CHAPTER 11

Improving Public Transport in Chinese Cities: Elements of an Action Plan
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Overview

Urban public transport can provide more energy efficient transportation than the average automobile and, because of this, urban public transport will be a key component of any low-carbon city. Realizing the benefits of urban public transport at a manageable cost, however, requires careful analysis and planning, along with communication among several government authorities, and appropriate transport policies and regulations.

This chapter summarizes the key elements of an action plan that a city could put in place to improve the quality of their urban public transport in a manner that would also lower the total carbon footprint of their transport system. The chapter address issues related to municipal institutional arrangements, including the nature and structure of the relationship between a city and its public transport operators, and provides suggestions for planning and strategic studies, as well as elements of an investment agenda. As bus systems are and will remain the backbone of public transport in Chinese cities, this chapter specifically discusses how to modernize and upgrade a traditional bus system and maximize the benefits of mass transit investments in bus rapid transit (BRT) and urban rail.
Urban Transport and Low-Carbon Growth

Public transport can be a cost-effective and efficient alternative to individual private modes for accessing urban opportunities. In addition, public transport provides a variety of benefits that private automobile transportation cannot: the efficient use of urban space, fewer traffic fatalities, and a reduction in the harmful effects of urban air pollution. This is no less true today than it was in decades past.

What has changed in recent years is that the climate change imperative has further strengthened the attractiveness of public transportation. As is shown in figure 11.1, at reasonable levels of vehicle loading, a bus or metro system can provide far more energy- and carbon-efficient transportation than the average car, per passenger kilometer.

This is the basic argument that supports public transport as an element of a low-carbon city platform—a public transport system can move more people more efficiently and with fewer negative externalities than a pri-

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**Figure 11.1 Life-Cycle Emissions by Passenger Kilometer**

Source: Chester and Horvath 2009.

Notes: MJ = megajoules; PKT = passenger kilometers traveled; g CO₂e = grams of CO₂ equivalent. Individual bars show energy consumption and GHG emissions per passenger kilometer for (from left to right) vehicle operation components (with number), vehicle components, infrastructure components, and the fuel production component.
Private transport system can. However, individual citizens with the freedom to choose their own mode of transport will usually not seek to maximize global environmental benefits. Rather, they will choose a mode that maximizes comfort, reliability, speed, convenience, and cost. On most of these dimensions, cars are an optimum choice for many commuters; and for reasons of status and function it is common that as incomes rise, those with financial means switch to cars. Chinese cities are currently following this pattern, and rapid economic development has led to a boom in car ownership.

The only public transport alternative for most people is a bus service steadily degraded by ever-increasing traffic congestion. Not surprisingly, for those with a choice, public transport is rarely competitive, and an overwhelming majority of public transport users in Chinese cities today are “captive” users with few alternatives. However, as economic development continues, today’s captive riders will have choices tomorrow—and only a high-quality system will be able to keep them from choosing individual transportation alternatives. Ultimately, the goal is to provide public transport of quality that not only satisfies the needs of today’s captive users, but also attracts customers away from cars and taxis. Such a public transport system that has the capability to attract customers from private automobiles is often a necessary political prerequisite for cities to consider restrictions on auto use.

All urban strategies for low-carbon growth will require a large share of passenger traffic to be carried by an upgraded public transport system, even as increasing income levels make auto use a viable choice for increasing numbers of people. Naturally, the definition of “upgraded public transport” will vary based on the context; a commuter in Shanghai has different expectations (and the city has different resources) than a commuter in a small city. For this reason, the appropriate program for public transport improvement will vary over time for any given place and will depend on the context. The general framework presented in this chapter, however, can be used by any city to assess and improve its public transport services.

The national government and urban public transport. In the first two decades after 1977, China’s national government was not much involved in the urban transport sector, considering it a local issue best left to local municipalities. At the highest levels, these policies have begun to change. In October 2005, a State Council decision declared that urban public transport development should be a national priority. Subsequently, particularly after the responsibility for urban public transport was given to the newly formed Ministry of Transport in 2007, the national government
has been actively looking to define its role in this sector (see also box 11.1). The current focus is to both (i) define a national policy toward public transport and (ii) review issues related to subsidies and institutions. These developments are timely and will work well to support urban transport and low-carbon developments.

**Box 11.1**

**World Bank Support for the Ministry of Transport**

The World Bank supports the Ministry of Transport through workshops and informal technical inputs on different models of national government participation in the public transport sector. Examples are a December 2008 workshop to provide access to experiences from the United States, France, and the Republic of Korea, and a June 2010 workshop about experiences from the United States and India. In addition, through a grant financed by the GEF, the World Bank is both supporting a strategy for national government participation and developing capacity-building tools to support the development of new regulations, standards, and codes to help national agencies exert technical leadership in the sector.

