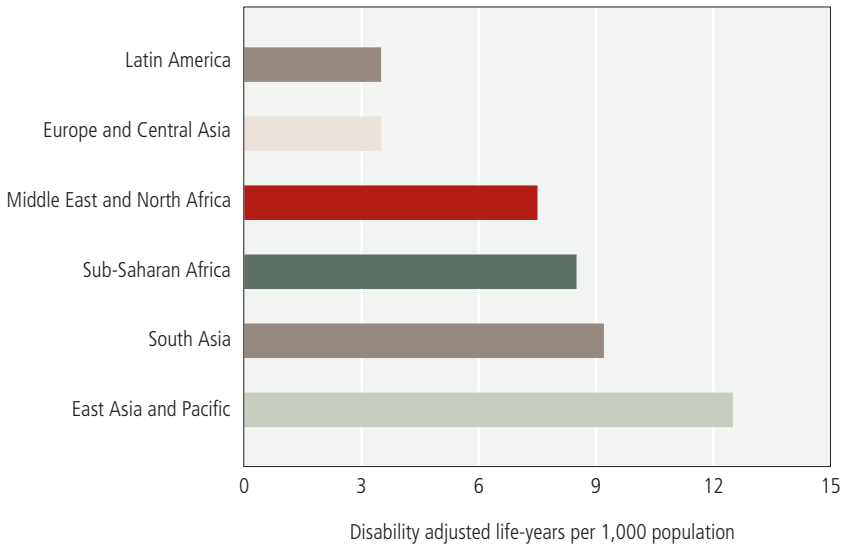
Air pollution is a major negative externality. It has become one of the worst environmental hazards in urban areas of developing countries, and transport is usually among its main sources. The problem of air pollution is particularly relevant to urban transport, considering the high concentrations of urban population, rapid rates of urbanization, and inefficient transport systems in developing countries (Kojima and Lovei 2001).

[1] PM10 refers to particles size 10 microns or smaller in aerodynamic diameter; PM2.5 refers to particles size 2.5 microns or smaller in aerodynamic diameter.

The large, dense concentrations of motorized emissions in relatively small areas mean that many, if not most, cities exceed any reasonable health standard for key air pollutants. Fine particulates, often associated with vehicular emissions, can cause health problems such as premature mortality and morbidity, as well as significant economic damage, and are thus of special concern in the developing world. Air pollution damages buildings and monuments, deters investors, and detracts from residents' general quality of life. The transport sector contributes to gases such as nitrogen oxides and volatile organic compounds that react in the presence of sunlight to form ground-level ozone, which poses risks to human health and plant life. Climate and meteorological conditions exacerbate air pollution, especially during winter, when thermal inversions inhibit pollutant dispersion. In Santiago the annual costs of traffic-generated air pollution are estimated to exceed $500 million (World Bank 2003c).

Mortality from urban air pollution is estimated at more than 500,000 deaths per year in developing countries (World Bank 2002a). In 1998 the Callao municipality in Chile reported 657,046 cases of acute respiratory infections and 64,934 cases of asthma and obstructive pulmonary

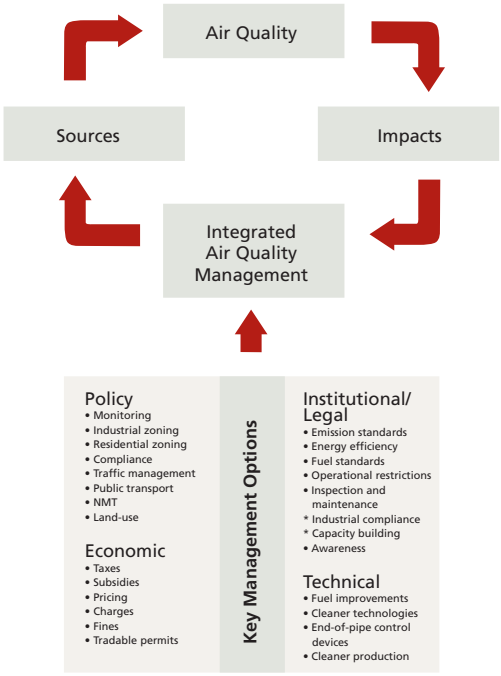
Figure 2. Burden of disease from urban air pollution by developing region



Source: Lvovsky and others 2000.

syndrome (GEF 2003b; World Bank 2003c). As figure 2 shows, East Asia and Pacific, South Asia, and Sub-Saharan Africa have the highest burdens of disease from urban air pollution. A large proportion of urban air pollution and of the associated burden of disease can be attributed to urban transport.

