

Climate Change and Urban Transportation in Latin America

Analysis of Recent Projects

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Urban transportation investments present an opportunity to mitigate climate change while supporting effective, clean, safe, and equitable transportation. This study reports on the response of a set of urban transportation investments in Latin America to climate change. A sample of recent transportation projects funded by an international bank was analyzed to learn what kinds of infrastructure, plans, and policies were being pursued and to assess whether projects developed specifically to address climate change differed from other projects. Loans and grants supported a mix of infrastructure for transit, bicycles, and pedestrians, as well as institutional strengthening. Although only a few projects explicitly addressed climate change mitigation, their impacts on mode choice and urban development almost surely have had positive effects compared with what would have happened without them. In some cases, however, funding for road construction at the urban fringe may induce outward urban expansion and greater automobile use. Specifically analyzing the carbon consequences of all projects as well as their combined effects in the overall system would provide better ability to track and take credit for carbon mitigation and also could flag potential problem areas.

This study explores how recent transportation projects in Latin American cities address, or could address, climate change mitigation. Projects examined include those specifically designed to affect climate change and the broader set of urban transport interventions.

Two methods were used to investigate the research questions: an analysis of the publicly available project documents for urban transportation work by a major international bank operating in Latin America and an analysis of their publicly available environmental and economic assessments.

The set of projects reviewed, all implemented between 2000 and 2008, included only a few official climate change projects, accounting for a tiny fraction of the overall investment, but many other projects of essentially the same character were implemented without an explicit climate change charge. Those charged with climate change included mass transit planning, equipment, and infrastructure; pedestrian and bicycle planning and infrastructure; and studies of land use, automobile use, and their greenhouse gas (GHG) impacts. Conven-

tional urban transport and urban development projects included many of these same elements. Thus, the broader set of urban transportation investments being made in Latin America aimed to reduce vehicle kilometers traveled compared with what might otherwise occur and contributed to climate change mitigation in the region even though they did not state that objective explicitly. One caveat concerns urban road projects. These projects may in some cases lead to development patterns that are dependent on motorized transport, especially at urban peripheries. Their assessment as part of any GHG analysis would therefore be very important.

CLIMATE CHANGE AND TRANSPORTATION: BACKGROUND

Urban transportation investments affect global GHG emissions regardless of whether their plans explicitly address this issue. Every new road, bus line, and bikeway has an effect on the local transportation and land use system. Wheeler and Beatley's anthology (1) of sustainable urban development illustrates the systemic, interconnected nature of urban systems and emphasizes the links between them, arguing that negative consequences of development can be managed when evaluated together instead of in isolation. Aspects of urban systems that should be considered alongside transportation include land use and design, urban ecology, economic development, energy, architecture and building, indicators and analytical tools, institutional design, and forms of governance. Deakin (2) presents a similar argument, offering specific strategies for sustainable transportation, including elements such as vehicles, fuels, roads, demand management, pricing, and land use planning. Sustainable transportation in developing countries uses similar logic, but it can present key differences. Developing countries may urbanize more rapidly, within different political and institutional contexts, and with some different technologies. Thus it is important to pay attention to the details of the local case (1, 3).

Several organizations offer specific strategies and policy frameworks for reducing carbon emissions from the transportation sector. The World Business Council for Sustainable Development (WBCSD) centers sustainable transportation on global economic development, emphasizing that countries do not necessarily face a trade-off between mobility and growth if they invest in transportation that is sustainable. The WBCSD proposes cleaner vehicle technologies and fuels, greater efficiencies in traffic flows, and shifting to less polluting modes (4). Information on fuels and vehicle technologies may be found elsewhere (5). The Organization for Economic Cooperation and Development provides a similar assessment of the link between mobility and economic growth

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and outlines a policy framework for improving transportation sustainability through pricing and economic instruments as well as regulation (6). These interventions would generally have the dual impact of promoting cleaner and less carbon-generating vehicles and fuels and encouraging greater use of collective and nonmotorized modes. The International Council for Local Environmental Initiatives provides reports aimed at guiding local governments toward climate-friendly transportation systems by providing examples of transport policy and design strategies (7). Here too the emphasis is on a multipronged approach involving vehicles, fuels, and less polluting modes.