*Source: Authors.*

**Action Plan Step One: Establishing the Correct Institutions**

**Creating a Unified Governmental Framework to Plan, Manage, and Monitor Urban Transport**

Fragmented governmental institutions are a fundamental hurdle for Chinese cities trying to make a quantum improvement in the quality of public transport they offer. Multiple municipal government agencies, usually working with minimal coordination, are involved in the delivery of urban transport investments and services. Bus operators are usually regulated by the transport bureau (sometimes also known as the communications bureau), following a 2007 national reform. This bureau also regulates regional, interurban bus services and manages all municipal roads outside the city center. The construction, and in some cases also the management, of bus stops, terminals, and other infrastructure, however, is done by the urban-rural construction and housing bureau. Other involved agencies are the land and planning bureaus, responsible for assessing...
transport operator applications to use land (both for public infrastructure like bus stops and essential operator-managed infrastructure such as depots). The planning bureaus are also responsible for developing the urban and transport master plans. Moreover, the Development and Reform Commission (DRC) has a strong role in developing plans that involve significant investments—such as for urban rail. Whereas the traffic police (either as an independent agency or as a branch of the police) own and operate the traffic signals and are responsible for on-street traffic management, including bus priority and on-street parking enforcement, parking policies and public transport fare policies are within the realm of the DRC. Finally, enforcement of illegal parking on sidewalks—an unfortunately common phenomenon—is again the responsibility of an entirely different agency. This fragmentation continues at an operational level, leading to poor coordination between rail operators (usually large, national-level, state-owned enterprises reporting directly to the city mayor) and bus operators (small, private, or city-level state-owned enterprises reporting to a small division of the transport bureau). Indeed, it is even difficult sometimes for cities to coordinate planning and investment implementation for bus and rail systems along just one corridor.

This fragmentation of responsibilities takes a heavy toll on the quality of the public transport Chinese cities are able to offer. At an administrative level, it is difficult for city leadership to place clear accountability for public transport development with any one municipal agency, and at the operational level it is difficult for bus companies to operate with adequate infrastructure support. For large cities with rail systems, this multiplicity of agencies inhibits the development of seamless physical transfers across modes, or the development of seamless operations and fare strategies. International experience suggests that significant benefits accrue when cities or metropolitan regions develop unified transport authorities that are able to plan, finance, manage, and operate a municipality’s transport system across modes. Hong Kong SAR, China, and Singapore offer good practice examples in the region. Vancouver and London provide other good examples internally. While fundamental reform and the realization of unified municipal or metropolitan transport authorities will likely require a national-level initiative, cities can improve the level of coordination across agencies involved with urban transport, for example, by placing those agencies under the responsibility of one vice mayor. This consolidation could be complemented by a standing group or standing committee with members of all relevant agencies, headed by a city leader, that meets regularly to coordinate activities.
Developing Institutional Management and Subsidies

Institutional management. Modern public transport management institutions and strategies for public transport subsidies are essential to a well-run, effective bus transport system. Both Chinese and international experiences suggest that the manner in which bus services are structured—the combination of supply arrangements, incentives for performance, fares, and arrangements to cover deficits—is critical. High-quality bus services have been provided by cities through a variety of structures. However, safe, high-quality, efficient bus services are usually found in cities where public authorities remain ultimately responsible, such as London, but where services are provided by several independent, well-capitalized bus operating companies. These companies compete for the right to operate given routes or bundles of routes for periods of five to eight years. Such a system requires strong oversight by a capable public transport authority that plays an active role in monitoring service quality and in keeping operators incentivized by retaining the right to terminate or penalize them for poor performance (see also box 11.2).³

Box 11.2

World Bank Support of Institutional Management of Bus Services

As the experience with institutional management of bus services has evolved in China, the World Bank has continuously provided advice and support on the topic to the Chinese authorities. In early Bank lending projects—most notably in Shanghai, Guangzhou, and Shenyang (the Liaoning Urban Transport Project)—the institutional arrangements for bus services were a key element of the World Bank’s dialogue with the city, as these cities became among the first in China to introduce private capital in bus operations and use competitive tendering mechanisms to select suppliers.

More recently, while dialogue in the form of technical assistance, training programs, workshops, and seminars at the city level remains an important element of World Bank projects, the Bank has also focused on providing policy support to the national ministry responsible for public transport. Starting in the mid-2000s, the national government became directly involved in the sector. As the Ministry of

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In China, service is most often provided by state-owned enterprises (SOEs) that use regulated fares (the global norm for urban public transport). Bus services have evolved considerably since China’s early economic transformation in the early 1980s. Initial reforms focused on creating operating companies, enterprises distinct from government. Further reforms in the 1990s focused on limiting or ending public subsidies. In many cases, these reforms resulted in a strong focus on operational efficiency and ensured relatively low staffing levels, often with little or no subsidy. However, in recent years the national mandate to “prioritize public transport” has been interpreted by some, most notably Beijing (see box 11.3), as a reason to incur large annual operating subsidies.

At the time of these earlier reforms, urban bus service was seen primarily as a local issue with little input from the national government. As a result, there were a diverse range of experiments in the use of the private sector. In a few cities, such as Guangzhou, Shenyang, and Changsha, operators independent of the municipal governments (either private operators or an SOE from another region of China) successfully obtained competitively awarded franchises to operate bus services. Other cities experimented with private owner-operators. In two notable cases, Shanghai and Chongqing, this led to fragmented on-street competition, which has since been replaced by gradual, city-encouraged consolidation (in Shanghai) or a return to public sector monopolies (in Chongqing). Generally, the most common route for the introduction of private capital in the industry has been the development of joint ventures, where the local SOE still has a majority stake and management control.

**Subsidies.** In many cities where public transport is regarded as a priority, economic performance is often considered secondary to improving
service and ridership, and there is limited interest in market-based institutional reform that could assure cost effectiveness. If international experience is any indicator, the appetite for reform of public transport management will change over time, particularly once ridership stabilizes and SOEs start becoming a significant burden on public expenditure. Even so, different cities have taken a variety of approaches to subsidize public transport—in some to lower fares and in others to support particular vulnerable groups and to enhance service (see box 11.3).

