SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACTS OF BRT SYSTEMS

Bus Rapid Transit Case Studies from Around the World

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EMBARQ catalyzes and helps implement environmentally, socially and financially sustainable urban mobility and urban planning solutions to improve people's quality of life in cities. Founded in 2002 as a program of the World Resources Institute (WRI), EMBARQ operates through a global network of centers in Brazil, China, India, Mexico, Turkey and the Andean region.

The EMBARQ network collaborates with local and national authorities, businesses, academics and civil society to reduce pollution, improve public health, and create safe, accessible and attractive urban public spaces and integrated transport systems. EMBARQ has built its global recognition on its local experience, and addressing national and international policies and finance. More information at www.EMBARQ.org

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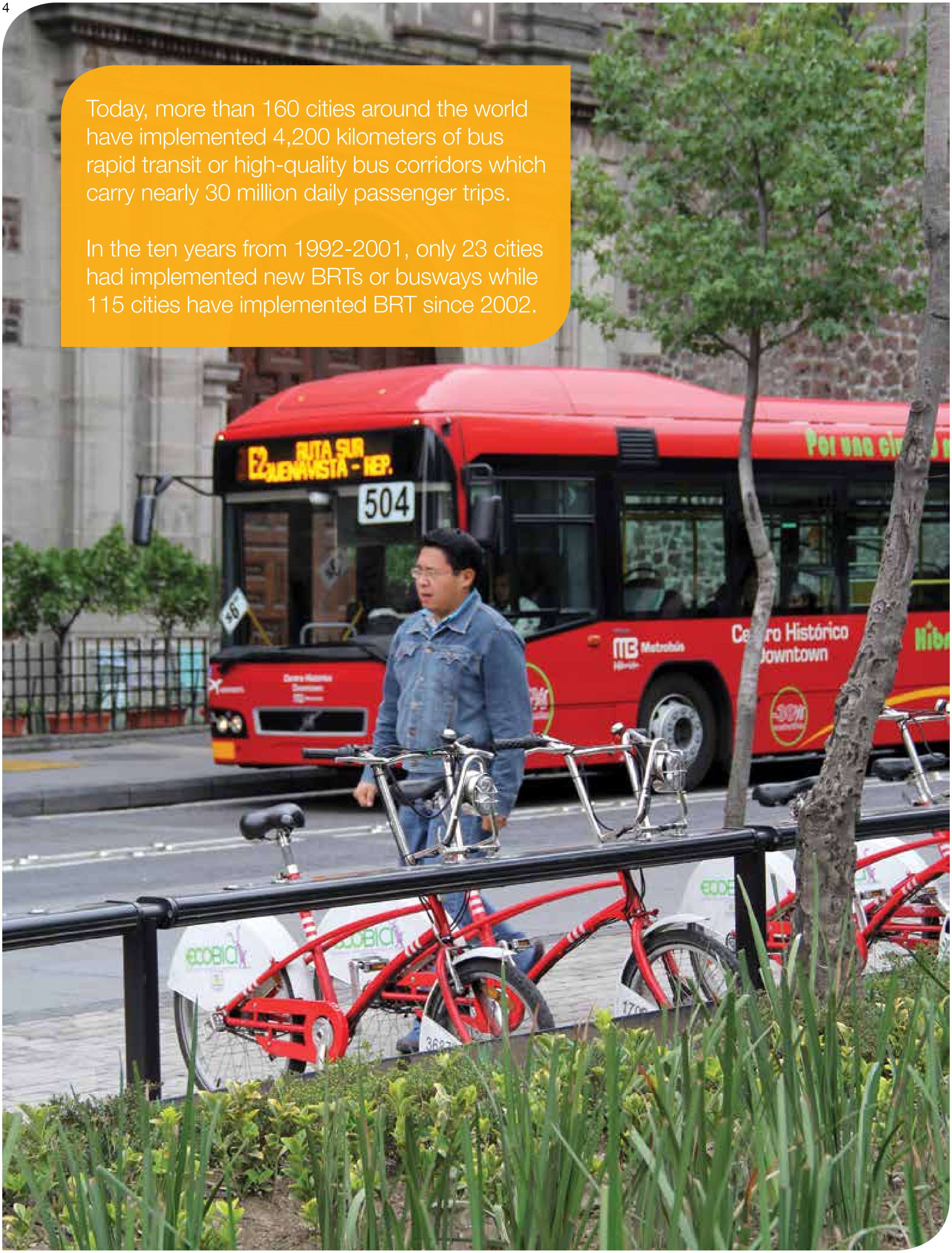
Today, more than 160 cities around the world have implemented 4,200 kilometers of bus rapid transit or high-quality bus corridors which carry nearly 30 million daily passenger trips.

In the ten years from 1992-2001, only 23 cities had implemented new BRTs or busways while 115 cities have implemented BRT since 2002.