In addition to the literature about transportation, there is a broader literature concerning the political economy of climate change mitigation and development (8), as well as policy frameworks to address global equity and fairness (9, 10). In some cases this literature approaches climate change as a technical problem of getting the right financial instruments to deliver enough resources to sectors and technologies that will reduce carbon emissions (11, 12), and sometimes it evaluates the performance of particular financial instruments, such as the Global Environment Facility (GEF) (13). Other documents focus on the political ramifications of already high levels of emissions per capita in the developed world versus rapid growth in emissions from developing countries, especially those in the middle-income categories [see, for example, the study by Chandler et al. (14)].

In this latter context, Latin America's relatively small contribution to global GHG emissions is important to note. In 2006, the world average emissions per capita was 4.3 metric tonnes, whereas Latin America's carbon emissions per capita were only 2.5 metric tonnes, or about 60% of the world average. Even by 2020, emissions per capita in Latin America will be small compared with those of the United States or the European Union (15). Nevertheless, Latin American emissions from transportation are growing, and light-duty vehicles in Latin American metropolitan areas generate most of these transportation emissions. Technology forecasts currently suggest that new fuels and vehicles could reduce emissions per kilometer by 30% by 2030. But car use is expected to grow by 300% during the same period unless additional steps are taken to moderate this increase (15).

Although questions remain about the responsibility of developing countries for climate change mitigation, the World Bank recently has published a number of studies on climate change in Latin America, arguing for Latin American participation in countermeasures (16, 17). World Bank experts believe that global warming impacts are already being felt in the region, in higher temperatures, more hurricanes, loss of glacier and snow mass, and extreme rain events in some locations and sharp declines in rainfall in others. For several Latin American countries, including Mexico and Colombia, the effects on agriculture could be devastating; in other countries, including Peru, freshwater availability to coastal populations could be threatened. Thus, self-interest would be one motivating factor for Latin American participation in climate change mitigation, in transportation as well as in forestry, agriculture, and the commercial and industrial sectors (16). Although the contributions of many Latin American countries to carbon emissions are relatively small and it is important for mitigation to occur among the world's largest emitters, some Latin American countries are already active in climate change actions. For example, Brazil is a leader in the use of biofuels, and Mexico is often called out as a leader in climate change mitigation. The high-quality public transit systems in Latin American cities such as Bogota and Curitiba also serve as examples of how urban transportation can be a strategy for mitigating GHG emissions (17–19).

CASE STUDY: ROLE OF WORLD BANK IN LATIN AMERICAN URBAN TRANSPORT

In this study, projects from the World Bank's Latin American grants and loans for urban transport were sampled to identify the extent to which they contribute to carbon mitigation. The World Bank is one of several international banks and development organizations working in Latin America; the Inter-American Development Bank (IBRD) and the Andean Development Corporation are examples of similar organizations doing similar work. The World Bank was selected as a case study because the urban transportation and urban development projects receiving its support are exemplary of urban transportation strategies in the region and serve as models for development.

The World Bank is actually two institutions, the IBRD and the International Development Association (IDA). The IBRD, by far the bigger of the two units, provides loans and other assistance to middle-income countries as well as to poor countries deemed credit-worthy. Nearly all Latin American and Caribbean countries are in the middle-income category (as are Eastern Europe, China, and Russia). The exceptions are Bolivia, Guyana, Haiti, Honduras, Nicaragua, and the island nations of Dominica, Grenada, St. Lucia, and St. Vincent, which are in the IDA recipient group. For the middle-income countries, World Bank services include analysis and advice, financial products, and assistance with implementation of financed projects. For the low-income countries, the bank provides zero-interest financing, donor coordination, and specialized support.

Through the IBRD and IDA, the World Bank offers two basic types of loans: investment operations loans for projects and development policy operations loans, which are for institutional reform. Loans are a key element in the bank program, but advisory services are also important elements of the bank's activities. Several sources examine how the bank positions itself as a source of technical knowledge and expertise as well as a financial institution and in so doing affects policy and practice in the countries served (20–22). For example, Smith (20) showed how the World Bank's role as a knowledge bank had important implications for policy and practice in South Africa: South African policy makers internalized the best practices learned through technical assistance and pursued a technical approach to development that was consistent with the World Bank's advice.

