CHAPTER 10

Reducing Transport-Related Greenhouse Gas Emissions in Developing Countries: The Role of the Global Environmental Facility

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Transportation is the fastest-growing sector of greenhouse gas (GHG) emissions globally. It is also the sector where the least progress has been made in addressing cost-effective GHG reductions. According to the Paris-based International Energy Agency (IEA), over the next 20 years, the growth of transportation sector energy consumption and related GHG emissions will be greater than for any other sector. Transportation's share of total energy use is projected to increase from 28 percent in 1997 to 31 percent in 2020. While the developed world will continue to be the main source of the problem, the growth of GHG emissions in transportation will increasingly come from developing countries over the next 20 years (IEA, 2002).

Though much depends on future oil prices, most experts believe that without significant intervention to reverse these trends, growth in motor vehicle use will overwhelm any efficiency gains from new fuels and technologies. While oil use in industrialized countries is growing by only 1 percent per year, it is growing by 6 percent annually in Africa, Asia, and Latin America. From 1995 to 2020, worldwide vehicle ownership is expected to grow by 75 percent to over 1.3 billion vehicles (OECD/ECMT, 1995), with the greatest rate of growth to occur in Latin America and Asia.

The Global Environmental Facility (GEF)—managed jointly by the World Bank, the United Nations Development Programme (UNDP), and the

UN Environment Programme (UNEP)—is increasingly important as a source of financing sustainable transportation projects around the world. After some initial missteps, the GEF is playing an increasingly constructive role in bringing about the sort of dramatic shift in transport paradigm that will be required to avert significant global warming.

Despite its rapidly increasing importance, transportation was one of the last major sectors that contribute significantly to global warming to be considered for GEF funding. The GEF was for many years reluctant to become involved in the transport sector, fearing that the cost of interventions would inhibit a productive role for the GEF, and fearing the GHG emissions impacts of transport sector projects would be difficult to quantify.

In its early years, the GEF funded two transportation-focused projects. One in Tehran, Iran, funded a number of studies of emission monitoring systems, inventories of pollution sources, and proposed new policy initiatives. A second project, approved in 1996, was a $7 million project in Pakistan, focused on establishing vehicle inspection and maintenance centers.

Creation of Operational Program #11

The GEF felt that these projects lacked focus, and the benefits were difficult to quantify. In the late 1990s, it decided to make transportation a specific operational program and began to draft Operational Program #11 (OP #11). The GEF Standing Technical Advisory Panel (STAP), which advises the GEF on technical matters, issued a set of draft recommendations, but the GEF ignored the STAP recommendations and hired a fuel cell researcher to write OP #11 as an outside consultant. Not surprisingly, the initial draft of OP #11 focused exclusively on hydrogen fuel cell vehicle technology. The GEF embraced the hydrogen strategy, and, for many years, hydrogen and fuel cell programs dominated the GEF portfolio of transportation project funding.

This first draft OP #11 provoked significant criticism among some government officials, nongovernment organizations (NGOs), and transport experts. Some government departments, including the U.S. Environmental Protection Agency (EPA) and Germany's Umwelt Bundesamt, complained, as did the UN Habitat. The initial draft was also viewed with skepticism by some within the World Bank. Intervention by these groups managed to get the mandate broadened to include the following funding priorities (GEF, 2001):

- Modal shifts toward more efficient and less polluting forms of public and freight transport through measures such as traffic management and avoidance and increased use of cleaner fuels
- Nonmotorized transport (NMT)
- Fuel cell or battery operated two- or three-wheeled vehicles designed to carry more than one person

- Hydrogen-powered fuel cell or battery-operated vehicles for public transport and goods delivery
- Hybrid electric buses equipped with internal combustion engines
- Advanced technologies for converting biomass feedstock to liquid fuels

The First Years of the GEF Transportation Program: Hydrogen Fuel Cells

During the first several years of implementing OP #11, some $36 million in GEF funds were approved for single-initiative hydrogen fuel cell bus demonstration projects, all of them sponsored by UNDP. For a project to be financed by the GEF, it had to meet one of the preceding criteria, and be endorsed both by the GEF focal point within the country and by an implementing agency. In the first phase of the GEF OP #11, the implementing agency could be the World Bank, UNDP, or UNEP. In the second phase of the effort, regional development banks also became eligible as implementing agencies for GEF projects. Project sponsors also had to provide 50 percent matching funds from non-GEF sources. This cumbersome and often difficult approval process constituted a fairly significant barrier to entry to many good projects.

The GEF-UNDP Fuel Cell Bus Program initially supported the commercial implementation of fuel cell bus and associated refueling systems in six of the largest bus markets in the developing world:

- Beijing, China
- Shanghai, China
- Sao Paulo, Brazil
- Cairo, Egypt
- Mexico City, Mexico
- New Delhi, India

As of the fall of 2005, however, only Beijing had received any fuel cell buses. The projects in Shanghai and Brazil are still moving ahead, with fuel cell bus procurement processes underway. Mexico has moved its program away from a focus on hydrogen toward various hybrid electric bus technologies. The projects in India and Egypt have been delayed indefinitely, awaiting the outcome of the other projects.

Criticism of Fuel Cell Bus Effort

Critics of the hydrogen fuel cell technology approach of the first GEF projects focused on several areas of concern. They pointed out, for example, that new and unproven technologies are not generally first introduced in developing countries but rather are brought to scale in developed economies and

TABLE 10-1. Greenhouse Gas Emissions by Mode

Mode	*CO_2-Equivalent Emissions (grams/ vehicle-km)*	*Maximum Capacity (passenger)*	*Average Capacity (passenger)*	*CO_2-Equivalent Emissions (grams/ passenger-km)*
Pedestrian	0	1	1	0
Bicycle	0	2	1.1	0
Gasoline motor scooter (2-stroke)	118	2	1.2	98
Gasoline motor scooter (4-stroke)	70	2	1.2	64
Gasoline car	293	5	1.2	244
Gasoline taxi car	293	5	0.5	586
Diesel car	172	1.2	1.2	143
Diesel minibus	750	20	15	50
Diesel bus	963	80	65	15
CNG bus	1,050	80	65	16
Diesel articulated bus	1,000	160	130	7

Source: Sperling and Salon, 2002.

then exported to developing economies only after the production costs have dropped significantly and the technology has become more mature. The other major criticism was that focusing on bus technology in isolation from the specific public transit markets where they will operate is likely to have perverse emissions effects.