EXECUTIVE SUMMARY

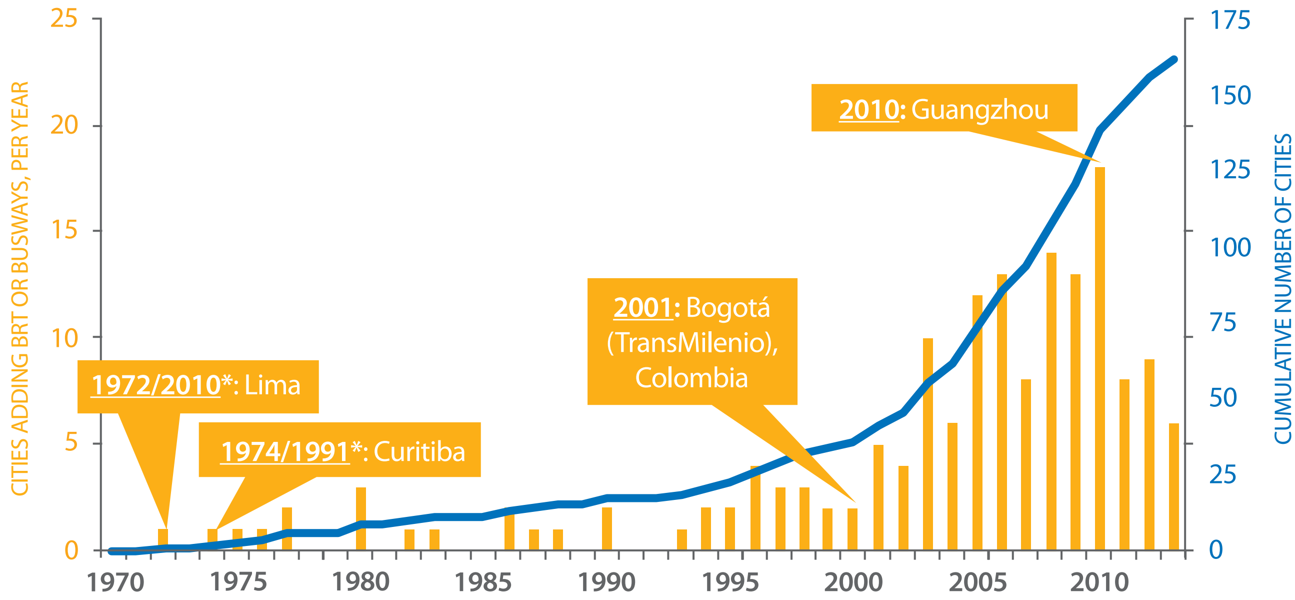
SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACTS OF BRT SYSTEMS

1.1 WHAT IS BUS RAPID TRANSIT (BRT)?

Bus rapid transit (BRT) is a high-quality, efficient mass transport mode, providing capacity and speed comparable with urban rail (light and heavy rail). Its insertion in urban transport systems is relatively recent and as a result there remains a need to introduce the concept to several audiences, particularly urban transport decision makers, and to better understand its cost, performance and impacts. To that end, this report provides a synthesis of existing literature and new data, and develops a detailed analysis on selected case studies to explore the economic, environmental and social impacts of BRT. BRT flexibly combines stations, buses, exclusive and segregated busways, and intelligent transportation system elements into an integrated transit system with a strong brand that evokes a unique identity (Hidalgo and Carrigan 2010). BRT provides higher quality of service than traditional urban bus operations because of reduced travel and waiting times, increased service reliability and improved user experience (Diaz *et. al*. 2004).

BRT has contributed to an urban transport transformation in the last decade. Today, more than 160 cities around the world have implemented 4,200 kilometers of bus rapid transit or high-quality bus corridors which carry nearly 30 million daily passenger trips (BRTdata.org 2013). The global growth of BRT has been tremendous in recent years. In the ten years from 1992-2001, only 23 cities had implemented new BRTs or busways while 115 cities have implemented BRT since 2002 (BRTdata.org 2013).

Figure ES-1 Growth of BRT Systems and Busways Around the World



Source: BRTdata.org, September 2013

* Busway / BRT year commenced

1.2 AIM OF THIS STUDY

This report aims to synthesize available evidence regarding BRT performance, costs and impacts, and contribute new evidence from four case studies. A range of comparative performance and cost indicators for a variety of BRT systems based on literature review and direct data collection are presented in Sections 3.2 and 3.3. BRT performance and costs are compared with those of metros and light rail. Section 4 then summarizes a range of mobility, environmental, public health and urban development impacts that can be expected of BRT systems, informed by extensive literature review supplemented by additional EMBARQ data collection and analysis. The cost-benefit analysis methodology EMBARQ employs to analyze four case studies is presented in Section 5.

High-quality bus rapid transit systems, like all good urban transport, can impact the quality of life, productivity, health, and safety of people living in cities. These impacts have been explored in varying depth in the existing research in the form of travel time benefits, environmental impacts, public health and safety benefits, and urban development changes. A brief summary of the current research regarding these categories of benefits is provided in Section 1.4.