Box 11.3
Subsidies for Public Transport: The Differing Experiences of Beijing and Kunming

In Beijing, the operating subsidy for public transit in 2009 was over RMB 10 billion a year. Bus users pay RMB 0.4 with a transit card and rail users pay RMB 2.0, which generates revenue far below operating cost. The Beijing government subsidizes the operator, a government-owned bus SOE, for all costs above operating revenue, and it is not clear what incentives the operator has for increasing its operational efficiency. Although incomes in Beijing are among the country’s highest, fares on its bus system are noticeably lower than many cities of more limited means.

Kunming, located in southwest China and with significantly lower average income than Beijing, has pursued a policy of limiting overall operational subsidies to covering specific costs such as reduced fares for elderly riders and income foregone from providing passengers with free transfers between buses. Overall, the bus system has a relatively high fare of RMB 1.00, a farebox operating cost recovery ratio of 90 percent, and overall high levels of ridership. The differing experiences of these two cities demonstrate different ways Chinese cities have used subsidies to support the development of public transport.

Source: Authors.

Action Plan Step Two: Strategy, Planning, and Operations

Developing Standards, Setting Targets, and Measuring Progress

China already has standards and national targets related to public transport, for example, specifying what percentage of trips in cities of a certain size should be done by public transportation (see table 11.1). While these high-level standards provide targets for cities that do not currently meet
them, standard and target setting can be improved. Specific recommendations are the following:

- **Develop and implement standards and targets that help improve services and make public transport attractive for car drivers:** This is the first strategic need, as any effort to make a city low-carbon requires that public transport attracts and displaces auto trips, more so than cycling or walking trips. It is inevitable that as cities grow spatially, many trips that used to be made by walking or cycling will transfer to public transport. The strategic goal of a city should be to increase the quality and comfort of trips in a way that public transport is able to attract trips that would otherwise be made in taxis and private automobiles.

- **Develop standards and targets that complement, not substitute, detailed planning:** The targets set forth in table 11.1 are good aggregate guides. However, they need to be seen as just that, high-level guides that need to be refined and complemented by detailed planning studies. Ultimately, the number of buses needed in a city to provide high-quality services would depend, for instance, on the spatial dispersal of the population and the demand for trips (both spatially and over the course of a day), among other factors. Similarly, quality coverage requires not

### Table 11.1 Chinese National Targets and Standards Related to Public Transport

<table>
<thead>
<tr>
<th>Urban population</th>
<th>Public transport mode share target</th>
<th>Average speed target</th>
<th>Bus ownership target (per 10,000 persons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 3 million</td>
<td>35%</td>
<td>15 km/h</td>
<td>15</td>
</tr>
<tr>
<td>1–3 million</td>
<td>25%</td>
<td>20 km/h</td>
<td>12</td>
</tr>
<tr>
<td>&lt; 1 million</td>
<td>15%</td>
<td>25 km/h</td>
<td>10</td>
</tr>
</tbody>
</table>


**Coverage:**
- No less than 50 percent of urban land area should have a functioning bus stop within a radius of 300 meters.
- No less than 90 percent of urban land area should have a functioning bus stop within a radius of 500 meters.

**Density of network:** 3–4 kilometers per square kilometer in the central city; 2–2.5 kilometers per square kilometer in the outskirts of the city.

Sources: Ministry of Urban Rural Construction and Housing (this Ministry was called Ministry of Construction at the time the standards were issued); Ministry of Transport.
only access to a bus stop within 300 or 500 meters, but high-quality services at that stop that allow trip makers to reach their destinations of interest. Ultimately, detailed planning studies (as described in the next section) are needed to understand the nature of demand and to design a system of routes, schedules, and services that best serve that demand. These studies and plans should finally determine the location of bus stops, the number of buses, and related structures of a public transport service in a city.

- **Consider the value of creating a regular system of customer feedback:** Regular monitoring to help cities gauge if current strategies are working will be critical. International experience suggests that regular customer surveys (in the form of short on-board surveys complemented possibly with online surveys) can provide city leaders and public transport agencies with valuable feedback on performance. Such feedback can help assess trends in performance, identify any issues that trip makers are particularly sensitive to, and also provide agencies with important information on the character of their customer base. From a low-carbon perspective, cities may find it particularly valuable to identify trip makers who may have had the choice of using a car for their trip, and pay particular attention to the feedback and satisfaction levels of that segment of trip makers.

**Planning—for Investments, Routes, and Coverage**

While planning studies of different kinds are important for any public transport system, they are perhaps more important in Chinese cities than elsewhere, mainly due to the speed with which Chinese cities are currently undergoing change. Cities are growing spatially, and therefore population size and characteristics are changing quickly. Locations and characteristics of residential, employment, and other trip-related opportunities are also evolving rapidly. Trips are getting longer and trip demands are becoming more complex. This is a difficult environment for public transport, and to remain competitive, cities need to constantly ensure that the mix of routes, schedules, and services being offered remains relevant to the city as it is evolving. Ensuring that a system of planning tools keeps the city’s transport system competitive is a key priority for any city leadership looking to improve its public transport system.

Four kinds of studies in particular are critically needed in many Chinese cities. These are as follows:
• **A current medium-term (five-year) public transport plan and strategy:** The basis of any public transport network is an understanding of travel patterns of likely customers, and the design of a system responsive to those patterns. Cities could, for example, prepare five-year rolling plans for route development. These plans, which should ideally be updated annually, include a systematic analysis of expected population and employment levels for the next five years, a study of evolving travel patterns (such as through origin-destination surveys), expected changes in car ownership and usage, a review of current levels of service on all existing bus routes, the need for new routes and adjustments to existing routes, future bus fleet requirements, future terminal and depot requirements, and expected financial performance. Such planning helps to ensure that the service level on existing routes is adequate; that plans are in place to serve new or growing areas; and that new transport facilities, such as new roads or rail lines, are taken into account. In addition, this work contributes to sound public asset investment plans that help system planners make the case for their intended use of land and resources from the city to develop depots, terminals, and other infrastructure.