The literature also shows that the World Bank policies expressed in environmental and social loan conditions are frequently adopted by countries as their own. For example, Sarfaty (23) discusses how World Bank policies on indigenous rights and environmental protection have become de facto laws for some countries and were replicated as well by other organizations. World Bank policies on climate change, as well as its standards, analytical approaches, and projects addressing climate change, could likewise be adopted by partners in this same way. In turn, bank staff also participate in a variety of technical and professional networks and through those networks often debate, and sometimes adopt, ideas developed in other policy arenas. For example, the safeguards for indigenous rights, resettlement, environment, and other issues were developed through a process of internal debate within the World Bank as well as debate involving activists outside of the bank (23, 24).

DATA AND METHODS

World Bank's Urban Transportation Projects in Latin America

The researchers set out to explore how a sample of urban transportation projects in Latin America, funded by the World Bank, addressed

climate change. The relatively small number of projects explicitly identified as directed toward climate change were reviewed and many others affecting urban transport that were not.

The World Bank maintains a project database that categorizes its loans and other projects by World Bank sectors (i.e., bank policy groups) that are involved (25). With this database, the researchers' first step was to flag all projects that had approval dates no earlier than January 1, 2000, and included at least some funding for transportation. This search returned 261 candidate projects, of which the World Bank's transportation group administered 161 and other groups such as governance, urban development, economic policy, water, and poverty reduction administered the remainder. Omitting dropped projects, the total budget for these projects was about U.S.\$20 billion, and the IBRD and IDA contributions were about U.S.\$11 billion and U.S.\$440 million, respectively.

Next, the list was narrowed to projects that were judged relevant to urban or metropolitan transportation and development. For some projects this was obvious; that is, the project funded an urban transport improvement directly. Other projects required more investigation. Rural poverty projects were included that funded infrastructure such as an urban boulevard or urban bypass, but road projects that were not explicit about whether there was an urban element were omitted. Also included were projects that focused on institutional strengthening around road network planning because of their potential influence on long-run urban development, but projects that were narrowly focused on paving, rehabilitation, or asset management without a spatial or network planning element were not included.

Of the original 261 projects identified for potential inclusion, 69 (26%), worth about U.S.\$6 billion, were omitted because it was determined that they were not related to urban transport; another 60 (23%) were left out because they had been dropped (either discontinued or combined with other projects). An additional 80 projects (31%), worth about U.S.\$6 billion, were omitted because there was no access to documentation (72) or because the documentation was insufficient for the purpose (8). Of the projects omitted because the details were unavailable, the vast majority were for technical studies, training, and other forms of technical assistance or were for proposed loans that had not yet been fully approved.

Of the remaining projects, nine were studies commissioned by the World Bank on topics relevant to metropolitan transportation such as competition in the transport sector, infrastructure and economic development, and infrastructure regulation. One of these studies was an urban transportation policy strategy for Panama. Unfortunately, the documentation for these studies did not include information about their development and costs.

Ultimately, it was confirmed that 41 projects were relevant to metropolitan development and urban transportation and had enough publicly reported data for analysis. Of these 41 projects, the bank's transportation group administered most of them (26). The others were administered by urban development (7), environment (5), and water (3). The total value of these projects was about U.S.\$10 billion.

For each of the 41 projects in the sample, data were collected from project preparation documents on project components (what the loan is used for), project costs, and loan amounts. In general, all of the available documents were used to collect and cross-check information, but the most consistent source of information came from project appraisal documents, which are created midway through the project development cycle and therefore may not always include the most up-to-date information. The 41 urban transportation projects in the data set were categorized on the basis of the aims of the overall project as well as on the characteristics of each component. The components

in the data set, and the logic behind their assignment, are described in Table 1. Each project can include a mix of components from several categories. For example, a climate change project may include components for transit infrastructure, water infrastructure, municipal improvements, technical assistance, and institutional strengthening.

A number of large transit projects included improvements to roads (and many included traffic management and technical training). In these cases, the overall project was classified as transit and the components were further classified according to the overall objective for including the component. For example, traffic signals provided for a bus rapid transit (BRT) project were coded as transit infrastructure. Where policy development was part of a project (e.g., air quality management), these aspects were classified as institutional strengthening (see Table 1).

