CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

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SECTION A. General description of project activity

A.1. Title of the project activity:

Title: Lanzhou Bus Rapid Transit (BRT) Project
Version: 01
Date: 21 July 2011

A.2. Description of the project activity:

Bus Rapid Transit (BRT) is a bus-based mass transit system that delivers fast, comfortable, and cost-effective urban mobility[1]. Through the provisions of segregated right-of-way lanes, a BRT system can provide a higher quality of public transport service than can ordinary buses in mixed traffic in terms of passengers per hour, passenger comfort, station quality, operational speed and other parameters.

The proposed Lanzhou BRT Project is aimed at meeting growing demand for urban public transport in Lanzhou by establishing a BRT system in Anning District of the city, which is scheduled to be operational from end of 2011.

Currently being developed, the proposed Lanzhou BRT will be featured with, amongst others, a new infrastructure consisting of 12.3 kilometres of dedicated bus lanes, flexible operation making allowance for both new specialized BRT buses and existing buses, at-grade boarding and alighting, real-time bus operation information displays, pre-boarding fare collection and fare verification, free transfers between routes, automatic vehicle location technology, centralized control providing monitoring and communications to scheduling services and real-time response to contingencies.

The baseline scenario of the proposed project activity, as elaborated hereinafter in Section B.4 of this PDD, is the continuation of the current public transport system in Lanzhou where passenger demands are met by various modes of transport including conventional buses, taxis, passenger cars, motorcycles and non-motorized transports (NMTs). The GHG emissions from trips that would have been made by BRT passengers using various modes of transport in the absence of the BRT system would form the baseline emissions. The project emissions are the actual fuel consumption attributable to the operation of BRT buses. Leakage emissions are caused by changes of traffic congestion and vehicle speed resulting potentially in a rebound and a speed effect of passenger cars plus potential changes of load factors of remaining buses and taxis. Difference between baseline and project scenarios in GHG emissions per passenger trip leads to the emission reductions, with leakage emissions taken into account.

The underlying basis on which the GHG emissions are derived methodologically is the higher resource efficiency of BRT system in transporting passengers as compared to various conventional modes of vehicle categories in urban transport system. The higher efficiency in resource utilization and the resultant lower emissions per passenger trip are attributable to a range of characteristics and factors associated with BRT operation and performance. Specifically, as far as the proposed Lanzhou BRT is concerned, it is

[1] GTZ, Sustainable Transport: A Sourcebook for Policy-Makers in Developing Cities, Module 3b: Bus Rapid Transit, page 11

envisaged to be able to lead to average annual GHG emission reductions equivalent to 12,343 tCO_2e through the following:

- Fuel-use efficiency improvement (per passenger transported) attributable to new and larger buses to be used by the BRT system as compared with vehicles used in the absence of the project.
- Mode switching of passengers from taxis, private cars and motorcycles characterized by higher emission rates to BRT system due to the availability and attractiveness of the system in terms of reduced transport time and increased safety, convenience and comfort.
- The flexible operation system integrating existing conventional bus fleets improving overall efficiency of public transport by providing a larger coverage of the BRT system in the district and allowing passengers to board and alight from a BRT route anywhere in the district where BRT routes are operating, not necessarily only along the BRT corridor.
- Load increase through centrally managed organization dispatching vehicles of BRT fleets. The occupancy rate of vehicles can thus be increased due to organizational measures.

Being in compliance with "*Measures for Operation and Management of Clean Development Mechanism Projects in China*"[2], the proposed project is envisaged to result in the following benefits across macro-level economic, social and environmental dimensions.