In all of the target countries, the income of bus passengers is quite low, with India being the most extreme case, where bus passengers often have incomes as low as one or two dollars a day. With such low incomes, bus price elasticity of demand is very high, so a small increase in the bus fare leads to a fairly rapid shift to motorized two-wheeler and three-wheeler shared taxi trips. Each shift of this type leads to an increase in emissions. While the impact of this modal shifting on GHG emissions will be case specific, some typical numbers are listed in Table 10-1.

Given that the shift of a single passenger from a bus to a motor scooter is likely to increase the per trip GHG emissions by nine times, even the smallest increase in the bus price that diverts bus passengers to private motorized modes is likely to have huge adverse impacts on aggregate GHG emissions. The purchase prices of various transportation vehicles appear in Table 10-2. At a projected market price of $1.5 million for each hydrogen fuel cell bus, these buses are 150 times the price of some buses currently being used in developing countries.

TABLE 10-2. Bus Vehicle Costs

Vehicle Type	*Purchase Cost (US$)*
Small, new, or secondhand bus seating 20–40 passengers, often with truck chassis	$10,000–$40,000
Large, modern-style diesel bus that can carry up to 100 passengers, produced by indigenous companies or low-cost import	$40,000–$75,000
Diesel bus meeting Euro II standard, produced for (or in) developing countries by international bus companies	$100,000–$150,000
Standard OECD Euro II diesel bus sold in Europe or United States	$175,000–$350,000
Diesel with advanced emissions controls meeting Euro III or better	$5,000 to $10,000 more than a comparable standard diesel bus
CNG, LPG buses	$25,000 to $50,000 more than a comparable standard diesel bus (less in developing countries)
Hybrid-electric buses	$75,000 to $150,000 more than a comparable standard diesel bus
Fuel-cell buses	$875,000–$1,200,000 more than a comparable standard diesel bus

Source: Adapted by IEA, 2002, p. 120; Wright, 2006.

Out of this experience, some important lessons should be learned about GEF involvement in the transit vehicle sector. First, it is probably inappropriate for the GEF to be picking technological winners and imposing them on developing countries. Prepicking technological winners runs the great risk that the technology will not actually reach expectations. Often, less publicized technological improvements on existing technologies achieve the same objective faster at a lower, more commercially viable price.

It is highly probable that far greater GHG emission-reductions could have been achieved if bus operators were given direct incentives to find the best solution to reducing their GHG emissions. The decision to switch bus technology ultimately has to be made by the bus operator, and if this switch is to be made in a way that does not disrupt bus services, the bus operators and bus system regulators need to be involved directly in the process.

Current GEF Transport Priorities

In the second phase of the OP #11 effort, the GEF shifted decidedly away from hydrogen fuel cell bus projects and refocused on projects with a demonstrated impact on shifting trips to less energy intensive modes. The turning

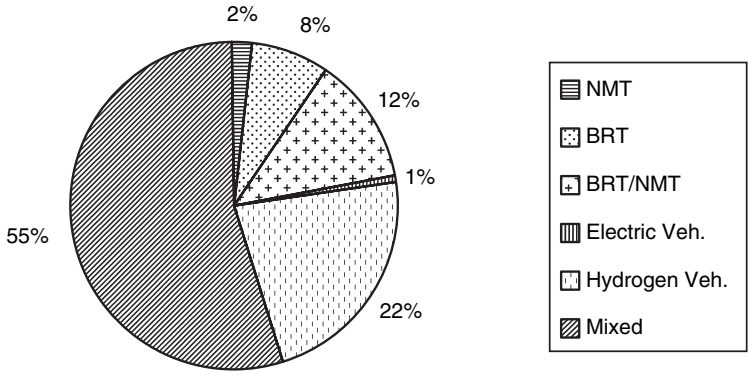

FIGURE 10-1. GEF resources by project type.

point occurred at a STAP meeting held in Nairobi in 2002. The conclusions of this meeting were summarized in a World Bank report (Karekezi, Majoro, and Johnson, 2002). This document asserted that the existing OP #11 was consistent with the World Bank's own urban transportation policies (World Bank, 2002) in the following areas:

- Promotion of low cost public transport modes, such as BRT
- NMT, including bikeways and pedestrian walkways
- Transport and urban planning to facilitate efficient and low GHG modes of transportation
- Transport demand management (TDM) measures the favor or enables public transport and NMT

By 2005, the hydrogen fuel cell part of the portfolio has fallen to less than a quarter of anticipated expenditures. It was replaced by projects which lump together several interrelated interventions, usually involving NMT, BRT, some TDM measures, and often a host of other measures. The distribution of 2005 funding by program area is shown in Figure 10-1. The shift also represented a move from funds granted by the UNDP toward World Bank funding. As shown in Figure 10-2, the World Bank now contributes 60 percent of OP #11 transportation funding.

This growing domination of the World Bank in GEF funding has some positive and negative impacts. On the positive side, the World Bank has an extensive network of field offices and a staff with long experience in transportation. The projects developed under the World Bank are also better grounded in the ongoing transportation decision-making process in the beneficiary countries than were the hydrogen fuel cell bus projects. The UNDP, by contrast, decided not to make transportation a priority area of their technical assistance in the late 1990s. However, UNDP continued to play an ad

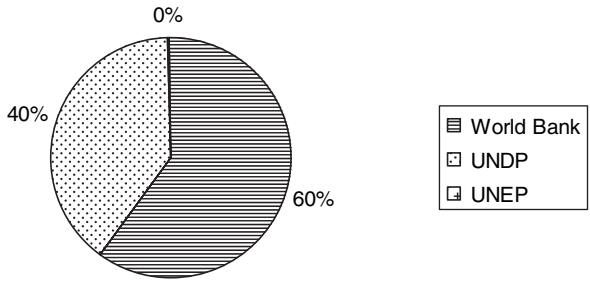

FIGURE 10-2. GEF transport funds by agency.

hoc but often important role in providing technical support to transport projects, particularly in Latin America. The UNDP in fact financed some of the technical work on both Bogota and Quito BRT systems.

Ultimately, the World Bank has a significant advantage over the UNDP and UNEP in that it has the capacity to use its own loans to provide the matching funds that the GEF Council requires. In Ghana, for instance, the government decided to work with the World Bank rather than the UNDP mainly because the World Bank also promised to provide low interest loans to finance the implementation of the project. The UNDP has some technical assistance funds at its disposal, while UNEP has very few of its own resources that it can bring to the table.