The resulting set of projects and classifications were judged reasonably representative of the bank's lending for urban transport projects in Latin America during the 2000–2008 period. For example, the data set includes several projects for each of Latin America's most urbanized countries where the World Bank carries out most of its urban transportation work. Moreover, 59% of the 220 projects excluded from the data set would not have had any effect on the findings because they were not urban projects or because they were not implemented. Thirty-six percent of the excluded projects were dropped because the details were not available to the researchers, and these documents included many technical assistance activities. Thus the data set does not represent the bank's many important technical assistance activities. More broadly, the quality of the data for the projects reviewed was good and the data were comparable across projects because lending projects require thorough review before they can be approved.

Reviewing Projects' Cost–Benefit and Environmental Analyses

In addition to reviewing project preparation documents for data about components and financing, the cost–benefit and environmental analyses that these documents summarize were also reviewed. These project reviews are key areas in which climate change considerations could be included, such as an estimation of a project's carbon emissions savings or generation. The publicly available project appraisal documents provided only summaries of the full analyses, but in most cases these were sufficient for understanding the topics covered and the data and methods used. The full documentation of the projects was not available.

PROJECT ANALYSIS

Of the 41 projects reviewed, 10 were in Argentina, 6 in Colombia, 5 each in Brazil and Mexico, and 4 in Chile (Table 2). Three-fourths of the projects in the data set were in these five countries, and they account for roughly 90% of the total project costs and lending considered here.

Overall, World Bank loans paid for about 44% of the total costs of these urban transportation projects. GEF grants administered by the bank—grants that support urban transportation projects addressing climate change explicitly—accounted for only half a percent of the 41 projects' total costs. Carbon finance funds (where a project sells its carbon emissions savings for a price on the carbon market) were a minuscule 3/100 of a percent of total project costs. Most of

TABLE 1 Components in Sample of Urban Transportation Projects, 2000–2008

Component	Description
Community development and participation	Stakeholder participation in a planning or policy-making process. May also include funding for the process.
Economic development	Economic development planning, works, and technical assistance.
Fleet improvements	Vehicle acquisition, replacement, and scrapping.
Freight rail infrastructure	Freight rail infrastructure and freight operations improvements.
Institutional strengthening	Activities that change or enhance planning or policy-making processes, markets, laws, government operations, and other institutions. Funding that supports ongoing monitoring and technology support for legal or institutional reform. May include technical assistance or physical infrastructure (e.g., a new government building).
Mixed infrastructure	Physical infrastructure for water, transport, social services, historic preservation. May include funding for technical assistance, monitoring, evaluation, auditing, and supervision.
Nonmotorized transport	Physical infrastructure, education, promotion, policy, and planning for nonmotorized transport. May include funding for technical assistance, monitoring, evaluation, auditing, and supervision.
Project management	Technical assistance, monitoring, evaluation, auditing, and supervision. May include consulting fees and the direct funding of operations.
Public campaign	Public campaign to promote, educate the public about an issue, or both.
Rail infrastructure	Rail infrastructure, institutional strengthening for rail. May include funding for technical assistance, monitoring, evaluation, auditing, and supervision.
Roads	Road construction, maintenance, paving, design, planning, policy, management, and safety. May include funding for technical assistance, monitoring, evaluation, auditing, and supervision.
Social service provision and facilities	Design, construction, operation, management, and planning for community services and facilities.
Technical assistance	Studies and technical support for project components, especially the design, planning, and engineering of physical infrastructure or the design and planning of institutions and policies. May include funding for policy work and planning that would overlap with institutional strengthening, but emphasizes the technical support.
Transit infrastructure	Policy, planning, design, engineering of transit infrastructure, including roads, rail, buses, mass transit systems operation, nonmotorized transport infrastructure. May include funding for technical assistance, monitoring, evaluation, auditing, and supervision.
Travel demand management	Studies and policy and planning work to manage automobile use.
Water infrastructure	Water infrastructure for drainage, sewage, and sanitation. May include funding for technical assistance, monitoring, evaluation, auditing, and supervision.