Figure 3. Air quality management model highlighting management options



Air quality management has an important role in urban transport planning and management. Figure 3 presents a schematic representation of the air quality management model, highlighting the management options. For example, SIM-Air, used in World Bank Group projects in Asia, is a simple spreadsheet air quality model that assesses particulate pollutants and mitigation options for cities. It takes into account fleet characteristics, technologies, fuel types, routes, and inspection and maintenance to capture the synergies and tradeoffs in urban transport. The model simulates the emissions inventory, estimates the impact of air quality on health, and permits the evaluation of policy, economic, and technical options to address the environmental and health impacts of pollution.[2] Reductions in vehicle density and improvements in fuel efficiency are expected to lower emissions of air pollutants.

World Bank Group priorities in the urban transport sector

World Bank Group transport sector policies, country assistance strategies, and project investments support the institution's urban transport priorities. The World Bank Group is actively engaged in transport sector development through policy support, infrastructure development, and capacity development.

[2] For further details, see, on the Clean Air Initiative Web site, "Small Models for Big Problems," http://www.cleanairnet.org/cai/1403/article-59386.html.

The country assistance strategy (CAS) forms the basis for country dialogue and World Bank Group investments in national development priorities. The CAS permits identification of medium-term priorities in the sector. For example, the Mexico CAS identifies climate change as a priority in transport sector development and proposes interventions to address anthropogenic GHG emissions associated with the transport sector through policy reform and through market-based approaches under the Clean Development Mechanism (CDM), a project-based initiative under the Kyoto Protocol of the United Nations Framework Convention on Climate Change.

The World Bank Group's corporate policy on the transport sector, adopted in 1996, emphasizes the transport problems of the urban poor. It accordingly focuses on access to transportation, travel time, and measures that reduce barriers to transport services, promote safety, and eliminate fiscal and financial impediments in transport planning (World Bank 1996). The World Bank Group's urban transport strategy, adopted in 2002, emphasizes improvements in modal choice through integration of cost-effective motorized and nonmotorized transport. It enunciates four major urban transport priorities: land use planning; operational efficiencies in various modes of transport; interventions to assist the poor; and policy, institutional, and fiscal reforms needed to implement the elements of the strategy (World Bank 2002a).

As a GEF implementing agency, the World Bank Group is supporting urban transport and air quality projects in Lima, Mexico City, Santiago, and Manila; several other projects are in the planning stages (table 2). World Bank Group cofinancing supports technical assistance to overcome barriers, strengthen institutional capacity, and augment the resources of other agencies.

Table 2. World Bank Group–implemented projects under GEF Operational Program 11 (U.S. dollars)

Country and region	Project	Stage	GEF financing	World Bank Group financing	Other financing	Total
Brazil	Transport and Air Quality Improvement Program for São Paulo	In preparation	12	0	34.1	46.1
Burkina Faso	Pilot Project to Improve Transport Efficiency and Reduce Urban Air Pollution in Ouagadougou	In preparation	0.9	0	13	13.9
Chile	Sustainable Transport and Air Quality for Santiago	Effective	7.0	0	7.0	14.0
China	Sustainable Urban Transport Program	In preparation	12	0	13.4	25.4
Ghana	Accra Urban Transport	GEF Council approved	8	115	41.5	164.5
Indonesia	Surabaya Sustainable Urban Transport	In preparation	1	0	1.9	2.9
Malawi	Rural Infrastructure Services	In preparation	3	50	17	70
Mexico	Climate Friendly Measures in Transport	Effective	5.8	0	6.4	12.2
Peru	Lima Urban Transport	Effective	7.9	45	89.4	142.3
Philippines	Metro Manila Urban Transport—Marikina Bicycle Network	Effective	1.3	60	36.3	97.6
Regional East Asia	Sustainable Transport and Environment Program (STEP) for East Asia	In preparation	6	0	9	15
Regional Latin America	Sustainable Transport	GEF Council approved	20.8	0	56.4	77.2
Russian Federation	Improving Fleet Management Practices in the Russian Federation (IFC)	In preparation	0.9	0	0	0.9
Vietnam	Hanoi Urban Transport Development	GEF Council approved	9.8	0	328.9	338.7

Source: GEF and World Bank Group project database and project documents; see References.
Note: Amounts for projects in preparation should be considered tentative. IFC refers to the International Finance Corporation, the private sector development arm of the World Bank.