- In addition to GHG emission reductions, the proposed project will also reduce emissions of CO, NOx, SO_2 and suspended particulates, contributing to alleviating air pollution and improving environmental quality in Lanzhou.
- The proposed project will contribute to meeting the growing demand for urban public transport infrastructure and service in Lanzhou, with specific economic benefits including vehicle operating cost savings, diverted traffic, generated traffic, time savings, and avoided accident costs.
- Transport-related social issues such as accessibility, safety and affordability are well addressed, with vulnerable groups such as the disabled and elderly that have special needs for public transport service being taken care of.
- Urban road infrastructure development by the proposed project will support new urban development on the north side of the Yellow River and improve connections between the two centres of Lanzhou, thereby reducing travel times and increasing the options of finding employment outside of Anning.
- The proposed project will speed up economic growth in Anning through attracting more commercial, residential, and industrial development to the area, leading to expanded local employment opportunities potentially available to local residents that currently leave Anning to work as migrant workers in other districts or cities.
- Improvement of perceived social well-beings are expected to be generated as a result of less traffic congestions, less travel time, better air quality, less noise pollution and less probability of traffic accidents.

A.3. Project participants:

Name of Party involved (*) (host) indicates a host Party)	***Private and/or public entity(ies) project participants(*) (as applicable)***	***Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)***
People's Republic of China	*Lanzhou Public Traffic Group*	*No*

[2] http://cdm.ccchina.gov.cn/english/NewsInfo.asp?NewsId=905

(Host)		
Sweden	*Asian Development Bank, as the Trustee of the Future Carbon Fund (FCF)*	*Yes*
Sweden	*Swedish Energy Agency*	*Yes*

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

People's Republic of China

A.4.1.2. Region/State/Province etc.:

Gansu Province

A.4.1.3. City/Town/Community etc.:

Lanzhou City

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

Located in Anning District of Lanzhou City, the proposed BRT system is designed to establish a BRT corridor of 12.3km, with its two terminal stations being situated at Renshoushan (Latitude North 36°7'38.83" and Longitude East 103°40'56.09") and Xizhan (Latitude North 36°4'12.07" and Longitude East 103°46'1.28"), respectively. The following figure shows the geographical location of Gansu Province in China and that of Anning District in Lanzhou City.