TABLE 2 World Bank Urban Transportation Projects in Latin America, 2000 to Present: Country and Type of Funding

Country	Number of Projects	U.S.\$ Millions			
		Total Project Cost	World Bank Loan	GEF Grant	Carbon Finance
Argentina	10	3,425.2	1,800.0	0.0	0.0
Belize	1	18.4	13.0	0.0	0.0
Bolivia	2	314.4	107.0	0.0	0.0
Brazil	5	2,759.9	893.3	0.0	0.0
Chile	4	80.2	65.0	7.0	0.0
Colombia	6	1,384.9	744.0	0.0	0.0
Costa Rica	1	79.7	72.5	0.0	0.0
Honduras	1	64.6	48.6	0.0	0.0
Jamaica	1	32.8	29.3	0.0	0.0
Latin America ^d	1	79.3	0.0	20.8	0.0
Mexico	5	1,467.6	468.0	6.8	17.4
Nicaragua	1	69.9	60.0	0.0	0.0
Panama	1	100.0	50.0	0.0	0.0
Peru	2	142.3	45.0	7.9	0.0
Total	41	10,019.2	4,395.7	42.5	17.4

^dOne regional climate change project has initiatives in multiple countries (Argentina, Brazil, and Mexico), and the World Bank classified its country as Latin America.

the urban transport funding reviewed went for road and transit infrastructure. On the basis of the classification of the projects, mass transit projects captured 46% of total expenditures and urban road projects another 32% (Table 3). The pattern is the same for the components in the projects in the data set: transit infrastructure components accounted for 47% of total expenditures and road infrastructure components accounted for 35% (Table 4). Another 9% of expenditures were for municipal improvement projects and 8% for projects involving a mix of road and transit infrastructure, community and economic development, land regularization, and municipal services improvements. Only 1.3% of project expenditures were toward climate change projects. GEF grants provided the main support for projects that were explicitly about climate change.

One of the main findings from the project analysis is that there is little difference between climate change projects and regular mass transit projects, since they are conceptualized and implemented by the World Bank. Both include infrastructure for transit facilities and access (e.g., feeder roads and routes, bicycle and pedestrian infrastructure and planning), as well as urban development and transportation planning. The main differences between the two kinds of projects were that climate change projects included support for climate change mitigation assessment and travel demand management. Another difference is that none of the climate change projects in this review funded urban rail projects, but conventional mass transit projects did fund rail. Both mass transit and climate change projects also funded fleet improvements, institutional strengthening, bicycle and pedestrian infrastructure and promotion, and technical assistance.

TABLE 3 World Bank Urban Transportation Portfolio in Latin America, 2000–2008: Project Type

Project Type	Total Project Cost		World Bank Loan		GEF Grant		Carbon Finance	
	U.S.\$ Millions	%	U.S.\$ Millions	%	U.S.\$ Millions	%	U.S.\$ Millions	%
Climate change	105.3	1.3	0.0	0.0	33.4	80.8	0.0	0.0
Development policy loan	210.2	2.6	210.2	5.8	0.0	0.0	0.0	0.0
Mass transit	3,756.7	45.9	1,418.4	39.1	7.9	19.2	2.4	100.0
Mixed infrastructure	667.6	8.1	519.6	14.3	0.0	0.0	0.0	0.0
Municipal improvements	754.0	9.2	304.3	8.4	0.0	0.0	0.0	0.0
Road infrastructure	2,605.9	31.8	1,107.8	30.5	0.0	0.0	0.0	0.0
Water infrastructure	91.4	1.1	69.8	1.9	0.0	0.0	0.0	0.0
Total	8,191.0	100	3,630.1	44.3	41.3	0.5	2.4	0.03

This finding suggests that all of the transit projects can in some sense be considered climate change projects, producing benefits along the same lines as those projects explicitly slated for climate change.

Although the majority of the projects funded urban transit, road building in urbanizing areas also accounted for a significant proportion of the projects in the data set. These road projects included investments in road infrastructure as well as training and institutional strengthening in highway planning, safety, and asset management. Specifically, these projects supported road widening and removal of bottlenecks; bridge, intersection, and bypass construction; and road rehabilitation and maintenance programs.

GEF grants and carbon finance funds—financial instruments associated with climate change projects—supported institutional strengthening, travel demand management, pedestrian and bicycle infrastructure, and mass transit, albeit in relatively small amounts compared with traditional loans.