Interventions implemented under GEF OP 11 urban transport projects

A number of interventions under OP 11 diversify the GEF portfolio, which encompasses bus rapid transit, light rail transit, traffic demand management, nonmotorized transport, land use planning, and regulatory and market regimes aimed at management of transport demand The main focus of these interventions is on strengthening the foundations for sustainable transport development through policy dialogue, institutional and technical capacity building, barrier removal, and the improvement of social and economic infrastructure, by leveraging GEF and World Bank Group funds to support OP 11 and World Bank transport sector priorities.

Bus rapid transit systems

Bus rapid transit (BRT) systems, with articulated busways, a restricted number of stations, less dwell time, and efficient route structures, are cost-effective modes of public transport that improve scale economies and limit GHG emissions. Long-term investments in BRT yield efficiency gains from improved safety, lower congestion, and full capacity utilization of the public transport system. Latin America is a leader in BRT systems. Table 3 lists BRT interventions in World Bank Group–implemented projects.

Table 3. Bus rapid transit interventions and outcome indicators

Intervention	Description	Indicator
Customer aggregation	BRT attracts customers from other transport transport modes that have high emissions.	Survey on modal shifts; emissions of competing modes
Capacity utilization	BRT replaces small vehicles.	Fuel economy; per-passenger comparisons
Land use planning	Land use planning rationalizes trips, trip length, and modes used to make a trip.	Before-and-after land use planning
Segregated bus lanes	Segregated lanes help reduce congestion and improve fuel economy.	Fuel economy comparison
Stopping distance	Dedicated stations at 500-meter intervals enable higher fuel efficiencies.	Fuel economy analysis
Dwell time	Rapid boarding and alighting at stops limit idle time.	Fuel economy analysis
Routing efficiency	Rationalized routes reduce travel time and distance and improve fuel efficiency.	Travel distance and fuel economy analysis
Technology	Low-emission propulsion systems reduce emissions.	Fuel economy and emission analyses
Maintenance	Regular maintenance improves fuel economy.	Fuel economy analysis

Table 4. Percentage change in pollutants and road space usage when buses replace other vehicles in the urban transport system

Type of bus	Change in CO_2 from fuel saving	Air pollutant				Road space usage
		Hydrocarbons	Carbon monoxide	Nitrogen oxides	Particulate matter	
High scenario						
Standard diesel bus	–72	–99	–97	–66	–83	–92
Euro II bus	–72	–100	–100	–66	–96	–92
Euro IV bus	–72	–100	–100	–93	–98	–92
Zero-emission bus	–78	–100	–100	–100	–100	–92
Low scenario						
Standard diesel bus	+50	+68	+46	+85	+41	–39
Euro II bus	+50	–60	–77	+85	–65	–39
Euro IV bus	+50	–92	–94	–63	–86	–39
Zero-emission bus	+50	–100	–100	–100	–100	–39

Source: Fulton and Schipper 2002.
Note: The high and low scenarios assume different percentages of passengers switching to buses from various travel modes: private cars; taxis; small, mini, or transit buses; two-stroke or four-stroke two- or three-wheelers; and nonmotorized transport.

As shown in table 4, when BRT systems replace other transport systems, particularly private vehicles, they can bring about large marginal benefits by reducing both GHG emissions and local air pollutants. Additional improvements, primarily in local pollutants, can be attained by employing cleaner vehicles in BRT systems. This analysis sheds some light on bus technology choices. Certainly, a cleaner bus yields lower emissions, but most of the reductions (at least in the high scenario in table 4) come from nonuse of other vehicles and from modal shift. With the possible exception of the effect on nitrogen oxide emissions, the difference in impacts between bus types is quite small and is overshadowed by the total reductions achieved through taking other vehicles off the road; the reductions amount to two thirds or more regardless of whether the new bus is a standard diesel bus, a very-low-emission bus (Euro IV), or even a zero-emission bus.