• **Route adjustment and service planning:** A service planning exercise builds on the tools and data that are also required for longer-term planning, but focuses on a more detailed, almost operational analysis of the route structure. It also includes an analysis of how routes function as a network. Outputs may include suggestions on route consolidation and adjustments to route stop patterns. Such a service planning study can often illustrate the value of new special-purpose routes, such as express bus routes (with only limited stops) or commuter routes (operating only at peak times). Providing cities with the tools to make more rational decisions on bus service planning can help them make better use of scarce resources, making public transport more attractive even without major new investment. A focus on service planning is likely to improve the quality of services of most Chinese bus networks.

• **A delay analysis of current bus routes to develop a near-term program of improvements:** Door-to-door travel times remain critical to providing competitive public transport service. Delay analyses can help public transport systems systematically assess the location and nature of delays faced by their customers and allow for the development of strategies to address these delays appropriately. For instance, if delays are
being incurred in traffic, a bus-only lane may offer relief. However, if most delays are related to waiting at traffic signals, then reducing delays would require a modified traffic management plan—perhaps limiting turns at certain critical intersections. If delays are being incurred by bunching of buses at stations, then service planning approaches such as different skip-stop patterns for buses may be appropriate. Different bus stop platform designs and off-board fare collection may also contribute to solutions. A delay analysis often supplies decision makers with a systematic understanding of the nature of the issues they need to address to improve service. Such studies can be conducted citywide to identify systemwide problems, or—depending on the complexity of the system—just along key corridors. Experience shows that all kinds of cities, ranging from megacities like Beijing to relatively smaller cities like Shijiazhuang, have benefited significantly from carrying out delay analyses.

- **Mass transit plans**—medium-term plans to identify and support mass transit corridors: Ideally, cities would identify key corridors appropriate for future mass-transit investments some time ahead of when such investments are actually required. The outputs of such work could then be used as a basis for discussion with land planning agencies (to reinforce development of such a corridor, particularly focusing on nodes where future stations are envisioned) as well as investment planning agencies (to develop an appropriate financial plan in light of the possible investments) (see also box 11.4).

### Action Plan Step Three: Upgrading Traditional Bus Services

Similar to the situation in other countries, traditional bus systems remain the most commonly used public transit service in China. For most commuters, the bus remains essential and is often the only mode of public transport they have access to. Despite their importance, buses are in many ways the most vulnerable element of a Chinese city’s transport system. First, unless systematic efforts are made to enhance quality and preserve speeds, the competitiveness of bus systems can rapidly deteriorate as a result of increasing traffic congestion; second, many urban bus companies lack the resources to allow their services to effectively compete with cars; and third, current institutional arrangements often do not provide operators with clear incentives to deliver efficiency and performance. As a result, rapidly developing cities can quickly find themselves caught in a negative feedback cycle in which an uncompetitive bus service leads to
Box 11.4

Support for Public Transport in Beijing: An Evolving Nonlending Partnership

With a rapidly growing urban population currently numbering 13 million, a total of 4 million cars, and 2,000 new cars registered each day, Beijing epitomizes the challenges facing the adoption of low-carbon growth paths for major Chinese cities. This has not gone unrecognized; after an initial focus on primary roads, Beijing has spent considerable sums of money on building a world-class public transport infrastructure. Billions of U.S. dollars are spent each year to construct a metro system that by 2015 will include over 550 kilometers of rail (225 kilometers have already been opened) and four BRT lines.

One of the many challenges facing Beijing is to derive maximum value from these investments. For the last two years, an unusual collaboration between Beijing’s Transport Bureau and the World Bank has focused on the technical underpinnings needed to address this challenge. Initiated at the request of Beijing, this donor-funded collaboration (financiers include ESMAP, AusAID, ASTAE, and the Korean TF) has focused on three key issues:

- Providing Beijing with peer city perspectives and contact with cities such as Paris, New York, and Seoul
- Detailed discussions with subject experts on technical concerns related to data and forecasting
- Technical assistance studies on selected high-priority issues, including a service-planning-oriented assessment of how to improve the performance of existing BRT lines, suggestions for developing a system of rapid commuting bus corridors, and strategies to integrate bus and rail service in corridors with newly opened rail lines.

The technical assistance studies have formed the core of this relationship. Using a hands-on approach, both partners have worked together on implementing priority corridors and developing practical tools and techniques that can be used beyond the demonstration corridors. In September 2010, Beijing Public Transport announced a 10-point priority program for 2011 that included several initiatives resulting from this partnership.

Source: Authors.

Note: ESMAP = the World Bank’s Energy Sector Management Assistance Program; AusAID = Australian Government Overseas Aid Program; ASTAE = the World Bank’s Asia Sustainable and Alternative Energy Program; Korean TF = Technology Foresight Center at the Korea Institute of Science and Technology Evaluation and Planning.
more commuters adopting private cars as soon as they can, further exacerbating road congestion and undermining the economics of bus transport. Because of the importance and vulnerability of bus systems, a key focus of any city’s effort in the public transport sector in China should be to modernize and improve their bus services. Efforts in this area can be categorized into three broad areas: (i) institutional management and subsidies (discussed previously), (ii) investments in bus infrastructure and planning, and (iii) improved services through bus priority schemes and integrated bus corridors, which will be discussed in more detail in the following sections.