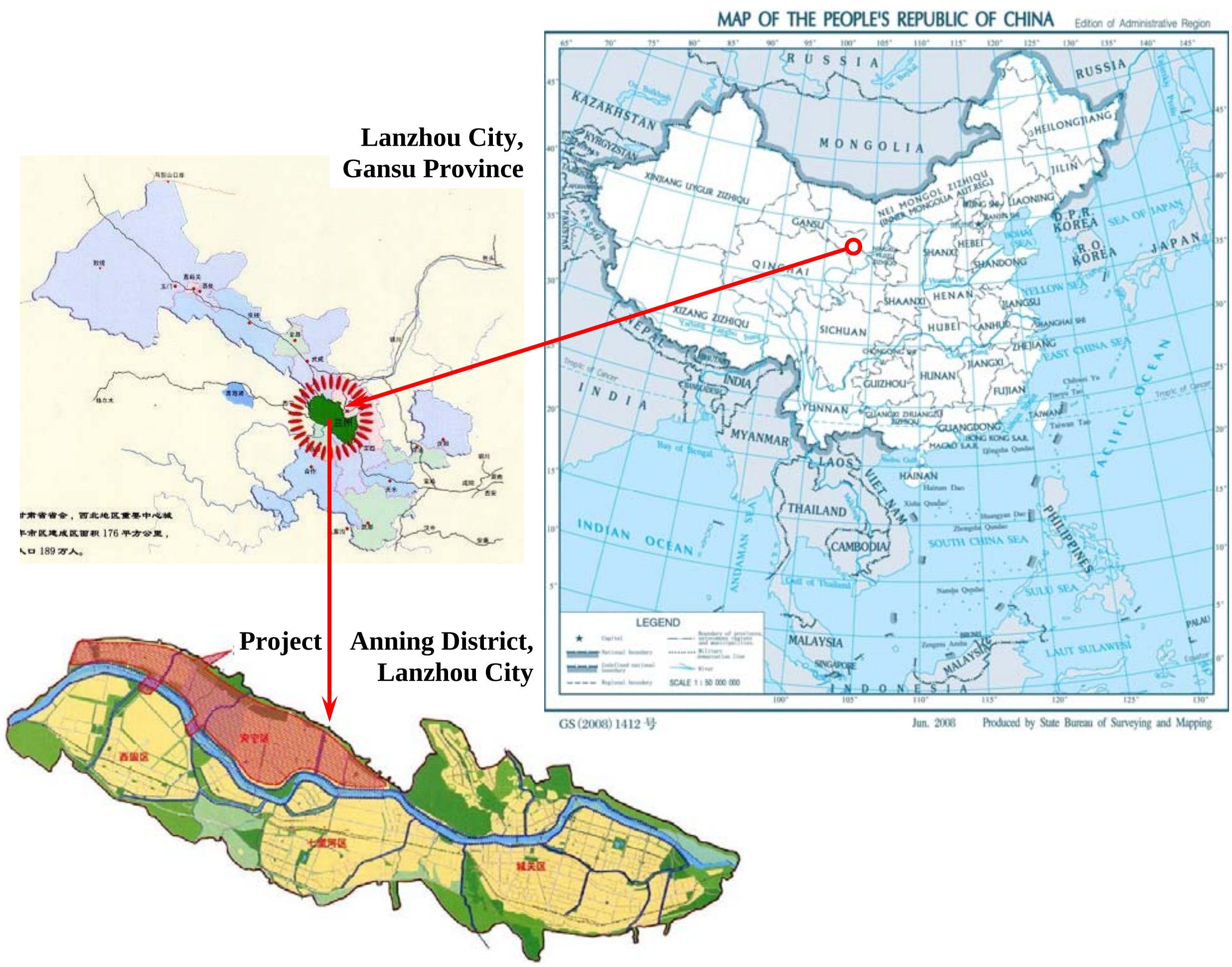

Figure 1: Geographical Locations of Gansu Province, Lanzhou City, Anning District

A.4.2. Category(ies) of project activity:

Sectoral Scope 7: Transport

A.4.3. Technology to be employed by the project activity:

According to "*Sustainable Transport: A Sourcebook for Policy-Makers in Developing Cities, Module 3b: Bus Rapid Transit*" published by Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, the main technical features of BRT systems that are successfully implemented are found to include, amongst others,

- Exclusive right-of-way lanes
- Rapid boarding and alighting
- Free transfers between lines
- Pre-board fare collection and fare verification
- Enclosed stations that are safe and comfortable
- Clear route maps, signage, and real-time information displays

- Automatic vehicle location technology to manage vehicle movements
- Modal integration at stations and terminals
- Clean vehicle technologies
- Excellence in marketing and customer service

The extent to which the above features are actually utilized within a BRT system is dependent upon local circumstances. As far as the proposed Lanzhou BRT is concerned, it is designed to have most of the above features[3], which can be categorized into the following four main components.

Infrastructure

A physically segregated BRT corridor with the length of 12.3 km will be established, with its two terminals being at Renshenshan and Xizhan respectively. Although the corridor will be constructed mainly in Anning District, it will across the Yellow River and connected to the current city centre (Qilihe District), increasing the efficiency and convenience of the BRT as part of Lanzhou's urban public transport system.

A total of 19 BRT-specific stations along the corridor will be constructed, with average spacing between stations being approximately 600 metres. All stations will be strategically located at least 75 metres from intersections but close to existing bus stops. The length and width of the stations will be determined based on demand surveys, and each station will be equipped with a fare collection system, sliding doors for safety, light and water, and real-time bus operation information boards, space for bicycle parking and ramp for accessibility of passengers with disabilities. The system is designed to allow for its capacity expansion in the future at comparatively low cost by reserving a green median that can later be converted into additional station extensions and bus lanes.