An analysis of BRT systems in World Bank Group projects found that a large percentage of benefits was attributable to modal shifts from private transport to BRT (80 percent), followed by

clean buses (10 percent) and maximum use of transport capacity, as manifested in more passengers moved with fewer buses (10 percent). A growing body of evidence demonstrates the pro-poor benefits of reduced transport costs, improved transport efficiency (Venables and Limão 1999), and expanded mobility choices (Heyen-Perschon 2001). In Santiago, where GHG emissions are mostly associated with the use of gasoline and diesel, measures aimed at improving efficiency of transport flows, at promoting modal shifts, and at adopting cleaner fuels and vehicles will not only help address local air pollution but will also reduce GHG emissions (World Bank 2003c).

Nonmotorized transport

Nonmotorized transport (NMT) includes all forms of transport that do not involve mechanized power from fossil fuel sources. Bikeways and walkways are the main forms of NMT supported under GEF OP 11. NMT is an important mobility option for the poor because of its lower cost, but it also has potential for mitigating GHG emissions and local air pollutants. NMT options therefore need to be preserved so that NMT remains a viable mode of transport for short trips instead of being displaced by roads and other urban infrastructure, as often occurs. NMT also serves as an important link to public transport.

A moderate shift to NMT is expected to result in substantial energy savings and reductions in congestion, emissions, and accidents. Analysis of the Lima project shows that use of bicycles twice a day results in per capita savings of up to $7.6 per month, or 9 percent of average per capita expenditure on energy (GEF 2003a; World Bank 2003b). In the Santiago project a 3 percent decrease in car and taxi travel as a consequence of a modal shift to bicycle is expected to reduce CO2 emissions by 126,000 tons per year; that is, by 1.15 percent (GEF 2003b; World Bank 2003c). In the Marikina bikeway project in Metro Manila an increase in bicycle use from 1.6 percent in 2000 to 2.8 percent in 2015 yields $4 million in benefits from the $2.1 million investment (World Bank 2001).

Transport demand management

Transport projects that promote integration of different transport modes can maximize overall system efficiency. Similarly, clean technologies, fleet renewal, increased speed, and decreased travel times promote the modes of transport that meet peak traffic demand, conform to the zoning regulations of urban areas, and contribute to system efficiency and reduction of environmental impacts. Traffic demand management, involving parking controls, area licensing, traffic calming, use restrictions, signal schemes, driver licensing, congestion charging, and parking management, can have quantitatively measurable impacts. Finally, intelligent transport systems and traffic rationalization can help leverage resources from state and local government agencies.

3. World Bank Group experience in implementing the GEF OP 11 priorities

The World Bank Group was engaged in urban transport and air quality management projects long before GEF OP 11 was launched. Among the Bank's early initiatives for urban transport in Latin America was a $75 million loan supporting the Urban Street and Transport Project in Chile, implemented from 1989 to 1995. The Bogotá Urban Transport Project (1996–2001), in which the public-private partnership Transmilenio sought to improve traffic infrastructure (bus lanes, terminals, accessways, parking lots and workshops), as well as the operation of the fleet and the fare collection system, attracted widespread attention. The project supported the rehabilitation of transport corridors and better access for poor neighborhoods. The integration of BRT, NMT, and traffic demand management is estimated to have led to a reduction of 318 metric tons per day of CO_2 emissions from 1997 levels. About 90 percent of the decrease is attributed to a modal shift from private cars and taxis to buses and bicycles. The project contributed to bus corridor improvements and financed studies to evaluate traffic congestion in Latin America.

Given the complexity of the transport sector, coupled with the magnitude of GHG emissions and local air quality impacts, the GEF's approach was to adopt a selective and catalytic role in promoting OP 11 priorities. GEF cofinancing helps lower the risk associated with investments through activities that include strategic planning, targeted research, training, capacity building, technical assistance, demonstration projects, investments, market-transforming activities to achieve full commercialization, and dissemination of lessons from experience to foster replication of successful measures. For the World Bank, linking with GEF-cofinanced projects provides a strategic advantage in leveraging funds. Lessons from the World Bank's experience in implementing transport projects were critical in contributing to the preparation and implementation of the projects in Lima and Santiago cofinanced by the World Bank Group and the GEF (World Bank 2003c).

