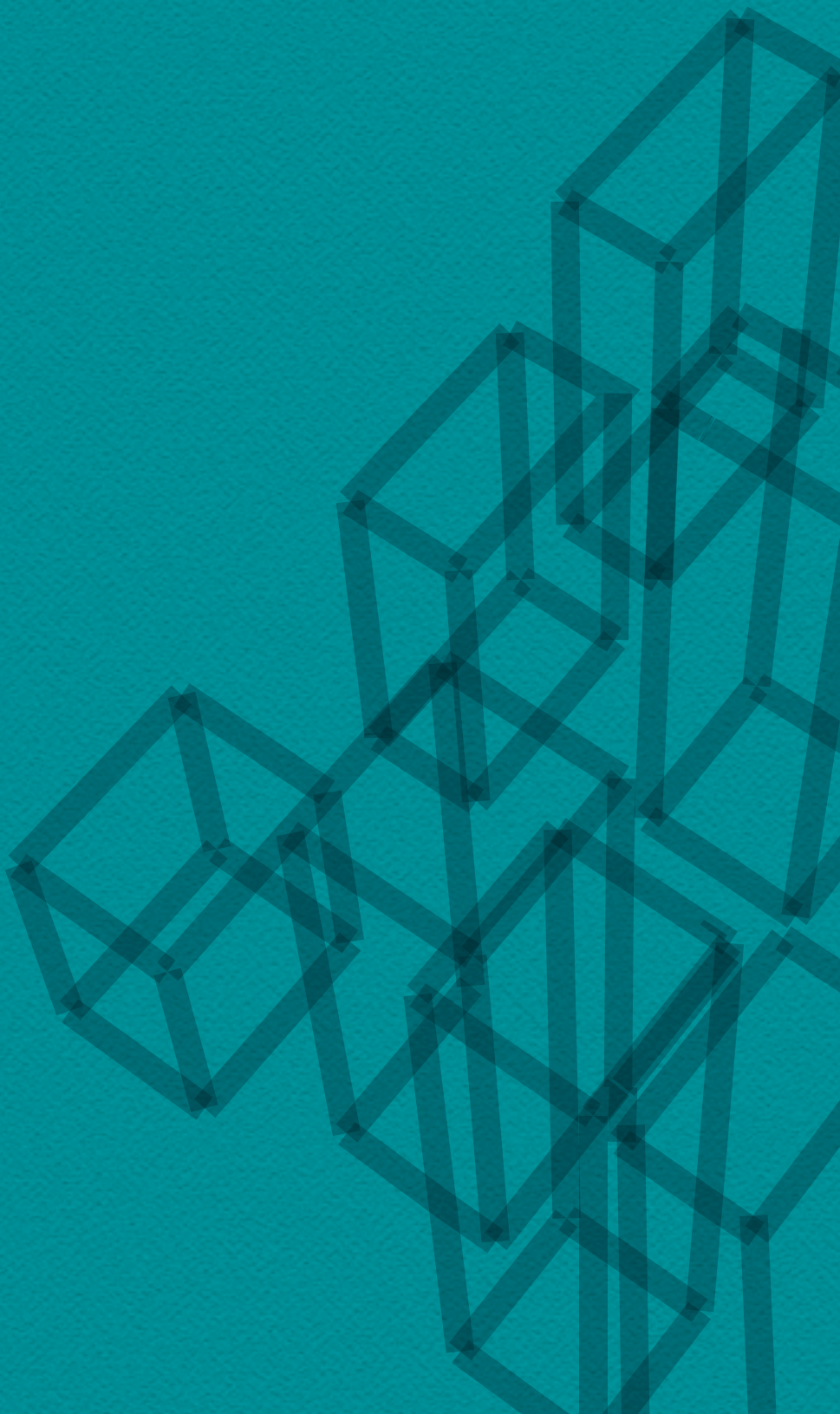
GOOD PRACTICE GUIDE

# Bus Rapid Transit



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*The C40 Cities Climate Leadership Group has developed a series of Good Practice Guides in areas critical for reducing greenhouse gas emissions and climate risk. The Guides provide an overview of the key benefits of a particular climate action and outline successful approaches and strategies cities can employ to implement or effectively scale up these actions. These Guides are based on the experience and lessons learned from C40 cities and on the findings and recommendations of leading organisations and research institutions engaged in these areas. The good practice approaches are relevant for cities engaged in C40 Networks as well as for other cities around the world.*

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## EXECUTIVE SUMMARY

Transportation plays a crucial role in cities as it significantly impacts the quality of people's lives and is often the key means of accessing education, employment and essential services. At the same time, transportation is the sector where global greenhouse gas (GHG) emissions are rising most quickly. In 2010, the transport sector accounted for 27% of final energy use, and CO2 emissions from the sector could almost double by 2050 if steps are not taken to counter this trend.[i] As emissions from private motor vehicle use rise, adopting measures to shift these trips to public transit is critical.

As one of the main components of a comprehensive public transportation system that may include motorised and non-motorised elements, Bus Rapid Transit (BRT) delivers significant benefits to cities, while requiring significantly less time and resources to build and begin operation than other comparable alternatives.[ii] A BRT is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services at metro-level capacities at a fraction of the cost. It can be expanded in phases as funding becomes available – allowing costs to be dealt with over time - and is faster to implement than other rapid transit services (metro, light rail, etc.). These projects, programmes and policies not only reduce emissions but also save travel time, reduce local air pollution, improve traffic safety and encourage physical activity.