**Investing in Bus Infrastructure and Planning**

In many cities, initial investments could be targeted at elements of public transport infrastructure that are crucial to day-to-day operations, but are often neglected because of their low profile. Examples of this are bus depots, passenger interchange terminals, and intelligent transportation systems.

**Bus depots.** Bus depots, areas where buses can be parked overnight, maintained, washed, stored, and efficiently dispatched, are essential for high-quality bus services. While bus riders do not directly interact with bus depots, they are essential to maintaining vehicles and help reduce breakdowns in service that severely impact passengers. In addition, having sufficient space to wash buses each night and properly sweep out cabins helps maintain the fleet’s image and influences overall passenger perception of the service.

Most transport-related World Bank projects in China have included the construction of modern bus depots, including in the cities of Guangzhou, Tianjin, Taiyuan, Wuhan, Fuzhou, along with several cities in Liaoning and Anhui provinces. In most places, depots had long been an underfunded and ignored part of the public transport infrastructure. The new depots are not only critical pieces of bus service infrastructure, but also demonstrate international best practice in efficient and sustainable design including water retention, efficient traffic management, safety features, and noise reduction. In many cases, acquiring the requisite land has been problematic and many depots have been cancelled due to unavailability of land. In the long term, changing the incentive structure for city leadership will be essential to allow land to be regularly released for bus depots.

**Passenger interchange terminals.** Most Chinese cities are inadequately equipped with passenger interchange terminals. Efficient bus operations require efficient route structures, and efficient route structures require terminals throughout the service area. Terminals provide space for bus
layovers, turnarounds, easy transfers between multiple routes and other modes, and space for passengers to wait for the bus. In addition, well-situated interchanges facilitate trunk and feeder systems and can improve passenger comfort. Where space for a full terminal cannot be provided, chaotic, inefficient, unsafe, and unpredictable operations can result. Terminals and interchanges, some resulting from World Bank–funded projects, have been constructed in a number of cities including Wuhan, Urumqi, and Shijiazhuang (see box 11.5).

**Box 11.5**

**Bus Interchange Terminal in Shijiazhuang**

At the bus interchange terminal at the railway station in Shijiazhuang, a well-designed bus terminal opposite the rail station allows for efficient transfer between the two modes. The new terminal, funded by the World Bank in 2005–08, alleviated a bottleneck and made public transport an appealing choice for a greater number of potential riders.

**Figure B11.5.1  Bus Interchange Terminal in Shijiazhuang**

*Source: World Bank.*

*Source: Authors.*
**Buses.** Bus fleets in China's biggest cities—Beijing, Shanghai, and Guangzhou—now are generally world class. They are modern, climate controlled, and often equipped with TV and other entertainment. However, in many other cities, bus fleets are old, functional rather than comfortable, sometimes even severely polluting, and often smaller than required. While buses in China are typically purchased and procured by bus operators, it is not uncommon for cities to support bus purchases, by way of extending credit or helping operators gain access to financing on the same terms as the municipal government. Buses are a critical part of the public transport experience, and their design can and should be customized to serve particular markets. For example, door sizes and locations can be designed to serve particular markets—with bigger doors to facilitate faster boarding and alighting, especially when off-board fare collection is possible, or doors on the left to facilitate median bus stops on priority corridors. In a World Bank–funded project in Panjin, the city focused on enhancing the overall quality of its bus fleet by enhancing the passenger experience with automatic transmission (for smoother acceleration compared to the manual transmission of the existing fleet), leaf springs for a more comfortable ride, and Euro IV diesel emission standards (figure 11.2). The upgraded buses were then put to work on bus priority corridors to provide a comprehensive upgrade in service.

**Figure 11.2  New Buses in Panjin Provide Improved Passenger Services**

*Source: World Bank.*
Intelligent transportation systems. Even at a basic level, new technology can bring great improvements in public transport efficiency by computerizing staff records, wage calculations, vehicle inventory, bus scheduling, and staff rostering. Advanced fare media and fare collection systems offer opportunities for significantly lower transaction costs, deployment of sophisticated fare strategies, and the generation of valuable trip maker data. In more advanced applications, intelligent transport systems (ITS) can directly support the operation of public transport services, including real-time monitoring of public transport vehicles using automatic vehicle location (AVL) systems. The use of global positioning system (GPS) transponders on buses with a control center monitoring the buses’ position enables real-time adjustments to even out headways, avoid bunching of buses, and provide more regular service. As traffic becomes more congested and causes large variations in travel time, the ability to monitor routes and make adjustments in real time can greatly improve reliability, which is highly valued by passengers. GPS facilities also allow for real-time passenger information at bus stops, which is also greatly appreciated by passengers.

The use of these new technologies, however, should be combined with an adequate amount of training for workers and skilled support in order to maximize its impact. Experience suggests that maximizing the benefits of technology investments is not just a matter of acquiring skills to use the new system, but also often is about making fundamental transformative changes in the manner in which the bus system is operated. Technology-equipped bus systems need a different mix of staffing and skills for planning (to make use of the extensive data available), operations (a much less labor-intensive system for bus dispatching), and financial management (modern fare systems are significantly more automated but offer new financial engineering possibilities). As with any other firm investing in transformative technologies, bus companies would benefit from pairing technology procurement with complementary investments in change management support that would help them realize the potential of such technologies with minimal disruption.4

Improving Services through Bus Priority Schemes and Integrated Bus Corridors

While the previously described investments in an improved bus system—developing institutions, management, and supporting infrastructure—are necessary to develop quality competitive bus systems, just by themselves they are not sufficient. Particularly if the goal is to attract riders of choice,
buses need to offer travel times that are competitive when compared to private modes. The experiences in China and internationally suggest that providing such competitive service often requires that buses be provided on-street priority using a series of targeted actions and initiatives that address traffic-related delays.