A government is much more likely to get a GEF grant from the World Bank if they are also considering a loan from other sources within the bank. The World Bank's management prioritizes GEF funds for this purpose. What this means in practice is that projects where the governments themselves do not need World Bank funds to implement a good project, which surely is a sign of political commitment, will face greater difficulties than those simultaneously approaching the World Bank for loans.

The influence the World Bank has over the GEF relative to the other implementing agencies means that it is often able to get approval for projects with only nominal political commitment, and where the specifics of the project are vague and the GHG emissions impacts are unknown and often unknowable, while other implementing agencies frequently face a higher standard of assessment. Lack of clarity about the approval process and the approval criteria have led to frustration on the part of potential beneficiaries, many of whom have spent long hours preparing projects in response to sometimes contradictory guidance from the GEF Secretariat and the implementing agency. Despite these shortcomings, the quality of projects being funded by the GEF is improving significantly.

Both the World Bank and the UNDP face a similar institutional tension between being responsive to the requests and requirements of the beneficiary countries on the one hand, and implementing projects that successfully

alleviate poverty and improve the environment on the other. An unpublished study of the UNDP's technical assistance in the transportation sector showed that 60 percent was targeted to civil aviation, which had no direct poverty alleviation benefit, despite the fact that poverty alleviation is the primary mandate of the UNDP.

The World Bank's transportation portfolio has in the past faced criticism from NGOs for doing little to alleviate poverty or improve the environment, while many large road loans had significant adverse air quality and involuntary resettlement impacts. While the World Bank has made significant changes in response to these criticisms, nonetheless, the staff is ultimately rewarded for making loans, and if a developing country government wants to borrow money for a problematic project, it is difficult for World Bank staff to refuse. The fundamental problem faced, therefore, by both UNDP and World Bank staff is how to generate large projects that will actually reduce poverty and improve air pollution, when borrowing governments frequently lack creativity in this regard, or have other motives.

GEF funds are increasingly playing a vital role in helping both the UNDP and the World Bank be more proactive in generating good projects, rather than just waiting for good projects to come to them. As shown in Figure 10-3, more than half of all GEF transportation grants are awarded to projects in Latin America. The Latin America division of the World Bank has been the most entrepreneurial in this regard, and the GEF projects for Mexico City and Santiago played a critical role in initiating BRT and NMT projects in those cities. The Asia and Africa divisions are increasingly using the GEF in this way as well, with new World Bank GEF projects underway in China, Vietnam, and Ghana. These projects are some of the most exciting initiatives in the transportation sector. The potential exists for truly historical change in transport sector system development being played by the

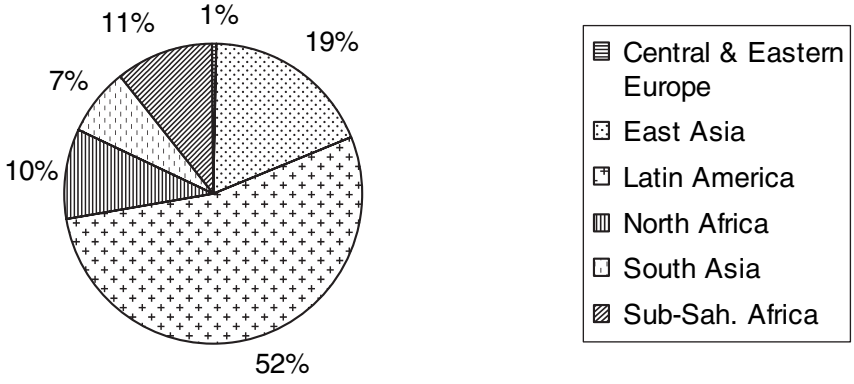

FIGURE 10-3. GEF Transport Funds by Region.

GEF. However, most of these projects are still only in the planning stages, and few concrete successes have actually been implemented through this mechanism to date.

The UNDP has also shifted the focus of its GEF transport program, and increasingly it is focused also on BRT and NMT projects. When India dropped out of the hydrogen fuel cell bus program, the money was reprogrammed to a project preparation grant for a large scale GEF project. This project now rests with the Urban Development Ministry, which is likely to focus on NMT improvements in secondary cities. The UNDP in cooperation with an NGO, the Institute for Transportation and Development Policy (ITDP), also helped initiate BRT projects in Accra, Ghana, and Dakar, Senegal, both of which received project preparation grants. While the project for Dakar is moving forward, the project in Accra has been taken over by the World Bank.

The third player in transportation GEF projects has been UNEP. Until recently, most of UNEP's work in this area was focused on multicountry studies and information sharing. Starting in 2002, the UNEP has become much more active in creating GEF transportation projects. The UNEP and the ITDP have a medium-sized GEF grant to develop the BRT and NMT project in Dar es Salaam, Tanzania, the BRT and NMT system in Cartagena, Colombia, and a BRT Planning Guide. A project preparation grant funded delegations from these and several other countries to participate in workshops on BRT and NMT in Bogota, Colombia. While not all the participating countries decided to move forward, the project played a key role in securing political commitment to these measures in Dar es Salaam. The UNEP is currently developing several GEF projects for different projects around the world, such as in Jakarta, Indonesia, and is playing a particularly important role where the government is not interested in World Bank loans. The regional development banks, particularly the Inter-American Development Bank and the Asian Development Bank (ADB), also have some GEF transport projects being developed. The former has a BRT project under development in Managua, Nicaragua, and the latter has a BRT project under development in Manila, the Philippines.

Ultimately, the overworked and understaffed GEF is trying its best and doing a good job, but in the end, decisions frequently reflect simply the degree of trust the GEF has in the implementing agency to implement the project. While this has led to domination by the World Bank, it is imperative that UNEP and UNDP be kept actively involved, if for no other reason than to keep the World Bank marginally accountable, and to provide an alternative mechanism for financing good projects where municipalities are ready to implement great projects with their own funds but do not want, for whatever reason, to involve the World Bank.

World Bank dominance over the GEF has also influenced the allocation of GEF funds by region. The predominance of Latin America in the OP #11 GEF portfolio stems largely from the fact that the World Bank's Latin

America division was the first to rely heavily on this funding mechanism. It also reflected the fact that two megacities in Latin America—Mexico City and Sao Paulo—were included in the hydrogen fuel cell bus demonstration project. The World Bank's Africa division, on the other hand, did not originally feel that urban transportation was a priority, though with rapid motorization in some cities this view has been modified somewhat. The low prevalence of GEF funds in South Asia is linked to the lack of World Bank urban transportation lending in the region and complicated and nontransparent procedures for focal point approval.