This report features four case studies that use available data to estimate the net benefit to society from a bus rapid transit project:

- **TransMilenio**, Bogota, Colombia;
- **Metrobús**, Mexico City, Mexico;
- **Rea Vaya**, Johannesburg, South Africa;
- **Metrobüs**, Istanbul, Turkey.

These case study BRT systems were selected on the basis of EMBARQ's strong relationship with the local transport authorities, and significant understanding of the projects, as well as a desire to have a geographically diverse set of cases. As a set, the cases provide a glimpse into the costs and benefits of BRT projects and shed light on the variance found among the over 160 cities around the world that

Table ES-1 Summary Characteristics of Selected Four Case Studies

	Bogota, Colombia	**Mexico City,** Mexico	**Johannesburg,** South Africa	**Istanbul,** Turkey
City Population[a]	7.3 million	9 million	4.4 million	10.9 million
BRT System	TransMilenio	Metrobús	Rea Vaya	Metrobüs
Scope of Case Study	Phases I and II	Line 3	Phase 1A	First 4 phases
Year of Operation	2000	2011	2009	2007
Daily Ridership[b]	1.6 million	123,000	40,000	600,000[c]

Notes:
[a] City, not metropolitan area population. Sources include Secretary of Planning, 2011; http://www.edomexico.gob.mx/sedeco/; CoJ 2013b; www.metropolis.org
[b] Daily ridership figures are for the portion of the BRT system analyzed in the case study, which is not necessarily the full system.
[c] IETT publishes system ridership figure of 750,000 passengers per day, but a more conservative estimate of 600,000 daily passenger trips is used in the Istanbul case study analysis.

have implemented BRT or high-quality bus corridors (BRTdata.org 2013).

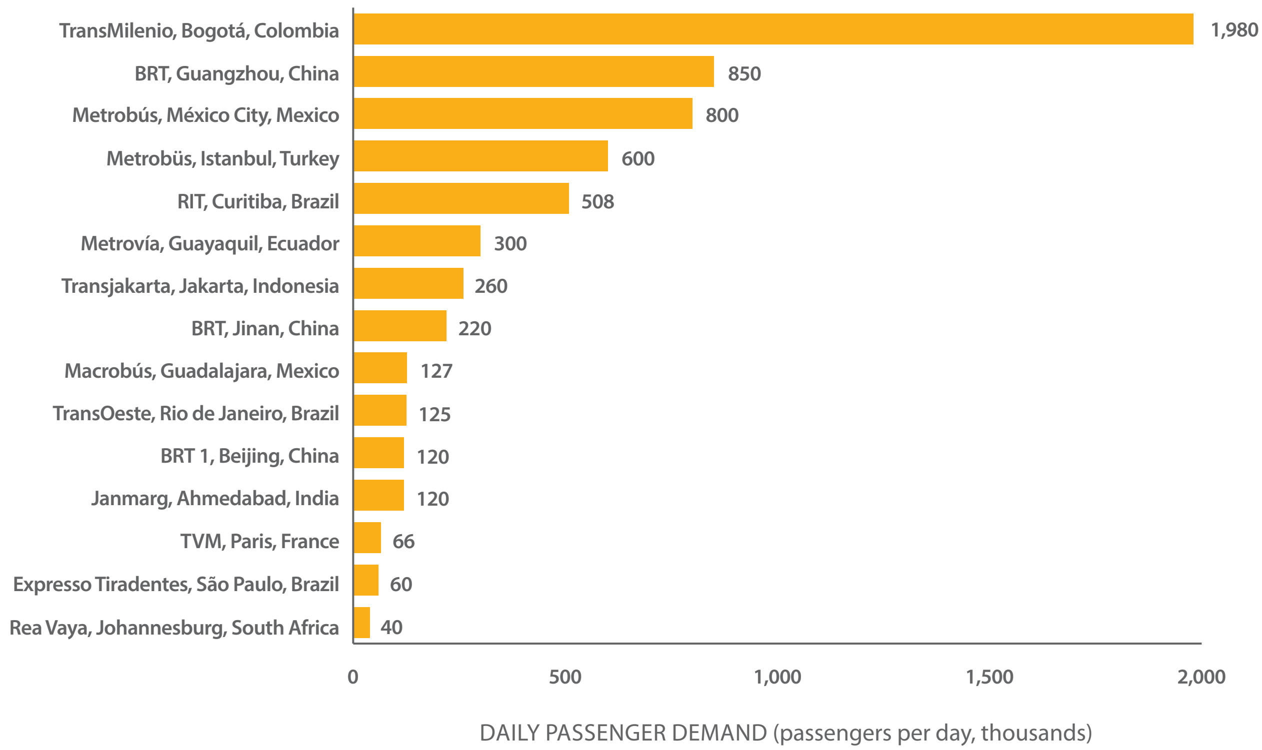
1.3 BRT COSTS AND PERFORMANCE

BRT system performance can vary significantly depending on design characteristics and level of integration with other transport modes. For instance, corridors with exclusive, segregated bus lanes will be able to move more passengers in an hour than a corridor where buses operate in bus-priority lanes, which also permit access to mixed traffic. Bypassing lanes at stations (which allow an arriving bus to pass those boarding passengers at the station) enable express routes to skip certain stations and reduce travel times for some passengers. Bus speeds will be higher on corridors with fewer intersections.