This Good Practice Guide focuses on the key elements to successfully develop a high-quality BRT system, leading to better economic, social, and environmental outcomes for cities. These good practice approaches include:

- **Adopt holistic planning for a high-capacity BRT corridor**
- **Develop benchmarking and measure the impacts of BRT**
- **Focus on strong stakeholder engagement and communications**
- **Integrate BRT with other means of public transport and urban planning**
- **Utilise innovative financing mechanisms**

The C40 Bus Rapid Transit (BRT) Network was established to support C40 cities' efforts to develop successful BRT programs, incorporating infrastructure, technology, scheduling, and financing solutions. The C40 BRT network currently has 16 participating cities and is led by Buenos Aires and Johannesburg.

The purpose of this Good Practice Guide is to summarise the key elements of BRT good practice for global dissemination, highlighting the success of C40 cities in planning and delivering a high-quality public transit systems.

# 1 BACKGROUND

## 1.1 Purpose

The C40 Cities Climate Leadership Group has developed a series of Good Practice Guides in areas critical for reducing greenhouse gas (GHG) emissions and climate risk. The C40 Good Practice Guides provide an overview of the key benefits of a particular climate action and outline successful approaches and strategies cities can employ to effectively scale up these actions. These Guides are based on the experience and lessons learned from C40 cities, and on the findings and recommendations of leading organisations and research institutions engaged in these areas.

The following Good Practice Guide focuses on the key elements necessary to successfully develop a good BRT system, leading to better economic, social, and environmental outcomes for cities. These approaches are relevant for cities engaged in C40's Bus Rapid Transit (BRT) Network as well as for other cities around the world.

## 1.2 Introduction

Transportation plays a crucial role in cities as it significantly impacts the quality of people's lives and is often the key means of accessing education, employment and essential services. At the same time, global GHG emissions are rising most quickly in the transportation sector, which accounted for 27% of final energy use in 2010. Baseline CO2 emissions from the sector could almost double by 2050 if steps are not taken to counter this trend.[iii]

C40 cities alone emit around 336mn tonnes/year from transport (2011).[iv] Fortunately, this sector also presents many opportunities to reduce emissions. Transport is a key action area for C40 member cities, with mayors exercising strong powers over the sector. In fact, approximately 90% of C40 cities are taking action on transport.[v]

# 2 BUS RAPID TRANSIT (BRT) AND CLIMATE CHANGE

## 2.1 What is BRT?

Bus Rapid Transit (BRT) is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services at metro-level capacities. It does this through the provision of dedicated lanes, with bus-ways and iconic stations ideally aligned to the centre of the road, off-board fare collection, and fast and frequent operations.

Because BRT contains similar features to a light rail or metro system, it is much more reliable, convenient and faster than regular bus services. With the right design, BRT is able to avoid most of the causes of delay that typically slow down regular bus services, like being stuck in traffic or

queuing to pay on board. As a safer, cleaner, and more efficient mode of transport that gives people more time for their personal lives, BRT is a smart solution to cities' urban transport challenges.

As a growing transport solution in both developed and developing countries, BRT and improved bus-way systems already have a combined daily ridership of more than 32 million people in 200 cities around the world.[vi] C40's own research for Climate Action in Megacities 3.0[vii] revealed that, following the lead of Latin American cities like Curitiba and Bogotá, 42 C40 cities now have or are planning to develop BRT systems; over half of these are in the northern hemisphere. This analysis supports the scaling up of BRT systems across the globe, in addition to offering recommendations for policymakers, technical experts, and financing bodies to maximize the benefits of BRT.

## 2.2 What constitutes good BRT system design?

The Institute for Transportation & Development Policy (ITDP)[viii], a key C40 partner, has identified a number of crucial design elements that are associated with high-performing BRT systems. As such, when cities wish to implement BRT systems, these elements should be assessed and included in order to deliver systems that maximize the benefits of Bus Rapid Transit. The ITDP standards can be found at:

https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/the-scorecard/

A basic set of general principles to follow in order to develop a good BRT system and reduce GHG emissions has also been identified within the C40 BRT Network:

- Develop a greater degree of integration between spatial and transport planning to encourage compact development patterns, to reduce car use and promote more sustainable travel patterns;
- Ensure improved alternatives to the use of private car are provided, including more sustainable, higher occupancy modes of transport (e.g. mass transit/public transport and non-motorised transport modes); and
- Establish better management of road space and the transport demand (e.g. via parking policy, congestion pricing, incentives, raising awareness of sustainable forms of travel).

In accordance with the ITDP standards and accepted best practices, the BRT system should include the following key basic elements, to be considered early in the planning process:

**Dedicated right-of-way:** A dedicated right-of-way is vital to ensuring that buses can move quickly, and are unimpeded by congestion. Physical design is critical to the self-enforcement of the right-of-way. Dedicated lanes matter the most in heavily congested areas where it is harder to ensure buses provide a strong alternative to private cars. In these areas, it becomes even more important to take a lane away from mixed traffic to dedicate it as a busway.

**Busway alignment:** The busway is best located where conflicts with other traffic can be minimized, especially from turning movements from mixed-traffic lanes. In most cases, a busway in the central verge of a roadway encounters fewer conflicts with turning vehicles than those closer to the curb, due to alleys, parking lots, etc.

**Off-board fare collection:** Off-board fare collection is one the most important factors in reducing travel time and improving the customer experience. There are presently two basic approaches to off-board fare collection: "turnstile-controlled", where passengers pass through a gate, turnstile, or checkpoint upon entering the station, where their ticket is verified or fare is deducted, and "proof-of-payment", where passengers pay at a kiosk and collect a paper ticket that is then checked on board the vehicle by an inspector.