In conclusion, after a period of institutional learning, the GEF has reoriented its focus onto projects that are much more likely to lead to profound GHG emission reductions. It has also grounded itself much better in what the development banks are doing in the transportation sector and thus has the potential to profoundly influence, not only the use of the GEF money, but also to leverage multilateral development bank loans toward more sustainable projects. As such, the potential exists for the GEF transportation portfolio to play a historical role in reorienting global transportation systems.

The devil, however, is in the details. Setting the basic programmatic direction of the GEF transportation program on tasks that will truly reduce GHG emissions has been largely accomplished. However, turning these programmatic priorities into successful projects is extremely difficult, and the track record to date is not that impressive. Getting up-to-date information on GEF projects is extremely difficult and requires querying the parties responsible for project implementation. The next three sections in this chapter discuss projects where the ITDP has had some sort of involvement or familiarity. They identify the range of difficulties currently being encountered in implementing GEF transportation projects.

NMT Projects Financed under the GEF

Support for using GEF funds for NMT infrastructure projects has been strong, although total dollar value of the NMT projects has accounted for just 12 percent of all GEF transportation project grants. The bigger problem has been finding governments that want to make significant improvements in NMT facilities.

The idea behind NMT projects is to promote bicycling and walking to reduce GHG emissions. If their modal share could be retained or increased, this would make a significant contribution to reducing GHG emissions at a very modest cost. There is considerable evidence from cities like Bogota, Colombia, that a municipal investment in bicycling facilities could result in a significant increase in NMT. The mode share of cycling in Bogota increased from less than 0.5 percent of all daily trips to over 4 percent of daily trips in less than five years with the construction of some 300 kilometers (km) of new bicycle facilities.

Bogota's success was implemented without any GEF funds, but it seemed certain that the use of GEF funds would help to induce other cities to follow Bogota's lead. Early project experience has been a mixed success, however, indicating that getting GHG emissions reductions from bicycle infrastructure projects is not guaranteed but requires political will, proper planning, and complimentary measures.

There were two early GEF projects that focused on NMT: Marakina, a district of Manila in the Philippines, and Gdansk, Poland. The first project was funded by the World Bank and the second by the UNDP. There were also several projects that have already been implemented where NMT infrastructure was a component of the project, including World Bank–sponsored GEF projects in Lima, Peru, and Santiago, Chile. Many others are in development.

The Marakina project proposed to spend about $1.27 million for pilot bikeways and bike promotion in a district of Manila where some bikeways already existed and that appeared relatively sympathetic to bikes. This project began in 1996 and was approved for World Bank funding in 2001. As of 2004, only about $400,000 had actually been spent. The tensions surrounding the project are typical of what has happened in many NMT projects. The main interest of the district mayor was to build a largely recreational facility along a watershed that was used as a park.

Advocacy groups in Manila complained that this focus had relatively little importance for expanded use of bicycles by the local population and that the planning for the project was done with no involvement from actual cyclists. Cyclists wanted bike lanes on the major arterials, where they could use them to reach shops and centers of employment safely, but the mayor was reluctant to implement these strategies for fear of antagonizing motorists. Some money was spent on promoting cycling in the area, with some positive effects. Most recent information, however, indicates that only the recreational elements of the bike network have been built to date, and the GHG emissions benefits have been minimal.

More recently, the Metro Manila Development Authority, which is responsible for transportation management in the metropolitan region, together with President Arroyo have launched a pilot bicycle plan for downtown Manila. It appears, however, that the facilities will be built on secondary streets where their need is less.

The Gdansk project was implemented somewhat better. The Municipality of Gdansk, a local organization, the Polish Ecological Club, and the UNDP cosponsored the project. The project, financed with $1.0 million from the GEF and $1.5 million in cofinancing, constructed a core network of cycling facilities and paths. To date, 12 km of bicycle paths have been completed or are under construction, with another 20 km planned. Other activities include measures to reduce traffic speed using speed bumps, strict speed limits, and public outreach and information campaigns to encourage cycling. According to the UNDP, the number of people in Gdansk

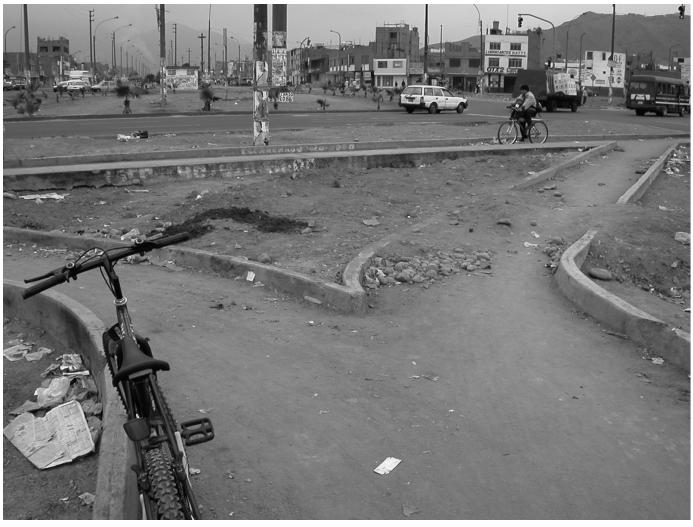

FIGURE 10-4. Lima bike lane financed with a World Bank loan.

that are now cycling as a result of the project has doubled so far, though it was from a very low baseline.

More recently, new GEF projects approved for Lima and Santiago de Chile designed in conjunction with World Bank urban transportation loans propose to build a number of bike lanes and to promote cycling. Lima had already built some cycling facilities under a previous World Bank loan (see Figure 10-4). These facilities were physically separated bike lanes both curbside and in a median, serving an industrial area where it was hoped that industrial workers would begin to cycle to and from work. The design of these initial bike lanes was not entirely successful, and utilization is fairly modest. They are in the process of being rehabilitated under another World Bank urban transportation loan not using GEF funds. There are GEF funds to implement some new bike facilities that were identified under a new bicycle master plan, and those that will be funded under the GEF have just been selected but not yet implemented.