Vehicle technology and operation mode

As designed, the proposed Lanzhou BRT will use the flexible operation system in which BRT routes can operate both inside and outside the BRT corridor, with the main advantages of (i) removing the need for interchanges, transfer terminals and feeder buses, (ii) greatly reducing the number of passenger transfers in the system, (iii) enabling the use of both existing buses and specialized BRT buses, and (iv) lowering construction and operating costs.

The existing conventional bus fleets in Anning District will be systematically re-planned, re-routed and well integrated into the BRT system. All existing conventional buses in Anning District are 12m CNG-fuelled buses. In addition to existing buses that will be remained as part of the BRT system, a number of new 12-18m Euro III CNG-fuelled buses will be procured and used for selected routes of the BRT system. Hence, in the first few years of operation, the BRT system will be serviced by a combination of existing and new buses.

Transit management (intelligent transport system)

The transit management of the BRT system will be realized through a centralized control and management centre employing intelligent transport system (ITS). Through GPS technology, real-time information on status, position and driven distance of buses equipped with GPS-based tracking system are

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[3] By the time this PDD is finalized and web-hosted for validation, the proposed is still in the process of development and thus subject to changes in some of the technical features in its final establishment.

tracked and transmitted to the centralized control and management centre, allowing for (1) immediate response to changes in passenger demand; (2) immediate response to equipment failures and security problems; and (3) efficient spacing between buses and avoidance of bus bunching. Advanced traveller information system will be made available to provide passengers with real-time information displays at bus stations. Public transport signal prioritization technology will also be employed to give preference to BRT buses at intersections where BRT buses must cross mixed traffic.

Fare system

Along the BRT corridor, pre-board fare collection and verification will be realized through employing a combination of smart card technology and coin-based system at each station along the BRT corridor where fare validation turnstiles will be installed. Since the proposed BRT system will adopt flexible operations, there will be passengers boarding and/or alighting buses outside the BRT corridor. Self-service ticketing is enabled through on-board fare system installed on buses.

All materials, equipments, devices, fixtures, and buses to be procured by the proposed project are domestically produced or manufactured. Thus, the proposed project has no relevance to foreign technology transfer.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

The project activity is envisaged to yield an average annual emission reductions equivalent to 12,343 tCO_2e, totalling to 86,402 tCO_2e during the first 7-year crediting period. The *ex-ante* estimated emission reductions for the first 7-year crediting period are presented in the following table.

Table 1: Estimated Emission Reductions

Crediting Period	Annual estimation of Emission reductions in tonnes of CO2e
2012	11,389
2013	11,867
2014	12,270
2015	12,597
2016	12,811
2017	12,780
2018	12,687
Total estimated reductions (tonnes of CO2e)	**86,402**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	**12,343**

A.4.5. Public funding of the project activity:

The proposed project activity does not involve any official development assistance (ODA) from Annex I countries.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

AM0031 "Baseline Methodology for Bus Rapid Transit Projects" (Version 03.1.0, EB58)

The following methodological tools are referred to by the methodology:

- "Tool for the demonstration and assessment of additionality" (Version 05.2, EB39)
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01, EB39)

The above methodology and methodological tools are publicly viewable and downloadable at: http://cdm.unfccc.int/methodologies/PAmethodologies/approved

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The methodology is applicable to project activities that reduce emissions through the construction and operation of a Bus Rapid Transit (BRT) system for urban road based transport. The particulars of proposed Lanzhou BRT Project are assessed against the applicability criteria and conditions defined by AM0031 and found to be in conformity with the latter as detailed in the following table.