World Bank Group implementation of transport projects under GEF OP 11

So far, urban transport projects cofinanced by the World Bank Group and GEF under GEF OP 11 have focused on aspects of public transport, traffic demand management, and nonmotorized transport. Land use, urban planning, and freight transport issues have received limited attention. Important opportunities for promoting urban transport objectives exist in these areas. The projects can be divided into two categories: city and metropolitan projects, and regional or multicity projects that focus on the urban transport priorities of several cities.

City-level urban transport and air quality projects

Bogotá, Santiago, Lima, Mexico City, and São Paulo provide examples of city-level projects. (The Santiago project is described in box 2.)

In Mexico City GEF financing supported segregated bus rapid transit systems, bikeways, climate-friendly technologies, and traffic measures. The Mexico City metropolitan area produces more than a third of the country's GDP and constitutes one of the largest metropolitan areas in the Americas. Both demand for energy and demand for urban services are expected to increase 1.9 percent per year more than population growth, and this will exacerbate the air pollution load

BOX 2

Promoting sustainable transport and better air quality in Santiago

The Santiago metropolitan area supports 40 percent of the Chilean population. The growth of private cars, from 12.3 percent of the total number of vehicles (320 cars per 1,000 households) in 1977 to 38.1 percent (560 cars per 1,000 households) in 2001, has been accompanied by a large increase in air pollution. The Sustainable Transport and Air Quality Project supports the transport and environment sector priorities identified in the 2002 country assistance strategy (CAS) and the multisector urban transport plan for 2000–2010. These priorities call for increasing the share of public transport to 60 percent of total trips and reducing air pollution from public transport by 70 percent from 2000 levels. The project includes testing of commercially available bus technologies, enhancing the capacity of the emissions testing laboratory, and retraining bus drivers. Other components include options for scrapping the displaced buses, incentives for housing near transit areas, promotion of modal integration and nonmotorized transport, and evaluation of options for travel demand management, including congestion pricing. These measures will help systematically reduce GHG emissions from point and nonpoint sources. The focus on land use planning and clean fuels strengthens the environmental dimension of the project. The reductions in emissions of sulfur oxides, carbon monoxide, particulate matter, nitrogen oxides, and greenhouse gases are directly attributed to the modal shift and improved efficiency.

The aims of the GEF financing include removing the barriers to implementing road pricing, introducing traffic-calming measures and new bus route systems and strengthening the environmental agency, Comisión Nacional del Medio Ambiente (CONAMA), which has the mandate of enforcing regulations and implementing the emissions trading program. World Bank Group cofinancing under a loan from the International Bank for Reconstruction and Development (IBRD) supports the public-private partnership in restructuring the public transport system, improving traffic management, constructing bikeways, expanding accessibility for low-income neighborhoods, and reducing air pollution.

Source: GEF 2003b; World Bank 2003c.

(GEF 2002). Annual emissions are estimated to result in 7 million metric tons of CO_2-equivalent emissions. A recent emissions inventory notes that mobile sources account for most of the emissions of nitrogen oxides, 40 percent of hydrocarbon emissions, and about 36 percent of particulate emissions. It is estimated that a 10 percent reduction in ozone and PM10 would yield an average annual benefit of $759 million, and the welfare gain from improved air quality is expected to result in an estimated annual benefit of $2 billion (GEF 2002; World Bank 2002b).

Regional transport and air quality projects

Regional transport and air quality projects leverage learning over several urban centers, capitalize on knowledge sharing and economies of scale, and help catalyze investments. The regional approach is particularly useful in scaling up urban transport and air quality programs in the rapidly growing urban areas of Asia and Latin America. About 300 cities in Asia are expected to have populations of more than 1 million by 2025 and several secondary cities are expanding rapidly. Interventions such as segregated busways and rationalization of public transport capacity have potential for replication in other geographic regions.

The regional projects seek to overcome technical, economic, regulatory, and financial barriers and to promote intercity cooperation within a country or cooperation among several cities in different countries. These projects lower transaction costs and facilitate cost-effective technology transfer and intercity partnerships. They also take into account experiences with Clean Air Initiative programs implemented in different regions.[3] The World Bank Group has

[3] The Clean Air Initiative (CAI) is a partnership that draws on the Bank's comparative advantage in convening stakeholders across sectors and disciplines to forge economically and politically efficient approaches to managing urban air quality.