Not all corridors have the same travel demand and so there is not a one-size-fits-all BRT. A city should aim to implement the highest-quality BRT that meets the travel demand and mobility needs on a particular corridor. Understanding the range of performance that different BRTs have achieved may help decision-makers identify the right fit for their particular urban context.

Globally, the range of systems varies from very high-capacity to relatively low-volume corridors (Figure ES-2). Bogota's TransMilenio remains one of the highest-capacity BRT systems, with a **passenger demand** of 1.98 million per day. Mexico City's Metrobús and Istanbul's Metrobüs are medium-capacity BRTs, moving 600,000 – 800,000 passengers daily, while low-capacity systems in Paris and Johannesburg move fewer than 70,000 daily passengers. The highest-volume systems are designed to maximize capacity, while systems with lower throughput have been tailored for the needs of a lower-demand corridor, or may not yet have reached their carrying capacity.

Figure ES-2 Passenger Demand of Select BRTs



Sources: BRTdata.org 2013; data published by transit agencies; McCaul 2012; Wilson and Attanucci 2010

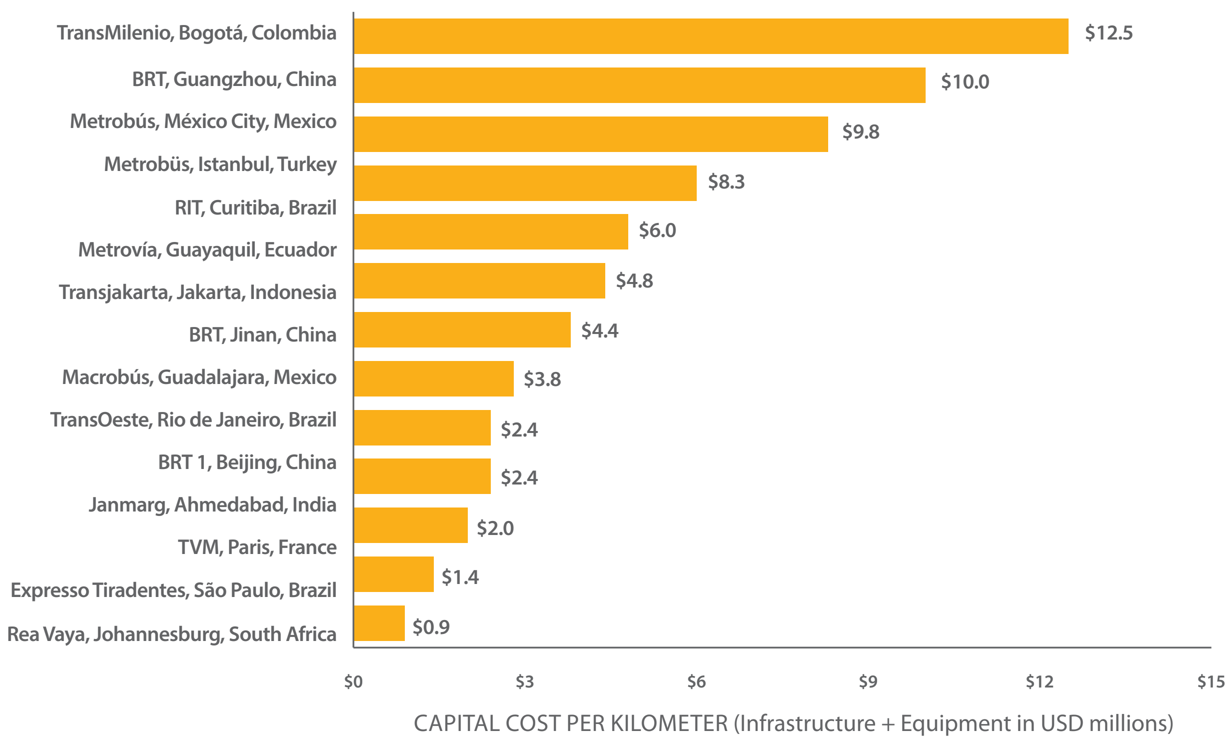
TransMilenio's Avenida Caracas in Bogota has achieved the highest **peak loads** on a single BRT corridor, carrying 45,000 passengers per hour in each direction. Particularly high-capacity corridors have by-pass lanes, which are additional bus-only lanes at stations to allow buses to overtake each other. Istanbul's TUYAP - Sogutlucesme Metrobüs Corridor also carries relatively high volumes, with 24,000 per hour per direction (BRTdata.org 2013). It achieves this capacity without bus passing lanes because it operates at high speeds in a highway median. Other BRT corridors carrying fewer than 20,000 passengers per hour per direction typically have much lower travel demand and only one bus lane at stations, which limits directional capacity.