**Intersection treatments:** There are several ways to increase bus speeds at intersections, all of which are aimed at increasing the green-signal time for the bus lane. Forbidding turns across the bus lane and minimizing the number of traffic-signal phases are the most important.

**Platform-level boarding:** Having the bus-station platform level with the bus floor facilitates universal access, and is one of the most important ways of reducing boarding and alighting times per passenger. Passengers climbing even relatively minor steps can mean significant delay, particularly for the elderly, disabled, or people with suitcases or strollers.

**Other elements to consider:** Operating multiple routes along a corridor; operating express BRT services along with local services; operating a central control centre; introducing passing lanes at stations; switching to low emission vehicles; setting stations back from junctions to avoid delays; building safe and comfortable stations with a minimum width of 3m; having multiple doors on buses; using unique BRT branding; providing access for those with mobility needs; integrating the BRT with other forms of public transport; and ensuring a good pedestrian access to and from the BRT.

Whilst cities should aspire to delivering a gold standard BRT scheme, it is accepted that local conditions may prevent the integration of all the elements listed above. However, the more these elements are included within a BRT scheme, the more likely the BRT is to deliver the wide assortment of benefits listed below.

### 2.3 Benefits of BRT

Research from EMBARQ, *Social, Environmental and Economic Impacts of Bus Rapid Transit Systems* (2013),[ix] examined global evidence as well as four in-depth case studies of BRT systems in Bogotá, Colombia; Mexico City, Mexico; Johannesburg, South Africa; and Istanbul, Turkey. It concluded that BRT improves quality of urban life in at least four key ways, to which a fifth one has been added:

**Travel-time savings**: Dedicated bus lanes that separate BRT buses from mixed traffic, pre-paid boarding and level platforms speed up passenger boarding, whilst traffic signal management prioritizes BRT buses. High-frequency bus service also minimizes waiting times to help save travel time for passengers. These features have a significant positive impact in cities where BRT systems operate.

In Johannesburg, BRT users save an average of 13 minutes each way during their daily commutes. In Istanbul, the savings are even greater – the typical Metrobüs passenger saves 52 minutes per day. The TransOeste BRT corridor in Rio de Janeiro has reduced inner city trips from one hour and 40 minutes to 45 minutes[x]. With the '9 de Julio' corridor in Buenos Aires, travel time was reduced from 55 minutes to less than 20.[xi] Mexico City stands to save US$141 million in regained economic productivity as a result of travel time reductions from Metrobús Line 3.

**GHG and local air pollutant emissions reductions:** BRT reduces the overall amount of vehicle kilometres travelled (VKT) in a city by shifting commuters to high-capacity buses that can carry up to 160 passengers at a time. Setting up a new BRT system also provides cities with an opportunity to scrap older, more polluting traditional vehicles. The incorporation of modern fuel efficiency technologies into BRT buses and better driver training contributes to lower fuel consumption and emissions. Introducing a new BRT corridor therefore has major implications not just for GHG emissions, but also for air pollution. Around the world, urban buses account for 25% of black carbon emissions from all passenger and commercial goods transport vehicles in 2015.[xii] Cleaner vehicle technologies and fuels lower the concentration of ambient air pollution and reduce the time passengers are exposed to air pollution at stations or inside the buses.

For example, Metrobús Line 3 in Mexico City is poised to eliminate more than 2,000 days of lost work due to illness, four new cases of chronic bronchitis, and two deaths per year, saving the city an estimated US$ 4.5 million. In Buenos Aires, the target is to have four additional BRT corridors in 2015, reaching 1.2 million passengers every day over a distance of 56 kilometres, with a reduction of 49,000 tons of CO2e per year. In Johannesburg, the city aims to move 200,000 passengers per average weekday on the Rea Vaya BRT system by 2018 and is working to ensure that the BRT buses will be low carbon emitters, reducing carbon emissions by 1.6 million tons by 2020.

**Traffic safety improvements:** Implementing BRT systems contributes to reductions in traffic accidents and fatalities in several key ways. First, an overall reduction in VKT results in fewer drivers on the road and a safer transport environment for drivers, pedestrians, and cyclists alike. Second, dedicated bus lanes reduce interaction between buses and other vehicles, minimizing the risk of accidents. Finally, BRT can change bus drivers' behaviour by reducing on-the-road competition with other vehicles and providing opportunities to improve driver training.

The case of Latin America showcases BRT's safety benefits: streets with BRT systems experienced a 40% reduction in fatalities and injuries on average. Further evidence suggests that BRT and other forms of sustainable transport are under-acknowledged components of traffic safety planning, with an enormous potential to reduce traffic crashes and save lives.

**Increased physical activity:** BRT systems also increase physical activity for passengers, thanks to the spacing of BRT terminals, which tend to require longer walking distances than private vehicles and other motorized modes of transport. Despite the distance, shorter overall travel times make BRT worth the walk, with passengers across the world consistently moving through the city faster, even with more time spent getting to the bus terminals. Mexico City's Metrobús passengers walk an average of 2.75 minutes more per day than before the city implemented its BRT system. Users of Beijing's BRT system have added 8.5 minutes of daily walking as a result of the BRT.