BOX 3

A multicity demonstration program for transport in China

China's recent economic growth is largely concentrated in urban areas, particularly in the megacities of the coastal provinces. China is the world's second-largest consumer of oil, with transport consumption already accounting for over 25 percent of the total. The main objective of the Urban Transport Development Strategy Partnership and Demonstration Program is to implement the national urban transport strategy and strengthen institutional capacity. It is to be carried out in five to eight cities, each with a population of over 5 million, to demonstrate the implementation of land use plans and transport strategies. The project is expected to increase the modal share of public transport and to pilot technologies, service options, traffic management, and standards designed to reduce GHG emissions. The GEF grants support the removal of barriers and the demonstration of clean technologies and assist air quality improvement and reform of urban transport law. World Bank Group cofinancing is expected to scale up the pilot city demonstrations of the project interventions.

Source: World Bank 2004a

initiated regional projects in Latin America (World Bank 2004d); East Asia (GEF 2006), particularly China (World Bank 2004a); and India. These projects seek to address issues of public transport modernization, demand management, land use, transport planning, nonmotorized transport, and freight rationalization. (See box 3, which describes the experience in China.)

The regional transport project in Latin America, a pilot investment and technical assistance project covering 22 cities of the region, seeks to reduce GHG emissions and improve air quality through the rationalization of urban transport and sound land use management. Among its aims are to encourage sustainable urban transport interventions that contribute to efficient modes of transport; promote sound land use development planning consistent with sustainable transport principles; induce air quality improvement; foster a common regional approach to sustainable transport and land use planning; and create a network of Latin American cities that allows sharing of regional experience.

Monitoring and evaluation of urban transport projects

Comprehensive monitoring and evaluation frameworks were an integral part of project design, with particular attention paid to the identification of appropriate performance indicators. Initial results measured by these indicators show that components such as BRT and transport demand management have systemwide impacts in the form of modal shifts, reductions in trip cost and travel time, and easing of congestion. Interventions related to NMT are observed to reduce the travel costs of poor households. These interventions targeted short travel trips where localized transport was used within residential zones and where commuter transport designated for longer distances was in fact being used only for short trips.

4. Opportunities for enhancing the environmental impacts of urban transport projects

The urban transport projects cofinanced by the World Bank Group and the GEF have focused on reducing congestion, integrating transport and development planning, and encouraging public transport, travel demand management, modal integration, and nonmotorized transport. The traditional approach of introducing low-emission technologies, although important, will not suffice to promote modal shifts to public transport or nonmotorized transport. Increased motorization driven by growing numbers of private cars is a trend of economic growth that has negative impacts on public transport. The key issue is to prevent large-scale modal shift to private motorized transport and to simultaneously support public transport in order to improve transport overall, reduce local emissions, and reduce overall energy use and GHG emissions. The strategies of the World Bank Group and the GEF should demonstrate effectively the comparative advantages of public transport in meeting the growing demands of urbanization. The urban transport portfolio under GEF OP 11 is still young, and there are opportunities for investments to further promote environmental objectives in urban transport.

Future projects could more effectively mainstream the environmental dimension into urban transport planning by focusing on strategies for dealing with heavy-polluting modes such as freight transport and high-density intercity transport, as well as new market-based and information-based mechanisms. Attention to transport demand in rapidly growing secondary cities, strengthening of market-based mechanisms to foster transport efficiency, and promotion of private sector participation, safety, efficiency, and information technology are other important ways of improving the environmental impacts of the urban transport portfolio. An overview of these opportunities follows.

Freight and long-distance transport

Freight transport has major environmental implications in the rapidly growing urban areas, where inefficient cargo fleets increase congestion. A logistical plan for goods delivery using information technologies, transshipment points, rationalization of freight traffic, and customized delivery options could improve fuel economy and ease congestion. Freight transport interventions involving modal links for freight movement and encouragement of alternatives such as railways and waterways increase modal choice, attracting local governments and businesses and translating into large savings to the regional economy.

With the growth of cities, long-distance commuter and intercity passenger and freight transport is increasing significantly. Highway traffic corridors offer important opportunities for improving energy efficiency in long-distance transport and thus for limiting GHG emissions and particulate pollution.