Average **commercial speeds** of BRT systems vary from 14 to 40 km/hr. Higher speeds are typically achieved as more BRT design components are integrated, such as segregated bus lanes, level platform boarding, pre-boarding fare collection, high-capacity buses, express services and centralized operational controls. Istanbul's Metrobüs achieves an average speed of 40km/hr by operating primarily in segregated lanes on a freeway, with no signalized intersections.

As with BRT performance, project costs vary significantly across systems depending on the extent of the roadworks required (e.g., bridge or tunnel construction), corridor capacity (e.g., inclusion of bypass lanes at stations), obligatory simultaneous repair or upgrading of urban utilities (e.g., water, sanitation and electric services along the BRT corridor) and the quantity and type of equipment used (e.g., articulated or bi-articulated buses, automatic fare collection, passenger information systems, advanced traffic control), among other factors. Local conditions, such as cost of labor and capital, will also have an impact on total system costs. Where BRTs are used as a vehicle for broader urban transport reform, such as formalizing an informal transport industry, there are added costs associated with that transformation.

While capital costs per kilometer and operating costs can vary significantly among BRTs, data from existing systems help to define an indicative range of BRT costs. Total BRT **capital costs** include busway infrastructure, stations, buses and technology systems such as passenger information and fare collection systems. These costs can vary from around USD 1 million per kilometer to USD 12 million per kilometer or more (Figure ES-3). The range of cost indicates the extent of the roadway improvements needed as well as the relative cost of labor and materials in each country. New transit systems requiring only minor physical improvements to the roadway cost in the range of USD 1–3.50 million per kilometer to implement while major reconstruction of corridor roadways (i.e., tunnels, extensive simultaneous utility upgrades or station bypass lanes) require capital investment in the range of US$3.8–12.5 million per kilometer. These costs are one third to one fifth of those of alternative rail technologies (UN HABITAT 2013).

Figure ES-3 Capital Cost per kilometer (USD/km) for Select BRT Systems



Sources:
BRTdata.org 2013; data published by transit agencies; McCaul 2012; Wilson and Attanucci 2010

1.4 BRT IMPACTS

Beyond singular performance indicators, high-quality bus rapid transit systems can impact the quality of life, productivity, health, and safety of people living in cities. These impacts have been explored in varying depth in the existing research as travel time benefits, environmental impacts, and public health and safety benefits (Table ES-2).

BRT systems can **reduce travel times** for their passengers by moving BRT buses out of mixed traffic and into exclusive, segregated lanes. Level and pre-paid boarding at stations along with high-capacity buses with multiple boarding doors help speed passenger boarding and alighting. Sophisticated traffic signal management and high-frequency bus service can help to minimize passenger waiting and transit times.

Bus rapid transit systems can have **positive environmental impacts** by reducing greenhouse gases (GHG) that contribute to global climate change as well as local air pollutants, which lead to citywide air pollution and smog. Emissions reductions can be achieved by reducing vehicle-kilometers travelled (VKT), and replacing older technology and smaller vehicles with newer, cleaner high-capacity BRT buses.

Bus rapid transit systems also provide valuable **public health benefits** by reducing road fatalities, crashes and injuries; reducing personal exposure to harmful air pollutants; and increasing physical activity for BRT users.

Table ES-2 Summary of Typical Impacts of BRT Systems

Impact	How does BRT achieve the benefit?	Empirical Evidence
Travel time savings	• Segregated busways separate BRT buses from mixed traffic; • Pre-paid level boarding and high-capacity buses speed passenger boarding; • Traffic signal management and high-frequency bus service minimize waiting times	• Johannesburg BRT users save on average 13 minutes each way (Venter and Vaz 2011) • The typical Metrobüs passenger in Istanbul saves 52 minutes per day (Alpkokin and Ergun 2012)
GHG and local air pollutant emissions reductions	• Reduce VKT by shifting passengers to high-capacity BRT buses • Replace/scrap older, more polluting traditional vehicles • Introduce newer technology BRT buses • Better driver training leads to improved driving cycles which have lower fuel consumption and emissions	• In **Bogota**, the implementation of TransMilenio combined with new regulations on fuel quality is estimated to save nearly 1 million tCO2 per year (Turner *et. al.* 2012). • **Mexico City's** Metrobús Line 1 achieved significant reductions in carbon monoxide, benzene and particulate matter (PM2.5) inside BRT buses, traditional buses and mini-buses (Wöhrnschimmel *et. al.*. 2008)
Road safety improvements – reductions in fatalities and crashes	• Improve pedestrian crossings • Reduce VKT by shifting passengers to high-capacity BRT buses • Reduces interaction with other vehicles by segregating buses from mixed traffic • BRT can change drivers' behaviors by reducing on-the-road competition and improving training	• **Bogota's** TransMilenio has contributed to reductions in crashes and injuries on two of the system's main corridors (Bocarejo *et. al.* 2012) • On average, BRTs in the Latin American context have contributed to a reduction in fatalities and injuries of over 40% on the streets where they were implemented.
Reduced exposure to air pollutants	• Cleaner vehicle technologies and fuels lower **concentration** of ambient air pollution citywide or inside the BRT vehicles; • Reduce **time** passengers are exposed to air pollution at stations or inside the bus by reducing travel times.	• After the implementation of TransMilenio, **Bogota** reported a 43% decline in SO2 emissions, 18% decline in NOx, and a 12% decline in particulate matter (Turner *et. al*. 2012). • By reducing emissions of local air pollutants, especially of particulate matter, Metrobús Line 1 in Mexico City would eliminate more than 6,000 days of lost work, 12 new cases of chronic bronchitis, and three deaths per year saving an estimated USD $3 million per year (INE 2006).
Increased physical activity	• Spacing of BRT stations tend to require longer walking distances than all other motorized modes with the exception of Metro • Higher operation speeds increases passengers' willingness to walk to stations	• Mexico City's Metrobús passengers walk on average an additional 2.75 minutes per day than previously • Users of the Beijing BRT have added 8.5 minutes of daily walking as a result of the BRT system