Santiago de Chile has built a much more extensive network of 53 km of bike lanes in a few pilot districts in the city center using GEF funds under the World Bank project. The system is now being expanded by 16 additional km. GEF funds also finance support for bike promotion, which is being handled by Cuidad Viva, a well-qualified local NGO, and a 900-person bicycle caravan was held. Other districts are also building bike lanes inspired by the Santiago de Chile experience but not implemented with GEF funds. The districts of Bella Vista, Plaza Nunoa, Brasil, and Lastarria now have bike lanes built or under construction. Some are high-caliber,

FIGURE 10-5. Shared bicycle and pedestrian facilities in Santiago de Chile.

grade-separated facilities, while others are on sidewalks, with some conflicts with pedestrians.

In most cases, there was considerable struggle over the placement of the facilities, with struggles around whether space would be taken away from motor vehicles or pedestrians. The ultimate compromise is inevitably a political decision, and the GHG emissions impacts will be in part the result of this political discussion. Shared bicycle and pedestrian facilities, as shown in Figure 10-5 from Santiago de Chile, do not work well if there are any significant pedestrian volumes. In such cases, modal shift impacts are likely to be marginal.

In summary, the potential of GEF-funded bicycle infrastructure projects has only partially been realized to date. Some new facilities have increased bicycle mode share, but the bike facilities have done little to improve bicycle mode share in other cases. Nowhere have GHG emission reductions been very impressive. However, the cost of these projects was also fairly modest, the projects have inspired municipalities to do more on their own, and, given the amount invested, the result was reasonable.

Ultimately, designing proper bicycle facilities requires the strong will of a mayor who is truly committed to cycling as a means of transportation. Involving cycling advocacy groups in the design process along with road

engineers will also help, as many road engineers have never ridden a bicycle in their lives. Standard road designs include detailed parameters developed over many years and codified in highway design manuals and, until recently, with little concern for NMT. By contrast, NMT infrastructure design is still an area very much in development, with even basic principles open to debate.

In summary, it is insufficient for the GEF to fund projects supporting NMT infrastructure in a categorical manner. Ultimately, both the specifics of the proposal and the level of commitment of the local government officials need to be carefully reviewed. Systems of accreditation have to be established to determine the competency of technical people chosen to plan and design NMT facilities. Without careful scrutiny, bad NMT projects with more powerful promoters may take precedence over good ones with promoters who understand less well how the GEF system operates.

The GEF and Bus Rapid Transit

BRT systems include various integrated improvements that increase the speed, capacity, and quality of bus-based transit services. The main point of BRT is to create an integrated mass transit system that has the quality of service and performance that can be achieved only at a much higher price by rail-based systems. The most complete examples of BRT systems are the URBS system in Curitiba, Brazil, and TransMilenio in Bogota, Colombia. These systems include physically separated lanes that take buses out of mixed traffic congestion, prepaid enclosed boarding and alighting platforms that significantly increase average bus speeds, larger buses that increase the capacity of the system, bus priority at intersections, and a clear marketing image.

Because BRT systems are much less expensive to build and operate than rail-based systems and can be built much more rapidly, they are the only mass transit system investment that has proven that it can halt and reverse a downward trend in public transit ridership on a citywide basis. While metro rail systems have increased transit mode share in specific corridors, they have never been able to reverse a citywide trend toward declining transit mode share on their own.

Furthermore, because BRT systems often require the reconstruction of central urban road corridors, they also create the opportunity to build complementary facilities for pedestrians and cycling. Most of Bogota's TransMilenio corridors include bicycle lanes and wide sidewalks that play an important role in the GHG emissions reductions benefits.

Mayors have embraced BRT projects in unprecedented numbers in recent years because they are visible, attractive projects that offer a significant political payoff within a single term of office without costing much to implement. Stand-alone bicycle and pedestrian improvements are generally harder to sell politically. Thus, BRT promotion has created a

TABLE 10-3. Public Transit Modal Split before and after BRT and Metro Construction

City	*% of Trips Before*	*% of Trips After*
Metro Systems		
Mexico City	80	72
Buenos Aires	49	33
Bangkok	39	35
Kuala Lumpur	34	19
Santiago	56	33
Warsaw	80	53
Sao Paulo	46	33
Tokyo	65	48
Seoul	81	63
BRT Systems		
Bogotá	53	56
Curitiba	74	76
Quito	76	77

Source: Compiled by ITDP.

TABLE 10-4. Select BRT Projects Funded by the GEF OP #11

City	*Implementing Agency*	*Status*
Mexico City	World Bank/WRI	Implemented
Santiago	World Bank	Partially implemented
Lima	World Bank	Advanced planning stage
Dar es Salaam	UNEP/ITDP	Advanced planning stage
Colombian Cities	World Bank UNEP/ITDP (Cartagena only)	Pereira and Cali under construction
Accra	World Bank	Early planning stage
Dakar	UNDP/ITDP	Planning stage
Hanoi	World Bank	Planning stage

Source: Compiled by ITDP.

successful wedge issue to begin a process of change in the approach to dealing with urban transportation that can be easily expanded to include measures promoting public space, cycling and walking, and transit-oriented development.

Recently, the GEF has played an increasingly important role in financing the initiation and development of good BRT projects. Examples of modal shifts due to BRT systems appear in Table 10-3. Some projects are listed in Table 10-4. Several others are in the discussion stage. The most important factor in the development of most of these projects was not the possibility of GEF funding but rather high-profile meetings and presentations made by

the dynamic former mayor of Bogota, Enrique Penalosa and former Curitiba mayor Jaime Lerner, and the powerful visible impact that Bogota's TransMilenio and Curitiba's BRT have had with political leaders around the world.

The GEF's involvement in BRT promotion and implementation has been particularly successful in Mexico City's new BRT system, though the GEF was only one of several actors involved. The World Bank and World Resources Institute's EMBARQ program, with money from the Shell Foundation, played the most important international role, with some modest ITDP involvement. Initially, the World Bank had hoped that the GEF money would be used for a BRT system in the state of Mexico that surrounds the Federal District of Mexico City that would serve as a feeder system to the existing metro, which faces declining ridership. The state of Mexico, however, was heavily in debt and unable to borrow additional funds to implement the project.

Meanwhile, Penalosa from Bogota and EMBARQ played a key role in convincing Mexico City Mayor Obrador to consider BRT on a major urban arterial where it would get political exposure, and the decision was made to put the first corridor along Avenida Insurgentes, largely because the bus routes were controlled by only one private bus concessionaire, making institutional conversion easier. The GEF paid the salary of the staff person based in the municipal government that led the technical development of the project. The system, despite issues with the ticketing system and construction, is now carrying 250,000 passengers daily. While the GHG emission benefits have yet to be quantified, they are likely to be quite positive.