WORLD BANK ENVIRONMENTAL AND ECONOMIC REVIEWS OF PROJECTS

The World Bank's project development process includes several reports and reviews in which consideration of climate change issues could be introduced. However, at the current time, the bank does not require an evaluation of climate change issues.

The bank and partner countries prepare an overview document called the country assistance strategy (CAS), sometimes known as a country partnership strategy (CPS). The CAS is a high-level policy strategy for each country, and it sets for a plan for future project work. The World Bank and ministries in the partner country work together to create the CAS. This plan joins a country's own development goals with the World Bank's assessment of the country's needs, which results in a set of strategic areas for partnership and an accompanying set of goals and performance measures.

TABLE 4 World Bank Urban Transportation Portfolio in Latin America, 2000–2008: Components

Component	Total Project Cost		World Bank Loan		GEF Grant		Carbon Finance	
	U.S.\$ Millions	%	U.S.\$ Millions	%	U.S.\$ Millions	%	U.S.\$ Millions	%
Community development & participation	6.7	0.1	2.5	0.1	0.0	0.0	0.0	0.0
Economic development	2.0	0.0	2.0	0.1	0.0	0.0	0.0	0.0
Fleet improvements	6.5	0.1	0.0	0.0	3.3	8.0	0.0	0.0
Freight rail infrastructure	6.6	0.1	5.9	0.2	0.0	0.0	0.0	0.0
Institutional strengthening	361.9	4.4	285.0	7.9	7.5	18.2	2.4	100.0
Mixed infrastructure	589.2	7.2	285.7	7.9	0.0	0.0	0.0	0.0
Nonmotorized transport	20.8	0.3	1.4	0.0	10.5	25.3	0.0	0.0
Project management	59.2	0.7	29.6	0.8	2.7	6.5	0.0	0.0
Public campaign	0.3	0.0	0.0	0.0	0.2	0.4	0.0	0.0
Rail infrastructure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Roads	2,828.7	34.5	1,279.2	35.2	0.0	0.0	0.0	0.0
Social service provision & facilities	19.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Technical assistance	166.4	2.0	83.4	2.3	5.7	13.8	0.0	0.0
Transit infrastructure	3,839.9	46.9	1,435.7	39.5	8.6	20.9	0.0	0.0
Travel demand management	6.3	0.1	0.0	0.0	2.8	6.8	0.0	0.0
Water infrastructure	277.1	3.4	219.7	6.1	0.0	0.0	0.0	0.0
Total	8,191.0	100.0	3,630.1	44.3	41.3	0.0	2.4	0.0

Using the CAS as an opportunity for strategic environmental review has been identified by previous authors as an appropriate place to introduce meaningful environmental reviews (26), and some of the documents in fact do so. For example, Mexico's CPS document discusses Mexico's leadership on climate change issues. It also sets forth carbon dioxide (CO₂) emission goals under the larger environmental sustainability goal and mentions that the World Bank has 25 ongoing climate change initiatives in Mexico. Although Mexico's CPS includes these ideas, their inclusion is not a widespread practice (27).

Another point of intervention would be in the environmental reviews of projects. The bank has established formal procedures (but not additional funding) for forecasting and mitigating potential negative impacts of the projects the bank funds (26). The preimplementation project appraisal process includes in-depth social and environmental impact analyses intended to act as safeguards. Each appraisal checks whether any of the bank's safeguard policies are triggered (e.g., environmental assessment, natural habitats, pesticide use and pest management, cultural property, involuntary resettlement, indigenous peoples, forests, safety of dams, projects in disputed areas, and projects on international waterways). These appraisals could provide an opportunity for carbon emission assessment, but such assessment is not currently required. These assessments are discussed further later.

In addition to preimplementation reviews, projects funded by the World Bank receive postimplementation evaluations by both the World Bank and independent consultants. Loans dedicate funding for conducting such evaluations. The World Bank provides the evaluations that it carries out as part of its project documentation (in the project database). These evaluations were reviewed when they were available, but they mostly addressed objectives defined internally rather than the full range of effects. Additional evaluations carried out by the borrowing country are not available through the World Bank, and they were not reviewed as part of this analysis.