By reducing local air pollution and emissions, **Metrobús Line 3**

in Mexico City has prevented more than 2,000 days of lost work (due to illness), 4 new cases of chronic bronchitis, and two deaths per year, saving an estimated USD $4.5 million.

1.5 COST-BENEFIT ANALYSIS METHODOLOGY

Bus rapid transit projects have the potential to provide travel time, public health, environmental, land use, and other benefits to society (see Section 4 for more detail). However, like all transport options, BRT systems can also impose social costs from construction, operation, and maintenance. In order for policymakers to make an informed decision regarding the development or expansion of a BRT project, the project should be evaluated in terms of total benefits compared to total costs. Ideally, an analysis of alternatives should be done comparing alternative solutions in a preconstruction phase. Often, however, little or no analysis is done.

Cost-benefit analysis (CBA) is used to capture both public and private costs and benefits for society as a whole (Harberger and Jenkins 2002; Gramlich 1997; Boardman *et. al*. 2006). In addition to the financial or market costs, it also considers externalities and indirect or intangible costs to capture social effects. Cost-benefit analysis therefore provides policymakers with a valuable tool for comparing net benefits (benefits minus costs).

For each of the four case studies, EMBARQ applied a consistent CBA methodology to analyze the effects of BRT. We have provided as comprehensive an analysis as possible based on available data, and have striven to be transparent in our assumptions. Where data is incomplete, we have extrapolated trends from existing data to estimate key inputs. We acknowledge limitations in this approach, but remain confident in its usefulness, given the broad professional acceptance of cost-benefit analysis. (A detailed discussion of EMBARQ's cost-benefit methodology and assumptions for each case may be found in Appendix A – EMBARQ's BRT Impact Evaluation Methodology. Assumptions used in the analysis of each case are presented in Appendices B-E).

Three summary indicators are used in the cost-benefit analysis:

- **Net present value.** Because the costs and benefits of transportation projects will continue over many years, the future costs and benefits are often discounted over the life of a project, in the form of an estimated net present value (NPV). A positive NPV implies that a project offers net benefits.

Table ES-3 BRT Costs and Benefits Considered in EMBARQ's CBA Methodology

BRT Costs	BRT Benefits

• Planning and design
• Capital costs
  • Infrastructure (e.g. busways, stations, depots)
  • Equipment (e.g. fleet acquisition, fare collection, passenger information, control center)
• Bus operations and maintenance
• Infrastructure operations and maintenance
• Negotiations with existing transit operators
	• Changes in travel time (BRT users and others)
	• Changes in vehicle operating costs (private vehicles and public transit)
	• Changes in CO2 emissions
	• Changes to exposure to local air pollutants
	• Road safety benefits (fatalities, injuries, property damage)
	• Changes in physical activity

- **Benefit-cost ratio.** A ratio of the net present benefits and costs greater than one indicates that the total benefits to society exceed the costs.
- **Internal rate of return (IRR).** The IRR is the discount rate at which the net present value of costs equals the net present value of the benefits and indicates the attractiveness of the investment. The IRR of a public investment should exceed the cost of capital.

EMBARQ's CBA methodology considers a set of typical BRT project costs and many of the common transport, environmental, public health and safety benefits described earlier (See Table ES-2). Where sufficient reliable data is available, each of the four case studies incorporates these elements into its CBA.

While CBA is a powerful tool to guide decisions, the methodology does not typically include a distributional analysis. EMBARQ's methodology goes beyond traditional CBA, evaluating the distribution of benefits and costs across society to identify which income groups are winners and losers. We consider the benefit-cost ratio by income strata as well as how net benefits (benefits minus costs) are distributed across socioeconomic groups.

Table ES-4 Summary of Case Study Cost-Benefit Analyses

BRT System	Scope of Case Study	Net Present Benefits (2012 million USD)	Benefit-Cost Ratio	Social IRR
TransMilenio, Bogota	Phase 1 & 2	$1,400	1.6	23%
Metrobús, Mexico City	Line 3	$36	1.2	14%
Rea Vaya, Johannesburg	Phase 1A	$143	1.2	12%
Metrobüs, Istanbul	Phases 1-4	$6,407	2.8	66%

1.6 CASE STUDY FINDINGS

The four BRTs presented in the case studies represent a variety of projects with a range of infrastructure and service designs, implemented and operated in different urban and political contexts. All of the projects have positive net present benefits and benefits exceeding costs. The internal rates of return indicate each of the investments was at least as socially profitable as the opportunity cost of public funds (Table ES-4).