**Meeting other social aims**: BRT projects often have a strong social component, and can enable a city to deliver on its social justice and empowerment objective. For example, Johannesburg is working to empower marginalised groups, and the BRT is supporting this objective – as the largest proportion of BRT users in Johannesburg are low and middle-income groups. By 2020, the city aims to set up at least three bus operating companies that are majority-owned by previously disadvantaged public transport operators.

These findings are supported by multiple case studies and examples emerging from across C40 cities, referenced in Section 3 below.

# 3 GOOD PRACTICE APPROACHES FOR DELIVERING A SUCCESSFUL BRT

## 3.1 Categories of best practice

Within the BRT Network, there are a number of different strategies that cities are pursuing to achieve their desired outcomes. Which type of approach a city chooses to deploy to reach its goal depends on:

- Powers that the city Mayor has over transport versus the state or national governments
- The legislative context at a regional and national level
- The asset ownership structure, i.e. who owns buses, stations and other infrastructure
- Relationships with bus operators and other agencies
- Citizen engagement and buy-in
- Availability of project financing

In order to address these issues, and deliver a strong BRT system, a few key best practice approaches that C40 cities have highlighted include:

- **Adopt holistic planning for a high-capacity BRT corridor**
- **Develop benchmarking and measure the impacts of BRT**
- **Focus on strong stakeholder engagement and communications**
- **Integrate BRT with other means of public transport and urban planning**
- **Utilise innovative financing mechanisms**

We have identified the following case studies, which sit in each of these categories and demonstrate best practice for cities in the C40 BRT Network.

## 3.2 Adopt holistic planning for a high-capacity BRT corridor

Holistic planning for a BRT corridor aims to ensure that two main characteristics of a successful BRT are achieved. First, the corridor is well-designed, and that elements such as dedicated right-of-way, busway alignment, off-board fare collection, intersection treatments, and platform-level boarding are collectively considered and built into the design of a new system or corridor. Second, the corridor is well integrated, and is ideally linked to high-density areas, promotes seamless transfers between modes, provides pedestrian access, secure bicycle parking, bicycle lanes and bicycle-sharing integration, allowing it to attract and retain a variety of transport users and expand the catchment area of the BRT.

Holistic planning ensures that a BRT system is both well designed and well connected, and is able to function as the centre-piece of a multi-modal transport network. This is crucial to deliver a system that is high capacity and is convenient for people to use, enabling the maximum shift out of private vehicles, thus reducing carbon emissions and ultimately benefiting the highest number of people in a city.

**Case study: *Rio de Janeiro*[xiii] *- TransOeste BRT***

*Summary:* The first BRT corridor, the TransOeste located in the west side of the city, was launched in June 2012. It began with 40 kilometres of exclusive, segregated corridors, 36 stations, and new articulated and standard buses. After only one year in operation the TransOeste BRT line grew to 56 kilometres of exclusive lanes and 58 stations, transporting 120,000 passengers per day (and now up to 185,000 per day).[xiv] The example of TransOeste in Rio de Janeiro shows how a BRT corridor (and ultimately a whole system) can provide a high-capacity transit solution for a city, enabling municipal authorities to increase liveability, mobility, and sustainability. Furthermore, while BRT is often compared to metro lines in terms of service and operations, they can cost ten to hundred times less and be delivered much more quickly as Rio de Janeiro has demonstrated.[xv]

The TransOeste corridor has reduced an inner city trip from 1 hour and 40 minutes to 45 minutes. By the time four BRT lines will have been opened in 2016, the share of trips made by public transport in Rio de Janeiro is expected to increase from 18% to 63%, with more than 150 kilometres of exclusive BRT corridors expected to carry two million passengers each day.[xvi]

*Results:* The TransOeste BRT drastically improved mobility in the city, reduced emissions and increased comfort for those using the corridor, delivering a better experience for users (travel time savings, increased comfort through new buses, etc., which attracted people to the services).[xvii] The BRT line is expected to save an estimated 107,000 tons of CO2e per year over a 20-year period, thanks to fuel-efficient buses and rationalized bus routes. The buses being used in the corridor are Euro V, to help reduce emissions. The value of time saved on the total of trips on the TransOeste BRT corridor averages $23 million a year.[xviii] The development of the BRT has also related co-benefits, such as reduced air pollution, construction of new bike lanes along the corridor, and expansion of sidewalks and green space.

*Reasons for success***:** TransOeste has proved so successful because it was part of Rio's holistic planning exercise for the corridor and a strong overarching transport improvement plan for the city. Moreover, the feeder bus routes were identified and optimised/rationalised as needed; implementation was done gradually in several phases; surveys were undertaken with users before and during implementation, as well as after, to get feedback on the BRT system and improve future plans.

Moreover, Rio de Janeiro seized the opportunity brought by the recent and upcoming global events (FIFA 2014; 2016 Olympic Games) and plans to complete their network of BRT corridors, to serve almost 2 million people every day. The new intermodal station locations were chosen strategically, for high demand and visibility, mostly adjacent to the 2016 Olympic sites. The city is now adding 7 more kilometres to TransOeste and connecting it to the subway system (also under construction), as well as adding another bus terminal integrated with the subway, with 7 more BRT stations to this corridor. These are likely to be launched by June 2016.

**Case study: *Guangzhou[xix] - BRT Corridor***

*Summary:* Guangzhou's innovative 22.5-km long BRT corridor opened in February 2010 and is an example of holistic planning, with the BRT at the centre of a multimodal transport network that integrates other urban design elements. The corridor's success was also recognised by the Institute for Transportation and Development Policy's Sustainable Transport Award in 2011[xx].