While the need for on-street bus priority is generally recognized by Chinese planners, implementing effective priority schemes remains a challenge. First, providing on-street priority to buses is often politically difficult because it requires explicit prioritization of buses over the alternative mode (that is, automobiles) and often requires city leaders to take away road space from auto users. Second, the experience of Chinese cities in recent years suggests that providing effective on-street priority is also a technical challenge. Initial approaches that focused on the implementation of bus-only lanes segregated from other traffic, usually targeted at individual “problem” intersections or road segments, often did not succeed (see box 11.6).

Integrated bus corridors. In response to similar experiences, cities such as London and New York developed a more comprehensive approach to bus priority that is often known as integrated bus corridors. Integrated bus corridors go beyond the first generation of bus priority by including not

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**Box 11.6**

**Reserved Bus Lane in Shijiazhuang**

In Shijiazhuang, in 2000, a reserved bus lane in the center of a major street went into operation as a pilot. Both city and provincial government leaders, however, expressed concern about the safety of bus passengers on the narrow center-street platforms, and after five years of operation, in 2008, the central bus lanes were replaced by curbside bus lanes. Because of a lack of enforcement, the curbside lanes quickly became ineffective. Another reserved bus corridor using curbside lanes was launched in Shijiazhuang in 2005. Shortly after implementation, however, the city concluded that there were not enough bus routes to warrant the aggravation of excluding other uses and decided not to activate the reserved bus lane. These early attempts at bus priority have provided valuable lessons that have been considered during the design of more recent projects.

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only physically segregated bus lane infrastructure (preferably located in central lanes), but also integrated bus service improvements (such as limited-stop or rapid bus services), improvements in pedestrian access to the corridor, new and better designed bus stations with real-time passenger information, new and upgraded buses with a larger capacity, traffic management to improve the flow of buses through intersections, and a distinct brand identity. Taken together, the integrated bus corridor is a comprehensive program of complementary improvements, covering an entire corridor or subarea and focusing on the passenger experience, from their front door to their destination.

Currently, this integrated bus corridor concept is being adopted in the cities of Benxi, Panjin, Jinzhou, and Liaoyang in Liaoning Province. The Liaoning project recently opened its first integrated bus corridor to positive press reviews (see figure 11.3).

Integrated bus corridors can result in improved public transport speeds between 20 percent and 40 percent, increased ridership (15 percent), and
fewer traffic accidents. Achieving these numbers in practice, however, requires optimal bus service planning and enforcement of parking restrictions at bus stops and in bus lanes. Often too many bus routes exist and too many small buses are operating in the dedicated bus lanes, leading to congestion at busy stops and intersections. On-board fare collection also makes bus boarding slow and inefficient, and traffic engineering, even on bus priority corridors, is often not designed to benefit transit passengers. Current signal cycles are too long, which results in bus bunching (and hence longer wait times for passengers), and too many left turns are permitted at high-volume intersections. Addressing these issues comprehensively is not merely a technical issue; it requires a great deal of political will and coordination across city agencies.

**Action Plan Step Four: Investing in Mass Transit: Bus Rapid Transit and Urban Rail**

While bus systems will remain the sole form of public transport in the vast majority of Chinese cities, for the largest cities, offering high-quality
public transport will require significant investments in mass transit systems. The term mass transit systems usually refers to relatively high-speed and high-capacity systems that carry at least 5,000 passengers per direction per hour at operational speeds at and over 20 kilometers an hour.

Options for mass transit systems range from (relatively) less expensive BRT systems that cost between US$2–5 million per kilometer, to various kinds of urban rail, with the most expensive underground metro rail systems costing upwards of US$100 million per kilometer. This section summarizes the Chinese experience, challenges, and benefits, with both BRT and urban rail. However, it is critical to emphasize that cities should not assume that any one particular system is appropriate for them without a careful analysis. Indeed, whether to upgrade a bus service or develop a BRT or metro system should be decided only after a rigorous, formal, alternatives analysis (see box 11.7).

Box 11.7
Using a Formal Alternatives Analysis to Identify Appropriate Mass Transit Solutions

Public transport investments tend to be expensive, difficult, and high profile. In Chinese cities, as elsewhere in the world, implementing successful mass transit requires political advocacy and support. However, unless this political support is built on a solid technical analysis, cities risk suboptimal outcomes on this expensive, long-lived infrastructure.

To address this risk, formal alternatives analysis has emerged as a planning framework for identifying public transport investment. Unlike the traditional “feasibility study”—which determines whether a preselected alternative is technically, financially, and economically feasible according to a given set of criteria—alternatives analysis begins from a broader base. The first step in the process is a rigorous analysis of existing conditions leading to an identification of the key problems to be solved. Following this step, a group of well-thought-out alternatives is developed and compared against one another according to a series of metrics.

The key element of alternatives analysis is that these different options are not “straw men” to be compared against a preselected favored alternative, but genuine efforts to develop cost-effective solutions. The alternatives should be carefully
Setting Up Bus Rapid Transit

In recent years, the BRT concept has gained increasing popularity as a low-cost option to provide high-capacity, high-quality public transport. Successfully implemented BRT systems typically use a package of improvements—such as new, high-quality buses, off-board fare collection, signal priority, passing lanes at stations, and quality branding and communications approaches—to transform traditional bus systems into true “metro-on-rubber-wheels” mass transit systems. At its core, BRT is a rapid, convenient, easily understandable system of public transport that functions on its own right of way with high speed and reliability.