Key findings from each case study include:

Bogota's TransMilenio

- The two largest benefits are travel time savings for transit users, and savings on the operation of traditional buses removed from service following the implementation of the TransMilenio system.
- The largest proportion of users of the BRT system is in the lower- and middle-income groups.
- TransMilenio benefits are biased towards the lower income strata, and with costs biased towards the highest socioeconomic stratum, reflecting the profile of users and the structure of the Colombian tax structure.

Mexico City's Metrobús

- The largest benefits were travel time savings for public transport users, due to the segregated bus lane allowing buses to achieve high operation speeds.
- Savings in operation costs of public transport vehicles are the second largest benefits. This is the result of larger, newer buses that operate at higher speeds. This also helps the system to achieve lower emissions.
- The largest proportion of users of the BRT system is in the lower- and middle-income groups.
- The largest proportion of benefits accrue to those of modest income (monthly income = MXN $4500-7500)—representing the second quintile of the income distribution.
- The largest losses accrue to those at the top of the income distribution.

Johannesburg's Rea Vaya

- Together the bus operation and maintenance contract and the capital costs constitute 96 percent of the total project costs.
- The high cost of the bus operating contract reflects, in part, the cost of formalizing and empowering the minibus taxi industry.
- The largest portion (37 percent) of benefits comes from travel time reductions followed by improved road safety (28 percent).
- Phase 1A has been a progressive project; the upper income quintile bears the majority of the costs, while the project benefits accrue to lower quintiles, predominately the 4th highest income quintile.

- The city's poorest residents are underrepresented in BRT users and therefore are not significant beneficiaries of the project. They do share in 4% of the project benefits, while only contributing to 2% of the costs.

Istanbul's Metrobüs

- The largest proportion (64 percent) of benefits comes from travel time reductions, followed by vehicle operating cost reductions (23 percent) and traffic safety (9 percent).
- Metrobüs costs are driven primarily by operating and maintenance costs.
- The largest proportion of users of the BRT system are in the lower- and middle-income groups, though benefits exceeded costs in all income groups.

The four cases suggest several general conclusions about BRT costs and benefits:

- **Travel time savings** dominate the BRT benefits as a result of segregated bus lanes and other design features that minimize waiting and in-vehicle times.
- Shifting from informal/unregulated service with smaller vehicles operating in mixed traffic, to newer, larger buses operating at higher speeds results in significant **reductions in vehicle operating costs** with BRT (Bogota, Mexico City and Istanbul).
- **Capital costs** and **bus operating costs** were the most significant portion of project costs in the cities.
- BRT projects can be a mechanism for broader **urban infrastructure or transport reform**. They can be used to facilitate formalization of an informal public transport industry (Bogota, Mexico City, Johannesburg) and simultaneously improve complementary urban services (Johannesburg). This can come at an extra cost to the BRT implementing agency, or at the same time as the BRT implementation. In any case, such reform has a broader purpose than the BRT itself.

For the most part, the largest proportion of users from the case study BRT systems is in the lower- and middle-income groups. The lowest and the highest income groups are not well represented among the BRT passengers, a fact which influences how the project benefits are distributed across society (See Table ES-5). Because the majority of the BRT costs in the cases are paid with public revenue derived from taxes, the project costs typically accrue to the highest income strata. Since the dominant benefit is travel

Table ES-5 Summary of Distribution of Net Present Benefits for Four Cases

Distribution of Net Benefits by Income Strata (2012 million USD)					
BRT System	1 (Lowest)	2	3	4	5 & 6 (Highest)
TransMilenio, Bogota	$ 92	$ 642	$ 603	$ 238	$ (176)
Metrobús, Mexico City	$ 11.4	$ 37.9	$$ 12.2	$ (9.5)	$ (16.4)
Rea Vaya, Johannesburg	$ 18.6	$ 8.2	$ 35.2	$ 353.9	$ (273.3)
Metrobüs, Istanbul	$ 765.9	$ 2,308.5	$ 1,414.0	$ 969.0	$ 952.1

Gain least/Lose | Gain most

Select Key Findings

$141.6m
in time savings in Metrobus Line 3 in Mexico city

$288m
saved due to avoided traffic injuries and fatalities in Bogota's Transmilenio

$392m
estimated savings due to lower GHG emissions from Metrobüs in Istanbul

time savings, the majority of benefits tend to accrue to the strata most represented by BRT users — typically lower- and middle-income. While the BRT projects tend to be progressive and beneficial to lower-income strata, the lowest-income residents are not benefitting the most from the four projects.