Among the key features of the system, which was developed in cooperation with ITDP China, are the following: fully segregated BRT lanes with world's highest BRT bus volumes (350 buses per hour in a single direction, approximately one bus every 10 seconds, transporting more than 800,000 passengers per day);[xxi] system location in a high-density area and station size based on passenger demand; flat-rate subsidized bus fares and discounted smart cards; direct access to metro or rail stations; bridges from bus stations connecting directly to adjacent buildings; bike

parking and public bike sharing available at or near BRT stations (more than 5,000 bikes); and a "greenway" combining bike lanes, walkways, parks and playgrounds on either side of the BRT corridor.[xxii]

*Results:* As the ITDP report suggests,[xxiii] the Guangzhou BRT system has reduced traffic congestion and increased speed of buses and mixed traffic by 29% and 20% respectively, saving 52 million commute hours in 2010, with an estimated annual value of US$ 24 million. It also improved efficiency of the city's overall bus system, increased use of public transport and reduced bus overcrowding (bus service satisfaction increased from 29% to 65%). The BRT system contributed to an estimated average annual $CO_2$ emissions reduction of 86,000 metric tons during its first 10 years through car-use reduction and biking promotion, and particulate emissions reduction of at least 4 tons per year, further increasing the efficiency of Guangzhou buses already running on LPG. At the same time, the BRT reportedly resulted in annual operating cost savings of US$14 million since the system began operating, securing a competitive return on investment (despite subsidized bus fares) expected at 79% within 10 years (131% if all local and global benefits, excluding health impacts, are taken into account).

*Reasons for success:* Guangzhou's BRT system is particularly successful because of the holistic and detailed planning process. The city considered very carefully how the new BRT corridor would fit in with people's expectations and needs, as well as with existing modes of transit e.g. existing bus routes, walking and cycling options in the city, etc.

*When/why a city might adopt an approach like this:* Cities seeking to develop BRT solutions for long-term sustainability benefits should look to the above examples for holistic implementation. Guangzhou has considered both design and integration features to ensure economic and social factors (demand, population distribution, fare structure, station accessibility, existing community sites and landmarks), physical and geographic factors (width of roadways and necessary expansion, elevation, existing infrastructure), and technological factors (vehicles, real-time monitoring, signals, fare integration) are taken all into account in the design and implementation phases of its BRT system.

### 3.3 Develop benchmarking and measure the impacts of BRT

Benchmarking and measuring impacts of BRT is a key area of best practice, as it enables cities to assess, and then demonstrate the value from its BRT system to other stakeholders. These assessments vary depending on the local conditions and objectives of the city government, but should include elements like time saving, emissions reduction, air pollution improvements and subsequent health impacts. Other factors like retail and economic impacts, and other aspects of social evaluation can also be considered by cities.

This measurement can enable a city to use the data in a variety of ways – to demonstrate the success of a corridor, the sustainability of the system, or showing how social aims e.g. reducing inequality, have been met. This benchmarking can form the basis of communicating to

stakeholders and/or politicians to meet the city's broader transport and social objectives. If data are available from other cities, comparing delivery across two or more cities is another effective way to identify future improvements that are needed in the system.

**Case study: *Istanbul - Metrobüs system***

*Summary:* Istanbul's Metrobüs system was designed to provide low cost, rapid service to the city's inhabitants traveling east to west and vice versa. It is the first bus rapid transit system in Turkey and has the distinction of being the first transcontinental BRT in the world. Metrobüs was designed to operate at near highway speeds and as a result, provides substantial travel time saving benefits to its users compared to alternative modes of transport. EMBARQ has completed a detailed analysis of social, environmental and economic benefits from the Metrobüs system in Istanbul.[xxiv] The analysis highlights various elements of BRT performance in Istanbul, including passengers carried, capital cost per kilometre, reduction in travel time, reduction in GHG emissions and local air pollutants, as well as improved road safety and physical activity. It also identifies the socio-economic groups benefiting the most from the Metrobüs system. This analysis forms a good model for other cities to benchmark their systems and assess which groups are benefiting the most and why, as well as to undertake a comprehensive cost-benefit analysis to guide future improvements or expansions of their BRT systems.

*Results:* The Metrobüs system serves an estimated 600,000 passenger trips every day over a length of 51.3km, with a maximum load of 30,000 trips per hour per direction. By reorganizing and consolidating informal transit and conventional buses, Istanbul's Metrobüs BRT system is estimated to reduce CO2 emissions by 167 tons/day and cut daily fuel consumption by more than 240 ton-litres – this equates to 60,955 tonnes per year.

*Reasons for success:* The city undertakes comprehensive surveys through the IETT (the Istanbul Electricity, Tramway and Tunnel Survey) annual rider assessments. This enables the city to continuously assess the quality of service being provided and improve it, which in turn ensures the BRT remains an attractive mode of transport for people to use.

*When/why a city might adopt an approach like this:* High-quality bus rapid transit systems can impact the quality of life, productivity, health, and safety of people living in cities. Examining these impacts in depth can help a city assess the net positive benefits to society of a BRT project, an important criteria when deciding to build or expand a BRT system.

## 3.4 Focus on stakeholder engagement and communications

Stakeholder engagement is a crucial component of getting a BRT project off the ground, as projects often face a number of preconceptions from decision-makers, stakeholders, press and citizens. These can include concerns about taking already congested road space away from

other users, as well as concerns about the performance of BRT systems versus rail. Until a system is in place and delivering benefits for them, people can be opposed to the idea of a BRT system due to fear of the unknown.