Detailed planning has also been done on a BRT system in Lima, Peru. The new system is fully designed, but as of the end of 2005, contracts for the construction of the BRT corridors and bus operations had yet to be awarded. Initially, the Lima BRT system was to receive GEF funds to finance the scrapping of older, highly polluting buses by the new BRT bus operators, but the scrapping component of the project has itself been scrapped. The actual construction of the system is to be covered by a joint loan from the World Bank and the Inter-American Development Bank, and not by the GEF. The BRT system in Lima has been continually delayed by political struggle with a competing metro project and general political turmoil.

TransSantiago's BRT project in Santiago, Chile, is similar to the bus sector reforms in Sao Paulo's Interligado system rather than the Bogota or Curitiba systems. Roughly 26 km of new exclusive bus lanes have been built, and bus routes have been restructured to reflect more trunk and feeder lines, increasing bus system profitability. Some new articulated buses have been procured, but the new bus lanes continue to have old buses operating on them. There is no prepaid platform-level boarding and alighting, and the system does not have a clear marketing identity. The few new buses procured operate both within exclusive bus corridors and also in mixed traffic.

Of the two sections of exclusive bus corridors, the first section was open for bus traffic in the fall of 2005.

The Dar es Salaam project is the farthest along of the GEF projects being funded for BRT in Africa. In this case, the GEF money is routed through the UNEP to the ITDP. This money is covering the business plan, the institutional development and capacity building of the BRT agency, which will be called DART. The physical design and operational plan, costing roughly $1 million, is being financed by a World Bank loan to the national government, but the authority for the planning has been vested in a project management unit under the Dar City Council. In this case, the World Bank is involved in the design and is a likely source of funds for implementation, but not with GEF funds. Though other implementation financing options exist, they come with more strings attached and are less desirable as a result. While the detailed designs should be completed in early 2006, it will probably be 2008 before implementation because of the time it is likely to take to put together the financing. A similar project in Dakar may be done under the UNDP, if the national government gives the project its approval. This second Africa project would probably also rely on the World Bank to finance the infrastructure.

The BRT projects being financed through the GEF by and large are good projects, and the institutions sponsoring them are quite competent. As with the NMT projects, however, the BRT projects are not categorically going to reduce GHG emissions. Several new BRT systems have been developed in recent years that have had adverse GHG impacts at least in their initial phases, such as the trial phase of the Beijing BRT system. The Beijing system initially carried less than 2,000 passengers per day, largely because there is no feeder system, the busway is only separated from mixed traffic where there is no congestion, and the busway enters mixed traffic at the most congested part of the corridor. In 2006, however, the line was extended to 15 km and ridership has increased to over 70,000 daily trips.

A project by TransJakarta in Indonesia had technical support from the ITDP using a U.S. Agency for International Development (AID) grant, but it financed the infrastructure and buses using general funds from the DKI Jakarta government budget. It is not yet a complete success, but it is politically successful, and the second and third corridors are already under implementation. The GHG emissions benefits have been significant.

The problems faced by the Indonesian project have been largely the result of underestimating the technical complexity of designing a successful BRT system, and an unwillingness to involve foreign experts directly in the design process. At first, the governor and members of his staff who had never even seen a BRT system began to design a system with curb level bus lanes and no enclosed stations. After technical staff visited BRT systems in Bogota and Quito under the U.S. AID project, the designs were changed to median bus lanes with prepaid boarding stations, but the stations were extremely small. After flying the governor of Jakarta personally to Bogota,

he ordered the stations redesigned. The system still uses buses with only a single door, which is creating passenger boarding and alighting bottlenecks.

A second problem stems from the lack of a feeder bus system and from allowing most of the existing bus lines to continue to operate in mixed, and congested, traffic lanes. The result of this decision was that ridership on the busway was lower than it could have been, and the continuation of many buses in the mixed traffic lanes significantly contributed to congestion in these lanes. As a result, travel speeds in the mixed traffic lanes dropped much more than anticipated.

These problems have cut the capacity of the Jakarta system to a third or less of what it could be. This has had an adverse effect on congestion and the concentrations of some transportation air pollutants. Evidence suggests, however, that the BRT has been successful in significantly increasing modal shifts. Some 19 percent of the TransJakarta passengers had previously been using taxis, private cars, or motorcycles. As of the fall of 2005, daily ridership has risen to a reasonable 75,000, and it has been increasing by about 10,000 daily passengers each year. Now that more parallel bus lines are being eliminated, passengers are being forced into two fare zones, with some adverse equity impacts, but this is also helping to decongest the mixed traffic lanes.

Ideally, BRT systems are designed to reduce mixed traffic congestion. This is not ideal in terms of maximizing short-term GHG emission reductions, but in the initial phase of a BRT project, political acceptance of the new system and building a political coalition for expanding the system is most important to the system's long-term impact on modal split. It is normally easier to win political acceptance for the system if even private motorists benefit from the new system. This is generally achievable in BRT projects by removing high volumes of existing buses from the mixed traffic lanes.

Other Areas for Future GEF Transport Sector Involvement

There are four other transportation project categories which are not currently receiving funding from the GEF but should be eligible under OP#11 enabling guidelines. They could play an important role in reducing transport sector GHG emissions. The project categories include TDM, traffic avoidance, nonmotorized vehicle improvements, and travel blending or social marketing. Brief descriptions of recent program activity in each of these areas follow.

Traffic Demand Management (TDM)

The potential GHG emission reduction benefits from TDM projects should in principle be far greater than through any other mechanism. As a result, the GEF should actively pursue projects in this area. As TDM is one of the

surest ways of inducing modal shift, such projects should be eligible for GEF funding under existing guidelines.

The success of the BRT schemes in Bogota, Curitiba, and other cities was in part made possible by the simultaneous implementation of a number of TDM measures. These measures reduce the total number of trips by a particular mode, normally private motor vehicle driving. It is important to distinguish such measures from traffic management measures generally aimed to increase the capacity of the existing road system, which tend to stimulate rather than suppress traffic. Assessing the separate impact of the BRT versus the TDM measure in this context is thus quite difficult. However, some countries have implemented only TDM measures, and these efforts provide some indications of the relative importance of this approach.