Ensuring that the poorest residents are well represented among BRT users is key to their benefiting more from BRT projects. This may require special attention during project planning to make BRTs accessible to the poorest residents; it also requires careful structuring of user fares compared to existing transport modes and may necessitate targeted fare subsidies.

1.7 LOOKING AHEAD

The four cases reinforce the conclusion that BRT projects can provide net positive benefits to society and can be socially profitable investments. Trends at the local, national and international levels suggest continued growth of BRT worldwide. Data collected by EMBARQ show that 143 cities are currently constructing 1,000 kilometers of new or expanded BRT corridors and planning 1,600 more kilometers (EMBARQ Brasil 2013).

Supportive national and international transport policies are helping to drive this growth. Several national transit investment programs facilitate funding for mass transit including BRT, and some explicitly earmark funds for BRT. Under PROTRAM, Mexico's national mass transit funding program, there are 35 BRTs approved or in final planning across Mexico. Brazil's development acceleration program (PAC) has earmarked USD7.7 billion for BRT systems in 32 cities, doubling the kilometers of BRT in Latin America by the 2016 Olympic Games. India's second national urban renewal program is expected to earmark USD12 billion for implementation of urban rail and bus systems over the next ten years. A policy directive of China's Ministry of Transport establishes a national goal of 5000 kilometers of BRT implemented by 2020 (China MoT 2013). At the international level, donor commitments that prioritize sustainable transport solutions to address urban development challenges are also spurring interest in BRT.

1.8 RECOMMENDATIONS

Lessons from TransMilenio, Metrobús, Rea Vaya and Metrobüs inform generalized recommendations for how policy, infrastructure and operations design, and project financing can maximize the net social benefits of BRT projects.

National and municipal urban transport policies dictate the type and quality of urban transport infrastructure cities implement. These policies can be structured in such a way to encourage transparent and objective assessment of the merits of a particular investment based on the societal impacts.

- National and local investment decisions should be predicated on objective and transparent evaluation of alternatives, including an assessment of social costs and benefits (such as a Cost Benefit Analysis) to determine whether proposed projects represent a good use of limited resources.
- Where possible, project evaluation should consider the distributive impacts — which segments of society benefit and which lose.
- National transit investment schemes can help catalyze widespread adoption of BRT as an urban transport solution.

Physical design, service plans and institutional arrangements dictate many of the benefits and costs analyzed in the case studies. Decisions made during the BRT project planning phases affect which segments of society gain and lose the most as a result of the project. The four cases suggest key recommendations for cities planning BRTs:

- BRT systems should be designed to best accommodate the local travel demand and urban context. Choices about expanding capacity with station by-pass lanes, larger stations, or bi-articulated buses should be driven by corridor demand and available funding.
- Travel time savings are often the most significant social benefits resulting from BRT systems. Design of routes, services and infrastructure should aim to minimize passenger waiting, transfer and in-vehicle transit times to maximize the travel time savings and to deliver a system that is attractive to users. Exclusive, segregated BRT lanes are a key design element.
- User fares should be defined based on technical methods and the actual cost of operations, to reduce the need for operational subsides and political interference (Hidalgo and Carrigan 2010).
- Engagement with existing bus operators early in the project planning phase can build buy-in and ensure inclusion. Be aware that negotiated operator contracts are often more costly than competitive contracts.
- To attract more users from the lowest income quintiles, cities should consider accessibility of

the BRT service to poor residents and the price of user fares compared to other transport options. Targeted subsidies for particular income strata may be warranted.

- The implementation and operation of BRT systems provide an opportunity to strengthen the capacity of institutions at the local level and to improve urban transport regulation.
- BRT systems should be part of fully integrated transportation networks.

The four case studies demonstrate positive social benefits of BRT, and banks that have been involved in BRT have identified positive commercial and financial results from the projects. Banks assess BRT investments considering the financial returns for the operator, as well as the social and environmental impacts. Doing so requires those who arrange BRT financing to have an informed understanding of the complexities of both the bus and BRT industries, as well as the scope of impacts of urban transport reform. Specific recommendations for **facilitating finance of BRT systems** include:

- Loans are typically required and should be adapted to the specific conditions of each BRT project. This may include analyzing the concession contract to permit advancing lines of credit to previously informal operators.
- Financial institutions should be brought into the project planning process early, and can support cities and other project stakeholders in the project planning and preparation.
- Trust funds are a good mechanism for facilitating debt repayment by earmarking funds, but conditions need to be assessed carefully so as not to negatively affect the bus operations. They can also ensure transparency of financial transactions.
- Special teams for bus and BRT finance that understand the industry (manufacturers, operators, government) can be very effective, as they have typically followed a large number of projects through all their phases (planning, implementation, adjustment, maturity).
- On-going dialogue with development institutions and non-governmental organizations is also advisable.

EMBARQ catalyzes and helps implement environmentally, socially and financially sustainable urban mobility and urban planning solutions to improve people's quality of life in cities. Founded in 2002 as a program of the World Resources Institute (WRI), EMBARQ operates through a global network of centers in Brazil, China, India, Mexico, Turkey, and the Andean region.

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