A strong and well thought-out stakeholder engagement campaign is crucial to ensure buy-in and commitment to the project, as well as to encourage ridership for the system. Elements of a good campaign will include identification of all groups likely to be affected by the project, and then tailoring appropriate communications to them through advertising, community meetings, leaflet drops, surveys, regular consultations on plans etc.

**Case study: *Buenos Aires[xxv] - Stakeholder management for BRT Corridors***

*Summary:* Like other growing cities, Buenos Aires faced significant problems with traffic congestion and transport related air pollution. As a result, the city developed a Plan for Sustainable Mobility to tackle these problems, with the BRT system forming a key element of this Plan. Stakeholder engagement has been crucial for the city's successful BRT delivery, enabling it to overcome initial negative publicity - to eventually deliver a BRT system with an extremely positive reaction from the media and citizens alike. This is in part due to the strong stakeholder management and time spent working with affected groups to overcome initial concerns. The BRT system now consistently rates among the best initiatives launched by the city administration, with positive impacts on everyday life.

*Results:* By 2015, the BRT corridors in Buenos Aires carried 1.2m people across the city and resulted in 49,000 tonnes of CO2 emissions reduction per year. So far, the introduction of BRT lines on key routes has cut travel times by 20 - 40% on average, although in some cases it has been by 50% or more. By the end of 2015 there will be 56km of Metrobus corridors connecting the main transport hubs in the city and 1.2m people will benefit everyday. Adopting articulated buses on some routes has also led to a further reduction in carbon emissions. All of these benefits have been made possible by the city's strong work on engagement and the support generated across the full range of stakeholders.

*Reasons for success:* The city's strategy was to phase in implementation of the BRT. The experience and positive results from the first route encouraged the city to proceed with the delivery of more corridors, accompanied by active opinion polling, awareness campaigns and the launch of a dedicated educational website. In subsequent stakeholder surveys, over 90% of commuters gave positive feedback for Metrobus.

**Case study: *Tshwane – Stakeholder engagement in "A Re Yeng"***

*Summary:* Tshwane's BRT system (A Re Yeng or "Let's Go"), approved in 2011, forms part of the City of Tshwane's 2055 Growth and Development Strategy[xxvi] and aims to provide an alternative to private cars and minibuses in the city, offering a faster, regular, more equitable and reliable transport option for getting into the city centre. Aware of the economic losses this may cause

for minibus and taxi operators along the corridor, Tshwane involved the affected stakeholders in the negotiations from the beginning of the project and provided for their integration in the BRT system, thus building a unique relationship between the city and the transport industry. Those affected by the transport system change received financial compensation, were offered shareholder position in the new Bus Operating Company (BOC) or were directly incorporated in the BRT system operation (as bus drivers or other employees). The pilot corridor for Tshwane's BRT is now in place, and expansion of the system is continuing.

*Results:* The project hopes to carry 100,000 passengers a day when the almost 70 km BRT corridor is fully operational in 2020. Around 209,000 tons of $CO_2$ will be reduced annually if Tshwane achieves its goal of shifting 10% of journeys to BRT. With more commuters shifting from private to public transport, the city also expects fewer traffic accidents.[xxvii] The Tshwane BRT bus fleet will also run on low-emission diesel engines and compressed natural gas, and will emit on average 34% less $CO_2$ and 24% less $NO_x$ than a standard diesel counterpart[xxviii].

*Reasons for success:* Early, strong and continuous engagement with stakeholders to ensure they are on board with the plans as much as possible, and are not fearful of/ in opposition to the new system being introduced, were key to successfully implementing the BRT system.

*When/why a city might adopt an approach like this*: Many cities around the world have existing minibus or taxi industries in place, whose livelihoods may be perceived to be at risk from the introduction of a new BRT system. Tshwane's approach is a great example of including the industry and other stakeholders early in the planning phase, and finding roles for them in the BRT system that is being developed.

### 3.5 Integrate BRT with other means of public transport and urban planning

As cities contend with resource constraints and environmental pressures, increasing public transport availability through the introduction of a BRT system is a very effective way of meeting transit demand. But introducing a BRT in isolation is not enough, and more connected transit-oriented urban policies are key to improving the long-term sustainability of cities. More holistic, transit-oriented urban policies would reduce $CO_2$ emission growth by 30% in Chinese and Latin American cities and 40% in Indian cities, when compared to their baseline scenarios.[xxix] This is also better and more efficient for cities where compact, transit-oriented development can have a massive economic benefit. For example, Copenhagen only spends 4% GDP on transport while sprawling, car-focused Houston spends 14%.[xxx]

**Case study: *Curitiba[xxxi] - Bus Rapid Transit Modernisation***

*Summary:* Curitiba was the first city to develop Bus Rapid Transit in 1974 and today the city continues to be a transit innovator, having recently launched a program to implement hybrid and electric buses. Curitiba's BRT system was developed as an integral part of an overall Masterplan (1966),[xxxii] its main objectives included radial expansion of the city along five

corridors, integrating land use and transport, and creating a dedicated planning institute IPPUC.[xxxiii] The Masterplan is revised every 10 years, and the latest revision includes a comprehensive urban sustainable development plan for the next 50 years.