Transport demand management

Opportunities for transport demand management are found in integration of different modes of transport and in traffic management. Measures that integrate long-distance freight transport, passenger transportation, and land use planning focusing on housing and employment along transit hubs have a significant role in transport demand management. GHG emissions from transport mostly result from combustion of fossil fuels and from fugitive methane emissions. Transport-related local air pollution originates from incomplete combustion of fossil fuels and from volatile emissions during the fuel cycle. Measures aimed at reducing fuel use will thus necessarily bring about a reduction of both GHG and air pollutant emissions. In Rio de Janeiro improved operation of diesel buses has resulted in an annual saving of 40 million liters of fuel (a 12.5 percent reduction), averting 107,800 tons of CO2 emissions per year.[4]

Market-based mechanisms to reduce emissions

Urban transport projects offer opportunities for promoting market mechanisms that can help build efficient, safe, and environmentally beneficial transport systems. Demand-side measures (congestion pricing, parking fees, efficiency-related tax credits, insurance schemes, and so on) can contribute to the rationalization of transport demand and generate additional revenue to supplement improvements in the transport system. Supply-side measures such as busways, free transit

BOX 4

Decontamination bonds in Santiago

Chile is a leader in the use of market-based instruments for environmental management. The country has a well-developed financial market, including an active stock exchange and secondary markets. A nascent market for permits for nitrogen oxide emissions from point sources exists. Under the Santiago transport project, the National Program of Decontamination Bonds, polluters buy emission permits, which can be traded on the local market. Thus, a coal-burning power plant can purchase emission permits in order to expand its capacity. CONAMA, the environmental licensing agency, acts as a clearinghouse for licensing point source pollution permits by supporting environmental options to invest. It proposes to expand the coverage of decontamination bonds to several other types of mobile emission in the future.

Source: GEF 2003b; World Bank 2003c

[4] For further information, see "Projeto EconomizAR, um caso de sucesso," http://www.rioonibus.com/meioambiente/index.asp.

zones, light rail, nonmotorized transport, pedestrian facilities, and carpooling can offer users modal choice. Emission reduction incentives (for example, project-based mechanisms such as the Clean Development Mechanism under the Kyoto Protocol) and local emissions-trading schemes provide targeted incentives for reducing GHG emissions and local pollutants. Air quality licensing (incentives for new companies to reduce emissions) can influence the location of industries and urban land use. Santiago's emission compensation program (box 4) demonstrates the significance of such licensing. Policies related to progressive taxation, vehicle registration, tariffs, and other economic incentives and disincentives can influence transport demand in urban areas.

Private sector participation in transport management

Private sector participation is central to the success of urban transport projects. The participation of representatives from the transport, automotive, energy (oil and gas), real estate, and infrastructure sectors facilitates the construction, maintenance, and operation of transport facilities. (For example, private sector–operated driver training clinics proved to be effective in Bangkok and Dhaka.) Attracting businesses and people to main transport corridors promotes public transport, reduces the number of private vehicles, and promotes real estate and business development along the corridors. Partnerships with academic, industry, research, and other institutions strengthen private sector participation. Involvement of real estate developers in transport planning can be a valuable tool for transit-oriented development, through regulations to allow mixed use along transit areas, combined with licensing for future real estate development. Public-private partnerships for building BRT systems through concession schemes are further options that have already been explored in cities such as Santiago.

Land use planning and modal integration

Modal access and modal shift can be improved by integrating urban land use and transport planning, taking into account business, employment, and housing and linking them to trip length so as to induce commuters to adopt energy-efficient modes of transport that will reduce GHG emissions. Regulatory measures, including zoning laws, transit-friendly location of public facilities, and encouragement of low-cost housing development near transit facilities, can limit urban sprawl and improve modal integration.

Transport information systems

There is a need to strengthen transport data and real-time information systems, including transport network overlays using geographic information systems that can promote spatial planning of transport networks in conjunction with other sectors. Transport data management should orga-

nize data on passenger and freight movements and on accidents and should share this information with the agencies associated with policy formulation and implementation. One constraint on expanding GEF support to new transport demand management measures is the lack of reliable data on energy savings and emission reductions. This data should be collected expeditiously and included in an integrated transport data and information system covering all the modes within a network.

References

Fulton, Lew, and Lee Schipper. 2002. "Achieving Sustainable Urban Transport in a Developing World: Non-Technology Approaches." Background paper for the Brainstorming Session on Non-Technology Options for Stimulating Modal Shifts in City Transport Systems, Nairobi, March 25–26, Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility, Washington, DC.