Congestion pricing is the holy grail of TDM measures, as it could, in theory, fully internalize the marginal social cost of operating a private motor vehicle into the individual's cost of making the trip. The recent political success of London's congestion charging scheme has proven that it is politically possible to implement congestion charging in a democracy. Singapore's area licensing scheme, which has recently been upgraded to include electronic road pricing, provides another example of congestion charging that has been successful.

Another fundamental obstacle to implementing TDM measures is political will. TDM measures are technologically, contractually, and institutionally complex, sapping enthusiasm of political leaders looking for quick fix solutions. Willingness on the part of the World Bank GEF to help Sao Paulo's former mayor with a pilot congestion charging project played an important role in overcoming the reluctance of political leaders to secure preliminary political commitment. The project stalled, however, when the mayor lost the election and the new mayor did not want to continue.

Finally, most cities indirectly subsidize on-street and sometimes off-street municipal parking by charging far less than market value for parking. In the developing world, undercharging for parking is an indirect subsidy for the wealthiest sector of the population. Many of the benefits of congestion charging could be achieved by internalizing parking charges.

Traffic Avoidance

The existing GEF guidelines mention traffic avoidance as a desirable goal of transportation programs. Traffic avoidance generally refers to programs that seek to eliminate motorized trips, mainly by individual passenger cars, in the long run through colocation of economic, commercial, and residential activity. Transit use and walking and cycling can be encouraged by increasing the density of development along corridors served by transit or provided with good walking and cycling facilities. Zoning regulations can be modified to encourage transit-oriented development. This has been successfully done in Curitiba and elsewhere. Such zoning changes do not really

require the involvement of the GEF because they can be implemented at the local political level with little direct cost.

More complex and difficult is intervening in the land development process early on to proactively encourage transit-oriented development. In the United States, rapid motorization and suburbanization starting in the 1920s and continuing today has led to a massive problem of urban blight that drove people from high-density urban environments to outlying suburban regions. This dramatically escalated the U.S. vehicle miles traveled and GHG emissions. The scale of this phenomenon in the United States is unique, but urban blight is spreading to numerous other megacities as motorization and suburbanization accelerate. Downtown Sao Paulo, North Jakarta, and the downtown brownfields of the former Socialist block countries are just a few examples of urban blight and rapid suburbanization.

Africa faces a unique problem. With a handful of exceptions, African cities were always historically associated with colonialism, and never became vibrant centers of indigenous culture. Developing viable projects to revitalize these city centers, particularly around transit nodes, will require a new set of technical and institutional skills and relationships that are largely absent in many developing African cities.

There is fairly limited international development bank involvement in traffic avoidance projects. No GEF funds have been used to support traffic avoidance measures, but the World Bank has funded some interesting urban revitalization projects in northern Africa with non-GEF funds, particularly in Morocco. The European Bank for Reconstruction and Development (EBRD) is exploring an urban revitalization project in Lublin, Poland. The Inter-American Development Bank has an ambitious city center revitalization project for downtown Sao Paulo that merits monitoring. These experiences need to be systematically assessed, and an appropriate role for GEF funds, if any, should at least be considered.

Low income housing projects that site new facilities on transit corridors should also be considered. The major development banks largely pulled out of the housing sector in the 1980s, but they have renewed activity. Housing loans have increased in Mexico, for instance, although there is still no direct linkage of these loans to transit-oriented development.

Nonmotorized Vehicle Interventions

The OP #11 guidelines do not clearly specify that nonmotorized transport interventions be focused on bicycle lanes, though in practice this is how the guidelines have been interpreted. While the initial focus on hydrogen fuel cell buses may have soured the GEF on working with the vehicle sector, to the extent that GEF funds are going to be used to make vehicles cleaner, they should also be usable to promote the dissemination of vehicles that do not generate any pollution. To date, there has not been any GEF activity in

this area, but there has been work done by NGOs in this area, with financing from a range of bilateral donors.

Nonmotorized vehicle interventions began in rural areas in the 1970s. Most were aimed primarily at increasing farmer productivity. The British-based Intermediate Technology Development Group (ITDG) and the consulting firm that grew out of this group, IT Transport, were early leaders in this area. In the 1980s, a large number of groups began exporting used bicycles from the United States, Japan, and Europe to Africa, mainly as a charitable activity. This has led to the emergence of a viable secondhand bicycle market in a few countries, especially Ghana. Studies indicate, however, that the vast majority of the bicycles are used in rural areas and few replace motorized trips; hence, their GHG emissions impact is marginal. Most did not lead to continuing viable commercial supply of nonmotorized vehicles or a viable bicycle industry. This industry has emerged independently in many countries.

Inspired by the successes of ITDG, which were primarily focused on rural poverty alleviation, the U.S.-based ITDP began in the 1990s to try to apply some of the lessons from these projects to urban areas. For years the Indian and Bangladeshi governments supported projects to improve cycle rickshaw technology, but none of them led to any significant commercial adoption as they remained based at university research departments.

In 1997, ITDP began a U.S. AID-funded Indian cycle rickshaw modernization project by working with existing cycle rickshaw manufacturers in the Agra and Delhi regions to make the vehicle more comfortable and to bring down the vehicle weight in order to attract more passengers. The cycle rickshaw had not substantially changed in design since its introduction in the 1940s. Being a technology used primarily by low income people, profit margins were low, and there was little capacity or incentive for the business community to modernize the vehicle.

The ITDP's technical experts worked with local industry to develop a rickshaw design that was more comfortable, 33 percent lighter weight, and carried more passengers and baggage, yet cost the same to produce. Thanks to extensive promotional work, this new design has caught on commercially, and there are an estimated 150,000 of these modernized cycle rickshaws on Indian roads, all being manufactured and sold with no subsidies. According to surveys by a local NGO called Lokayan, each vehicle makes on average nine trips per day, and their average trip length is 1 km. While most of their passengers were taken from traditional cycle rickshaws, 11 percent were diverted from bus trips, 6 percent from auto rickshaws, 19 percent from higher capacity auto rickshaws known as vikrams, and 2 percent from motor scooters. Using emission factors from Table 10-1 and the Urb-Air Study from Mumbai, an estimate of 3.2 tons of CO_2 emissions reductions per day is a reasonable estimate of the impact of this technological innovation. It is possible that the entire fleet will switch to the

modern design over the next decade. If this happens, 1,980 tons of CO_2 emissions may be reduced per day.

The entire rickshaw project cost was only $350,000. Moreover, the incomes of the cycle rickshaw operators increased by 20 to 50 percent. These operators are among the lowest-income people in India.