Environmental Review

World Bank operational policy requires environmental assessment for all projects to evaluate the project's potential risks and impacts, consider alternatives, and inform the design and implementation of the project. The environmental assessments consider local impacts as well as "transboundary global environmental aspects" such as climate change (28). Depending on the potential impacts identified during an initial screening, a project may be subject to one or more of a variety of assessment instruments. World Bank policy also states that when a borrower does not have sufficient institutional capacity to participate in the environmental review identified by the World Bank, the project will include institutional strengthening in this area for the borrower. Goodland explains that task managers must secure grants to cover the costs of these studies (26).

The environmental and social assessments included in the project appraisal documents for the 41 urban transportation and metropolitan development projects in the data set were reviewed. These documents summarize the environmental evaluations and plans but do not present the full environmental assessment for each project. They focused primarily on the protection of local project impact areas and were concerned with limiting the scope of the impact by operating within existing rights-of-way, for example. The reviews were not coordinated across different projects in a city or country.

These documents also report on potential environmental benefits from projects, including improved air quality from lower emissions or air pollutants. The air quality studies estimated the additional or saved emissions compared with a baseline scenario. The analyses also considered the short-, medium-, and long-term effects of projects. For the three projects funded with climate change instruments such as the GEF, the assessments included forecasts of the reductions in GHG emissions expected for the project. Otherwise, GHG emissions were not analyzed for the projects in the data set. This is an area in which technical capacity could be directed to producing estimates of GHG emissions, as well as other relevant impacts such as car use, and urban development patterns for a baseline scenario and for project alternatives.

Economic Review

The World Bank conducts economic evaluations of projects following a cost-benefit approach by comparing the discounted expected present value of the net benefits of a project scenario compared with alternative scenarios, including doing nothing. The analyses use country-specific discount rates in the range of 10%, projecting costs and benefits 10 years into the future for paving interventions; 20 years into the future for roads, transit, and nonmotorized transport projects; and 30 years for water, sewerage, and drainage projects. The evaluations also consider nonmonetary benefits of projects (29).

The project appraisal documents available for the projects in the data set summarized the original economic evaluations, and these included analyses of at least two scenarios—with and without the project—and sometimes included other alternatives depending on the uncertainties of the project at the time of the evaluation. Without the full economic analysis for each project, it is difficult to know all of the assumptions and decisions that were part of the analysis, but the patterns that were found in the evaluations summarized in the project documents are worth mentioning.

The road projects reviewed identified reductions in vehicle operating costs, road maintenance expenditures, and travel time as key benefits. The evaluations used the Highway Development and Management model (HDM-4 in most cases, or sometimes HDM-3) to estimate the value of these benefits. HDM-4 can also model vehicle emissions, including factors for vehicle age, congestion, and other variables, but the documents reviewed for the road projects did not report on emissions (30). Using this model to forecast GHG emissions would be a straightforward way to begin quantifying the carbon impact of projects.

Urban upgrading projects evaluated transportation improvements by analyzing their effect on property values with hedonic price models. One project found that the sidewalk, stairway, and road improvements (considered together) increased monthly rents by 27% (31). Projects also considered the fuel savings from trunk road improvements (due to increased speeds). However, despite the sophistication of the analyses carried out, the analysts did not take them to the next step by asking what effect the rent increases would have on location choices and mode shares or how induced demand for the trunk road or any modal shifts or location shifts would affect traffic and speeds, and thus emissions.

Urban mass transit projects analyzed time savings benefits for all modes, various reductions in costs, the benefits of trips generated by the new service, and reductions in air pollution and traffic crashes. From the descriptions of methods in the appraisal documentation,

the evaluations used different methods depending on the quality and availability of data. One project explicitly used EMME/2 to model regional transportation; other projects used simpler estimates. Most projects had data about average daily traffic and transit level of service. However, in some cases, the consultants doing the evaluations needed to collect original data to make their estimates.

Calculations of the benefits of air pollution reductions accounted for passengers shifting from bus to rail and fleet upgrading but did not always include emissions saved from shifting automobile trips to transit. This omission may be the result of demand analyses that show minimal switching from automobile trips to transit trips as a result of the improvements, or it could be a lack of data on mode choice. The details were not reported in the documents reviewed.

The appraisals of climate change projects measured a range of benefits consistent with other similar projects and included additional analyses of CO₂ emission savings. Again, the methods for making these estimates ranged from regional modeling to simpler analyses, depending on the availability and quality of data.