GEF (Global Environment Facility). 2002. "Mexico: Introduction of Climate Friendly Measures in Transport." GEF Project Brief, Global Environment Facility, Washington, DC.

———. 2003a. "Lima Transport Project." GEF Project Brief, GEF, Washington, DC.

———. 2003b. "Sustainable Transport and Air Quality Project for Santiago." GEF Project Brief, GEF, Washington, DC.

———. 2004. "GEF Climate Change Program Study 2004." Office of Monitoring and Evaluation, GEF, Washington, DC.

———. 2006. "Sustainable Transport and Environment Program for East Asia." Project Development Facility, GEFSEC Project ID 2981, GEF, Washington, DC.

Heyen-Perschon, Jürgen. 2001. "Non-Motorized Transport and Its Socio-Economic Impact on Poor Households in Africa: Cost-Benefit Analysis of Bicycle Ownership in Uganda." Institute of Geography, University of Hamburg, Hamburg, Germany.

Hook, Walter, and Lloyd Wright. 2002. "Reducing GHG Emission by Shifting Passenger Trips to Less Polluting Modes." Background paper for the Brainstorming Session on Non-Technology Options for Stimulating Modal Shifts in City Transport Systems, Nairobi, March 25–26, Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility, Washington, DC.

Karekezi, Stephen, Lugard Majoro, and Todd M. Johnson. 2003. "Climate Change Mitigation in the Urban Transport Sector: Priorities for the World Bank." A World Bank Group Global Environment Facility Program Publication, World Bank, Washington, DC.

Kojima, Masami, and Magda Lovei. 2001. *Urban Air Quality Management: Coordinating Transport, Environment, and Energy Policies in Developing Countries*. World Bank Technical Paper 508. Washington, DC: World Bank.

Lvovsky, Kseniya, Gordon Hughes, David Maddison, Bart Ostro, and David Pearce. 2000. "Environmental Costs of Fossil Fuels: A Rapid Assessment Method with Application to Six Cities." Environment Department Paper 78, Environment Department, World Bank, Washington, DC.

Naess, Petter. 1996. *Urban Form and Energy Use for Transport: A Nordic Experience*. Oslo: Norges Tekniske Høgskole.

Newman, Peter W. G., and Jeffrey R. Kenworthy. 1998. *Sustainability and Cities: Overcoming Automobile Dependence*. Washington, DC: Island Press.

Venables, Anthony J., and Nuno Limão. 1999. "Geographical Disadvantage: A Heckscher–Ohlin–von Thunen Model of International Specialization," vol. 1. Policy Research Working Paper 2256, Development Research Group, Trade, World Bank, Washington, DC.

World Bank. 1996. *Sustainable Transport: Priorities for Policy Reform*. Development in Practice Series. Washington, DC: World Bank.

———. 2001. “Metro Manila Urban Transport Integration Project.” Project Appraisal Document, Report 20767-PH, World Bank, Washington, DC.
———. 2002a. “Cities on the Move: A World Bank Urban Transport Strategy Review.” Private Sector Development and Infrastructure Department, World Bank, Washington, DC.
———. 2002b. “Mexico: Introduction of Climate Friendly Measures in Transport.” Project Appraisal Document, World Bank, Washington, DC.
———. 2003a. “Bogotá Urban Services Project.” Project Appraisal Document, Report 24941-CO, World Bank, Washington, DC.
———. 2003b. “Lima Bus Transport Project.” Project Appraisal Document, Report 27253-PE, World Bank, Washington, DC.
———. 2003c. “Sustainable Transport and Air Quality Project for Santiago.” Report 26848-CL, World Bank, Washington, DC.
———. 2004a. “China Urban Transport Development Strategy Partnership and Demonstration Program: Request for Pipeline Entry and PDF B Block Proposal.” World Bank, Washington, DC.
———. 2004b. “Colombia Mass Transit Systems Project.” Project Appraisal Document, Report 28926-CO, World Bank, Washington, DC.
———. 2004c. “Hanoi Urban Transport Development Project.” World Bank, Washington, DC.
———. 2004d. “Sustainable Transport and Air Quality Program for Latin America and Caribbean Region: Request for Pipeline Entry and PDF B Block Proposal.” World Bank, Washington, DC.
———. 2004e. “Transport and Air Quality Improvement Program for São Paolo: Request for Pipeline Entry and PDF B Block Proposal.” World Bank, Washington, DC.