Successful BRT systems can compete with metro and light rail transit (LRT) systems and provide mass transit services at a generally much reduced cost. However, the challenges involved in implementing such a system are significant and require sustained political leadership and collaboration among various agencies and offices not always used to working together. These include the traffic police, bus companies (often more than one in a given municipal area), the planning bureau, the communications or transport bureau, and the transport research institutes that often carry out the service planning for the bus companies.

Source: Authors.
The World Bank’s involvement with BRT systems in China has developed from simply promoting the concept to eventually providing technical support and, in some cases, financial support for the development of new BRT systems. Initially, the World Bank funded capacity-building seminars and pilot projects promoting the concept, which had an impact on the development of the BRT system in Guangzhou, among other places (see box 11.8). In 2008, the Urban Transport Partnership Program, funded by the Global Environment Facility (GEF) under GEF’s climate change agenda, allowed the World Bank to work directly with several cities that had expressed interest in developing their public transport systems. As a result of a collaborative effort among several national ministries and the World Bank, cities from nine provinces (including Chongqing, a municipality with provincial status) developed grant proposals for transport planning and project preparation work. The selected cities included a number interested in developing bus priority schemes, as well as seven cities requesting support to plan BRT systems: Chongqing, Jinan (Shandong), Weihai (Shandong), Changzhi (Shanxi), Urumqi (Xinjiang), Zhengzhou (Henan), and Dongquan (Guangdong). In addition, Guangzhou requested GEF support to complement its BRT development with a study on demand management strategies. The World Bank is currently financing BRT systems in some of these cities. More important,

Box 11.8

**Guangzhou: China’s Highest-Volume BRT System**

Guangzhou recently opened the highest-volume BRT system in China, carrying as many as 800,000 daily passengers. The inception of this system took place during the World Bank–financed Guangzhou Urban Transport Project. Under the project, the Bank financed a series of seminars and workshops that helped to raise the awareness and credibility of a BRT approach. The World Bank also financed a pivotal study tour to Latin America that built institutional support for the concept in city leadership. The World Bank–financed project was closed before works could commence; however, the studies and works related to the project (financed by Guangzhou with technical assistance from the Institute for Transportation and Development Policy [ITDP]) were managed and supported by the project management office created to manage the World Bank–financed project.

*Source: Authors.*
since the inception of the GEF program, the cities of Chongqing, Jinan, Guangzhou, and Zhengzhou have initiated BRT service—even before GEF planning funds were released. This success indicates that national and international organizations can provide a strong incentive for the adoption of sound urban transport solutions through the promotion and support of concepts, even when not directly funding their implementation.

**Supporting Urban Rail**

In the last decade, China’s explosive urban growth has stimulated an unprecedented boom in urban rail construction. Figure 11.4 shows the operating and approved networks as of January 1, 2010. At that time, 10 cities were operating metros on 870 kilometers of total track, and 23 cities had approved metro plans with a total track length of 5,148 kilometers. An informal tally suggests that the total of all approved plans in China is larger than all existing mileage of metro systems in Europe and North America together. Shanghai, by some measures, is now the largest system in the world, only 15 years after the opening of its first line.

**Figure 11.4  Operating and Approved Metro Networks as of January 1, 2010**

![Operating and Approved Metro Networks as of January 1, 2010](image)

*Source: World Bank.*
When properly developed, urban rail is the fastest, highest-capacity form of public transport. Under the right circumstances, it can handle very high levels of passenger demand at high speeds with minimal disruption to other city traffic—thus providing a public transport alternative very competitive with the private car. In addition, urban rail has the potential to catalyze a pattern of urban growth that conserves energy, reduces carbon emission intensity, and forms the core of a public transport–oriented city. Implementing urban rail, however, can be difficult because of the exorbitant costs relative to other modes. In addition, to be successful, rail requires a supportive transport environment that restricts auto use in central cities and fosters public transport and non-motorized travel.

In 2008, a study identified areas where the World Bank could best add value to Chinese urban rail practice, after which the Bank started supporting the Kunming Urban Rail Project. Experiences from this project may help inform urban rail developments in other cities. The Kunming project is currently in the early stages of implementation. The World Bank will finance the second of two lines to be opened in the initial phase of Kunming’s metro development. The line stretches from east to west through the city’s existing central business district, running primarily underground for 19.54 kilometers with 17 stations (see figure 11.5). It is scheduled to open in 2016.

The project experience so far has suggested three areas that Chinese cities interested in implementing rail systems may want to focus: (i) transit-oriented development, (ii) bus and rail integration, and (iii) comprehensive transport policy, including developing progressive parking and travel demand management policies.

Transit-oriented development. In Kunming, the Municipal Urban Planning Bureau is in charge of promulgating the city’s urban development vision and managing the mechanisms to implement it. The Bureau is planning for significant growth in central Kunming, with the population in urban districts projected to expand from the current 2.8 million residents to about 4 million by 2020. The city’s vision includes the development of compact urban centers focused around new urban rail stations.

A key issue identified during project preparation is ensuring that urban design around stations—both the design of the public domain and the restrictions and conditions placed on private developers—is carried out with attention to detail. The success of both the Singapore and Hong Kong SAR systems highlights the relationship between details of the urban environment—such as station design, entrance location, land-use mix, road widths, setbacks, and height—and ridership and the ultimate
success of urban rail systems. To date, in Chinese practice, this issue has not received the attention it deserves. Realizing this kind of compact growth will require the following:

- Hold continuous consultations between the planning bureau, developers, and the rail company on plans and design guidelines for develop-
ment adjacent to any new rail line. Ideally, special design guidelines—such as those relating to building setbacks and floor-area rations—would be prepared for these developments to create pedestrian- and bicycle-friendly built environments that attract public transport riders.