This project is currently being replicated for the becak, a vehicle similar to the rickshaw, in Indonesia under the auspices of the ITDP, Gadjah Mada University, GTZ, the Toyota Foundation, and Instrans, a local NGO. To date, roughly 110 modern becaks have been built, but finding a solid market has proven difficult. Unlike in India, where in many cities the market for new cycle rickshaws was tens of thousands of units per year, in Yogyakarta competition from motorcycles has led to a declining use of becaks, and the willingness of fleet owners to invest in new vehicles has been weak.

The ITDP is also trying to modernize and popularize the urban bicycle in Africa with its California Bike project. Many of the reasons for the lack of cycling in African cities are related to road safety, but some of the reasons are related to the immaturity of the bicycle industry. For decades, the traditional English roadster has dominated the African bicycle industry. When first introduced among the very poor, these vehicles were high-status items. As years passed, however, these bicycles became associated more and more with the rural poor. Lack of modern high-quality bicycles with trusted brand names undermined bicycle use among young people. Rather than switching to modern bicycles, much of urban Africa switched instead to cars and paratransit vehicle use.

The ITDP developed the California Bike in cooperation with Trek. The bike is one of the more expensive bicycles available in Africa, but it is at least 25 percent cheaper than any bicycle of equivalent quality available in the African market. By combining the sales of bicycles to small, independent bicycle dealers, donor agencies, government agencies, and large employers who sell the bikes to their own staff through payroll deduction schemes, the ITDP has managed to sell all 1,920 bicycles sent to four countries—Ghana, Senegal, South Africa, and Tanzania—in 2004, and earned a 16 percent rate of return on its initial investment. The project has brought 35 independent private bicycle dealers into a distributors network and trained them in modern business techniques. A second shipment of an additional 1,920 California Bikes arrived in Africa in 2005 and the bicycles are selling well.

Travel Blending or Social Marketing

Travel behavior is in part cultural. People take more polluting modes mainly because they are cheaper, faster, and more convenient, but there is also a cultural element in the decision-making process that should not be overlooked. Most people find it difficult to switch all of their trips to

nonmotorized and less-polluting modes, but recent efforts show that many people can easily be convinced to switch to less polluting modes for at least some of their trips with modest levels of effort. Recent studies show that cultural attitudes not only are important, but they are also subject to influence through social marketing and should not be seen as an excuse for doing nothing.

Bogota's Mayor Penalosa used the mayor's office as a bully pulpit to promote car-free days, car-free Sundays, and other high-profile public events that were able to create a culture of walking and cycling. The international Car Free Days movement has caught on in Europe and many cities in the developing world, from Surabaya, Indonesia, to Chengdu, China, to Paris, France. The ITDP and other NGOs have sponsored similar events around the world to great effect.

Several cities in Australia and Europe have developed a new technique for achieving dramatic changes in mode shares at very low costs through a form of social marketing known as "travel blending." The idea is to give people more information on their commuting options through a completely personalized process and then facilitating changes in travel behavior. While the focus to date has been in developed countries, recent successes in Santiago de Chile indicate that it may be applicable to higher-income developing economies.

The technique involves phone contact with all households in the area, identifying the proportion of respondents who would be interested in making some changes in travel behavior and supplying them with information, such as public transport timetables and maps of cycling routes. Household visits are conducted with interested respondents. Respondents are asked to complete seven-day travel diaries, which teams later analyze to devise suggestions on alternatives for the participant. In some cases the diaries and interviews lead to changes in the local transportation systems—such as better access to public transport services, new bus stops, provision of new timetables, and the extension of service hours.

The results to date have been remarkable. In the first trial in Perth, Australia, approximately $61,500 was expended to conduct the surveys and provide information. Of the 380 households targeted, the program produced a 6 percent decrease in auto use immediately and an additional 1 percent decrease after 12 months. Public transport trips rose from 6 percent of all trips to 7 percent, and cycling trips doubled from 2 to 4 percent. The results have held even two years after the assistance was delivered. The technique is now being applied throughout Australia and in some cities in Europe, where similarly impressive results are being achieved at extremely low costs.

The consulting firm Steer Davies Gleave implemented a travel blending program in Santiago, Chile. The Santiago results suggest that travel blending could become part of an effective, low-cost emissions reduction package for cities in developing nations. Steer Davies Gleave reports an

astonishing 17 percent reduction in car driver trips as a proportion of combined participating and nonparticipating households, with a 23 percent reduction in kilometers driven and a 17 percent drop in the time spent traveling (Hutt, 2002).

Travel blending techniques may be well suited to an active role by NGOs, particularly in the collection of survey data and the development and dissemination of transport alternatives. In many communities, NGOs maintain a close dialog with residents and thus would be well suited to this sort of activity.

Conclusions

The GEF is an increasingly important source of financing for bringing about a fundamental transformation in travel behavior that could dramatically reduce the level of GHG emissions being generated from the transport sector. This benefit is disproportionate to the money it brings because it overcomes the critical structural difficulty faced by the development banks: proactively generating good projects worthy of bank financing. After a questionable start, the priorities of most recent GEF projects are well focused on reasonable projects with promising opportunities to bring about significant GHG emission reductions. Now the challenge is to ensure the implementation of successful projects. Everyone has a stake in their success.

References

ECMT/OECD. *Urban Travel and Sustainable Development*. Paris: 1995.

Global Environmental Facility (GEF). *Operational Program #11: Supporting Environmentally Sustainable Transport.* 2001.

Hutt, G. Una herramienta para el cambio de conducta. Tranvia, No. 18, 1 July 2002. www.revistatranvia.cl/revista/tv18.

International Energy Agency. *Sustainable Urban Transport Program (SUTP) Draft Final Report.* Paris: IEA, 2002.

Karekezi, S., L. Majoro, and T. Johnson. "Climate Change and Urban Transport: Priorities for the World Bank." Washington, D.C.: Environment Department, The World Bank, 2002.

Menckhoff, Gerhard. Interview by telephone to Washington, D.C. August 2005.

Sperling, D. and D. Salon. *Transportation in Developing Countries: An Overview of Greenhouse Gas Reduction Strategies.* Arlington, VA: Pew Center on Global Climate Change, 2002.

World Bank. *Cities on the Move: A World Bank Urban Transport Strategy Review.* Washington, D.C.: World Bank, 2002.

Wright, L., ed. *Bus Rapid Transit Planning Guide*, 3rd ed. New York: ITDP, 2006.