Two of the climate change projects used a simple ASIF approach (32)—where ASIF stands for estimates of Activity A in total vehicle kilometers, shares by Mode S, Intensity I or fuel use per kilometer for each mode and fuel, and the CO₂ content of fuel type F—to estimate changes in fuel use and CO₂ emissions due to the projects. For one GEF project the analyst used ASIF to estimate the reduction in GHG emissions in an urban transportation environment that would result from the implementation of a hypothetical, representative BRT system. A second GEF project used the ASIF approach to estimate the overall project impact on CO₂ emissions and noted that this would be the method used throughout the project for CO₂ assessments. In each case, the analysts used a combination of data and measurements both from project cities and from other comparison cities to construct the scenarios and support assumptions.

None of the evaluations of climate change-related projects accounted for potential changes in settlement patterns, origin-destination patterns, or trip generation rates in their estimation of travel demand or benefits, and only two considered increasing motorization in their models (one other project assumed that motorization would decrease). Although the models did not include any of these topics in their estimates, they were nonetheless discussed with more depth in the climate change and mass transit projects than in roads or urban services projects. The climate change and transit documents discussed the relationships between GHG emissions, motorization, urbanization, and transportation investments, but the road project documents did not mention these relationships.

DISCUSSION AND CONCLUSIONS

How is the World Bank responding to climate change in its urban transportation operations in Latin America? In explicit terms, it is responding by obtaining GEF and other grants for projects where staff can demonstrate potential carbon emission savings. However, in the period analyzed, GEF grants and carbon finance were only a tiny portion of the bank's total outlay for urban transportation in Latin America. One reason for the small scale of carbon finance and GEF funding is the lack of carbon accounting as a regular part of project analysis. A second reason is the relative difficulty of obtaining these funds, particularly in light of the low price for carbon and the high costs and resource constraints of project preparation. The bank's role was much larger in lending for transit projects and related improvements, but in most cases the bank did not assess the

carbon savings of these investments. At the same time, the bank invested in highway projects, at least some of which may reshape metropolitan areas and alter mode choices; here too the carbon impacts were not analyzed.

Overall, transit projects are doing a somewhat more sophisticated job of modeling systems effects than are highway projects. This finding may be because the World Bank maintains an organizational distinction between road projects and urban transport, even when its road projects are in urban areas. A multimodal systems analysis approach would surely produce more robust results. In addition, project analyses could strengthen the treatment of secondary impacts due to feedback effects, especially with regard to location and land use shifts.

Bank-supported urban mass transit projects often include facilities and planning for nonmotorized transportation, pay some attention to land use and settlement patterns, and include funding for transportation and land use planning, studies, and capacity building. By pursuing a range of established transportation goals (e.g., accessibility, equity, sustainability), the World Bank's urban transportation is in all likelihood supporting carbon reductions, but the projects do not allocate resources to demonstrate this possibility. Carbon analyses were included in the public evaluations for only 3 of the 41 projects examined here.

The World Bank's project-by-project analyses do not easily lend themselves to consideration of systems effects. Furthermore, project analyses use highly simplified approaches that cannot capture secondary and tertiary impacts except through exogenously specified scenarios. However, improved data and models offer increasing opportunities for formal systems analyses.

Projects that are explicitly designed to reduce carbon often include a significant share of funding for institutional strengthening and technical assistance to do analyses and support the costs of including climate change considerations in transportation planning. Technical assistance could more generally provide the means to incorporate climate change into all project evaluations. However, if the cost of this technical assistance for the climate change studies must be funded through loans, it seems plausible that at least some borrowers will resist. Grants and other nonloan approaches for capacity building might be more persuasive and effective.

In short, during the 2001–2008 period, the World Bank's urban transportation practice in Latin America assisted more projects that have likely carbon benefits than it is taking credit for, in large part because the analysis of carbon emissions had not been integrated into the data gathering, modeling, and evaluation process. In addition, the World Bank was not examining the effects of its road projects on future urban development and long-run patterns in carbon emissions. Bringing a carbon perspective to the road work would not necessarily mean building fewer roads or inhibiting access to markets. Rather, it could mean designing roads that could adapt to future urbanization by allocating space for future transit access, pedestrian and bicycle facilities, and land uses.

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