- Support the rail company’s own property development arm in identifying properties and developing them with appropriate connectivity to the metro system and surrounding properties.
- Support the inclusion of bicycle infrastructure at stations, including parking and easy access, to help foster inviting, safe, and attractive station environments.
- Consider the possibilities to facilitate commercial property development above maintenance depots and yards.

**Bus-rail integration.** Metro systems need to integrate with existing bus services to provide a comprehensive network and high-quality service to urban public transport passengers. A lack of bus-rail integration is not uncommon in recently completed Chinese urban rail systems. These problems center on the following:

- **Institutions:** In most Chinese cities, urban rail and urban bus systems are managed by two separate agencies, with no formal mechanism for integration between them.
- **Service planning:** Bus and metro services are often planned without careful cooperation between their respective services.
- **Bus interchange facilities:** Often, bus interchange facilities are omitted from the initial design of metro systems, significantly hampering operations on opening.
- **Fares and ticketing:** In many Chinese cities, bus and rail fares have not been integrated in a way that benefits both systems and limits the subsidy required from the city government.

Therefore, cities implementing rail systems should pay special attention to bus-rail integration. Issues that require particular attention in this respect include the following:

- The development of fare policies that integrate bus and rail service into a unified system, maximizing rider benefit while balancing the financial needs of both the bus and metro system. Such a policy may require, for instance, transfer discounts for intermodal trips and a discounted fare for feeder bus routes developed to “feed” passengers to the rail system.
The inclusion of land requirements for interchange facilities into the feasibility study. Current practice in China does not include such facilities in the right-of-way or “red-line” for the rail system. As a result, these facilities are not constructed, even though most rail system planners recognize the critical need for such interchange facilities.

A focus on institutional and operational issues related to bus-rail service integration. Issues range from creating agencies responsible for achieving effective operational integration, to the actual restructuring of bus routes and schedules to complement rail services.

**Comprehensive transport policy.** Experience elsewhere in the world has demonstrated that the construction of an urban rail system in the absence of a broader comprehensive transport policy that supports public transport is unlikely to achieve its policy goals.

Parking, in particular, is an area that needs attention. Parking in areas well-served by public transport, most crucially the downtown core, needs to be limited. Kunming is already ahead of national best practice on this issue. Limits have been placed on downtown parking—which is significant and rare, even around the world—and traffic impact analysis will be used for new developments to analyze parking impacts. Any city making investments in rail transport needs to consider their parking strategy and related policy so that it complements their urban rail investments and encourages passengers to use urban rail. A comprehensive parking policy to replace currently fragmented policies and agency responsibilities will support this effort.

**Conclusion and Looking Forward**

This chapter has summarized the range of measures a Chinese city can take to improve the quality and competitiveness of its public transport system. This starts with a focus on institutions and the character of the relationship between the city and operators. It includes a strong emphasis on planning and measuring progress. The core of the public transport system in a city is the bus network, and investing in a high-quality modern bus system should be an important priority for all cities. Finally, some cities will need to invest in mass transit systems. The choice of system should be made carefully, and implementation will need careful “systems” thinking and coordination to maximize the benefits of these expensive investments.
While improving public transport is very much in the fundamental interests of any city for reasons that have nothing to do with global climate change (reasons of productivity, efficiency, and equity for its citizens), the issue of climate change further reinforces the need to improve public transport—with a focus on attracting high-end riders who would otherwise use automobiles. The analysis in this chapter suggests that while solutions are often context-specific and every city will need to find ways to improve public transport based on detailed local needs and conditions, there are broad similarities in the strategies that almost all cities will benefit from following. The following “three-integrations” summarize the key focus areas and challenges facing Chinese cities as they work to develop public transport systems that would support a low-carbon economy:

- **Developing customer-oriented services**: Modern customer-oriented public transport enterprises can attract users of choice. This will require greater attention to the details of bus and rail transfer facilities, as well as the creation of premium services and a customer-oriented mentality.
- **Integrating schedules and fares across modes and services**: Although the use of multimodal smartcards is common, bus interchange facilities that help passengers change modes or services are systematically underused. In addition, fare policies are rarely designed to facilitate intermodal fare transfers. Integrated bus and rail services, schedules, and fares will contribute greatly to improved services for passengers.
- **Integrating land use with transport planning**: It is increasingly evident that even the most effective systems of public transport cannot be competitive if they are not carefully integrated with land-use planning and design.

The examples, framework, and action steps described in this chapter can be a starting point for cities to analyze their situation, travel demand needs, and opportunities for a sustainable, low-carbon development of their urban transport sector.

**Notes**

1. State Council Decision # 46. The State Council is similar to the federal cabinet in the United States.
2. For more information on institutional arrangements for urban transport and possible reform initiatives, see World Bank (2011).
3. For a full description of the World Bank’s approach and a summary of international bus practice on bus system management, see Gwilliam (2007).

4. For more information on the World Bank’s work supporting public transport ITS in China, see World Bank (2009).

5. A full description of BRT systems and their various elements is found in ITDP (2007).

6. The identified areas included support for the integration of new metro systems with existing and future bus service; the use of urban development tools to maximize the benefit of new infrastructure; and the development of supportive travel demand management measures.

Bibliography