In the 1990s, after creating the BRT system thanks to a partnership between the municipality and bus operators (which made the first BRT lanes cost 50 times less than subway[xxxiv]), Curitiba tackled the integration of all bus lines into the Rede Integrada de Transporte, with a hierarchy of bus service types and common terminals, allowing passengers to use one ticket for as many bus lines as necessary.[xxxv] In 2011, BRT expanded its carrying capacity with the implementation of the Direct Line – a bus stopping at fewer stops, reducing substantially longer-distance travel time. In 2012, the city also initiated the integration with a bicycle network, expanded through the 2012 Bicycle Masterplan.[xxxvi] Curitiba also continues innovation in other parts of its transport sector: since 2014, they have been promoting 100% electric buses.

*Results*: Today, 80% of travellers use the BRT system and it carries around 2 million passengers per day.[xxxvii] The BRT has 30 hybrid buses, reducing overall fuel needs by 35% and limiting pollutant emissions ($NO_x$, particles). Curitiba's BRT system model has already been replicated in more than 150 cities worldwide.

*Reasons for success:* The success of the BRT system is related to its integration in Curitiba's masterplanning and support from different stakeholders. On the micro level, some employers subsidise their employees who use the BRT system. On the macro level, urban planning is integrated with the BRT system, with urban growth being restricted to corridors of growth – along key transport routes – using a combination of control and incentives, such as extended permitting for developers that wish to construct taller buildings close to the transit corridors.

*When/why a city might adopt an approach like this:* Cities developing or updating urban development plans, planning for upgrade of their transport system or looking into implementing a BRT system, can all use this approach to ensure that different transport modes are well integrated and constitute the most efficient system possible.

### 3.6 Utilise innovative financing mechanisms

BRT projects have typically been financed in a range of ways. To date this has included: government grants (national or municipal); loans; revenues from fuel tariffs, fares, advertising; local commercial bank financing to operators, etc. In addition, cities are now starting to explore more innovative means of financing new BRT systems or expanding existing ones, such as through Green Bonds, as discussed in the Johannesburg example below. Carbon credits are also an emerging area of interest for C40 BRT Network member cities and are currently being explored in more detail.

**Case study: *Johannesburg*[xxxviii] *- Green Bond***

*Summary:* The city of Johannesburg has pioneered a municipal "Green Bond" in South Africa to raise funds to help respond comprehensively to climate change and to ensure the sustainable management of resources. The Green Bond issued by the city in June 2014 is worth ZAR1.5bn (approx. US$143m) and is funding projects across a range of sectors including 150 new dual fuel buses and converting 30 buses to biogas.

*Results:* The Green Bond allows the city to show its commitment to environmental stewardship, while receiving a market-related financial return. The Green Bond has provided the City with a new funding source to improve and expedite the implementation of its climate change mitigation strategy and move Johannesburg towards low carbon infrastructure.

*Reasons for success:* Johannesburg had political leadership that was supportive of exploring innovative mechanisms to finance upcoming "green" projects. In addition, the city's investment-grade credit rating helped them take the bond to market and for it to receive a very positive response. In addition, the city also benefited from international guidance, such as from the Green City Bonds Coalition, which – in cooperation with C40 - recently released the specialist Green Muni Bonds Playbook.[xxxix]

*When/why a city might adopt an approach like this:* The use of Green Bonds to finance low carbon buses (and green projects more broadly) offers the opportunity for creditworthy cities to access large-scale, debt finance to introduce clean buses into their BRT (and other city) fleets. The cost of finance will depend on the structure of the bond and the creditworthiness of the project or the issuer, but is generally a competitively priced source of long-term finance. It also offers cities the opportunity to grow and diversify their investor base, increase collaboration between city environment and finance departments, and publicly highlight a city's long-term commitment to sustainable development.

## 4 FURTHER READING

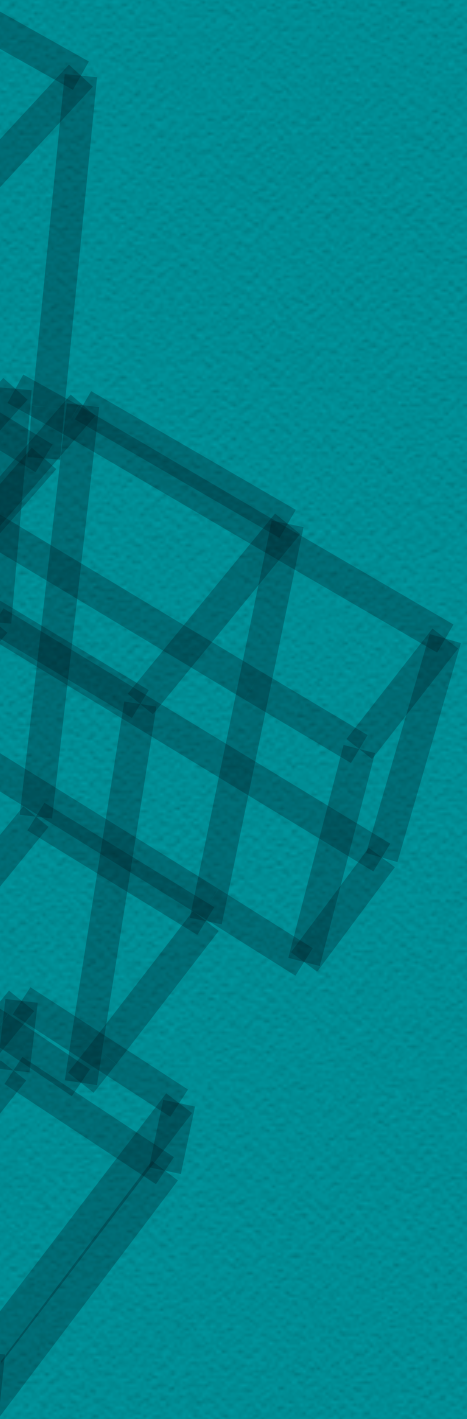
A number of external organisations, including C40 partners, have published best practice guidance in different BRT-related areas including:

- The 2014 BRT Standard from ITDP, available at https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/
- The BRT Planning Guide from ITDP, available at https://www.itdp.org/the-brt-planning-guide/
- EMBARQ's report on Measuring the Social, Environmental and Economic impacts of BRT systems is also an excellent resource and is referenced heavily in the Istanbul case

study. Available at http://www.embarq.org/sites/default/files/Social-Environmental-Economic-Impacts-BRT-Bus-Rapid-Transit-EMBARQ.pdf

- World Bank (2015). Moving Towards Climate-Resilient Transport, available at http://viewer.zmags.com/publication/4d0729a6#/4d0729a6/8

[i] https://www.iea.org/publications/freepublications/publication/transport2009.pdf
[ii] https://www.c40exchange.org/display/BUSR/Bus+Rapid+Transit
[iii] https://www.iea.org/publications/freepublications/publication/transport2009.pdf
[iv] http://bit.ly/1l9seqi
[v] http://issuu.com/c40cities/docs/cam_3.0_2015
[vi] http://brtdata.org
[vii] http://issuu.com/c40cities/docs/cam_3.0_2015
[viii] https://www.itdp.org
[ix] http://www.embarq.org/en/social-environmental-and-economic-impacts-bus-rapid-transit
[x] Source: Expert Voices: Marcos Tognozzi, Rio de Janeiro's Transport Operations Coordinator, on the expansion of Rio's BRT network on the C40 blog, September 2014
[xi] Source: City Climate Leadership Awards case study available at http://cityclimateleadershipawards.com/buenos-aires-plan-for-sustainable-mobility/
[xii] http://www.unep.org/Transport/new/PCFV/pdf/2015_DART_Reducing_Emissions.pdf
[xiii] http://www.c40.org/case_studies/rio-bus-rapid-transit
[xiv] http://www.wricities.org/media/photo-essay/transoeste-bus-rapid-transit-brt-rio-de-janeiro-brazil
[xv] http://www.c40.org/case_studies/integrating-transport-modes-for-sustainability
[xvi] http://www.c40.org/blog_posts/expert-voices-marcos-tognozzi-rio-de-janeiro-s-transport-operations-coordinator-on-the-expansion-of-rio-s-brt-network
[xvii] https://www.itdp.org/wp-content/uploads/2014/07/Transoeste_Analysis_FINAL.pdf
[xviii] http://www.indiaenvironmentportal.org.in/files/file/Sustainia100_2015.pdf
[xix] http://ccap.org/assets/CCAP-Booklet_ChinaTransport.pdf
[xx] https://www.itdp.org/sustainable-transport-award-cities-guangzhou/
[xxi] http://ccap.org/assets/CCAP-Booklet_ChinaTransport.pdf
[xxii] https://www.itdp.org/where-we-work/china/guangzhou/
[xxiii] Hughes, Colin and Xianyuan Shu. May 2012. "Guangzhou, China Bus Rapid Transit: Emissions Impact Analysis." Institute for Transportation and Development Policy. Web. July 2012. <http:// www.itdp.org/documents/20110810-ITDP-GZBRTImpacts.pdf>
[xxiv] http://www.wricities.org/sites/default/files/Social-Environmental-Economic-Impacts-BRT-Bus-Rapid-Transit-EMBARQ.pdf
[xxv] http://www.c40.org/awards/3/profiles/74
[xxvi] http://www.tshwane2055.gov.za/home/tshwane-2055-info/tshwane-vision-2055
[xxvii] http://issuu.com/sustainia/docs/cities100/127?e=4517615/31305566
[xxviii] http://www.engineeringnews.co.za/print-version/a-re-yeng-tshwane-rapid-transit-system-south-africa-2015-04-24
[xxix] OECD, 2015, http://www.internationaltransportforum.org/Pub/pdf/15Outlook-Summary.pdf
[xxx] New Climate Economy Report, 2015
[xxxi] http://www.c40.org/blog_posts/curitiba-a-leader-in-transport-innovation
[xxxii] http://www.cifalscotland.org/docs/CuritibaIntegratedPlanning_.pdf
[xxxiii] http://www.ippuc.org.br/default.php
[xxxiv] http://www.theguardian.com/cities/2015/may/26/curitiba-brazil-brt-transport-revolution-history-cities-50-buildings
[xxxv] http://www.theguardian.com/cities/2015/may/26/curitiba-brazil-brt-transport-revolution-history-cities-50-buildings
[xxxvi] http://curitibainenglish.com.br/government/urban-mobility/curitiba-to-have-400km-of-bike-lanes/
[xxxvii] http://www.bbc.co.uk/schools/gcsebitesize/geography/sustainability/sustainable_living_rev4.shtml
[xxxviii] http://www.c40.org/awards/3/profiles/56
[xxxix] http://www.c40.org/blog_posts/new-playbook-guides-cities-through-green-bond-market



**London**
North West Entrance, City-Gate House
39-45 Finsbury Square, Level 7
London EC2A 1PX
United Kingdom

**New York**
120 Park Avenue, 23rd Floor
New York, NY 10017
United States

**Rio de Janeiro**
R. São Clemente, 360 - Morro Santa Marta
Botafogo, 22260-000
Rio de Janeiro - RJ
Brazil

www.c40.org
contact@c40.org


*February 2016*