Table 2: Applicability Conditions of AM0031

Applicability conditions	Lanzhou BRT
The project has a clear plan to reduce existing public transport capacities either through scrapping, permit restrictions, economic instruments or other means and replacing them by a BRT system;	The existing public transport system in Anning District of Lanzhou City will be systematically reduced by being integrated as part of the to-be-constructed BRT system which will adopt flexible operations using existing CNG-fuelled buses and new specialized BRT buses. The BRT operator, Lanzhou Public Traffic Group being the sole operator of existing public transport system in Lanzhou, has established plan and programme of retiring existing old buses and procuring new buses specially designed for the BRT system.
Local regulations do not constrain the establishment or expansion of a BRT system;	There are no policies or regulations in Lanzhou that constrain the development and establishment of a BRT system.
Any fuels including (liquified) gaseous fuels or biofuel blends, as well as electricity, can be used in the baseline or project case. The following conditions apply: o In the case of biofuels, project buses must use the	Only fossil fuels are used. Specific types of fossil fuels under baseline scenario and project activity consist of gasoline and CNG. In particular,

same biofuel blend (same percentage of biofuel) as commonly used by conventional comparable urban buses in the country i.e. the methodology is not applicable if project buses use higher or lower blends of biofuels than those used by conventional buses. In addition, the project busses shall not use a significantly higher biofuel blend than cars and taxis.	o No bio-fuels are used in either baseline scenario or project activity.
The project activity BRT system is road-based. The baseline public transport system and other public transport options are road- or rail-based (the methodology excludes air and water-based systems from analysis). However the methodology is not applicable if the project activity BRT system replaces an urban rail-based Mass Rapid Transit System (MRTS), i.e. if the MRTS stops operating after project implementation due to the project activity;	All transport modes under baseline and project scenarios within the boundary of the proposed project are road-based. There is no established MRTS in Lanzhou. Neither air nor water based transport system has relevance with the proposed project.
The BRT system partially or fully replaces a traditional public transport system in a given city. The methodology cannot be used for BRT systems in areas where currently no public transport is available;	The proposed BRT system will fully replace the traditional public transport system in Anning District as part of Lanzhou City. Currently there is city-wide public transport system established and operational in Lanzhou with its urban area covering Chengguan, Anning, Qilihe and Xigu Districts.
The methodology is applicable if the analysis of possible baseline scenario alternatives leads to the result that a continuation of the current public transport system is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity (i.e. the baseline scenario).	The continuation of current public transport system is the baseline scenario of the proposed project activity, as demonstrated in detail hereinafter in this PDD. Refer to Section B.4 for details.

B.3. Description of the sources and gases included in the project boundary:

According to AM0031, the project boundary is defined by the passenger trips completed on the BRT project that is part of the public and private road-based passenger transport sector of the city in which the project is realized. The physical delineation is determined by the outreach of the new BRT or public or private urban passenger transport project.

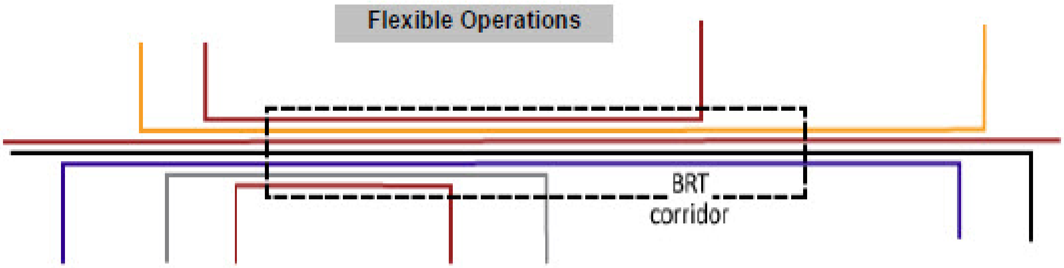

Figure 2: BRT System with Flexible Operations

As far as the proposed project is concerned, the BRT system is designed to adopt "flexible operations", thereby the BRT routes operate both inside and beyond the BRT corridor, making allowance for both existing buses and specialized BRT buses (See Figure 2). Since all existing conventional bus fleets will be systematically re-planned, re-routed and well integrated into the BRT system, upon set-up and operation the flexibly operated BRT system will serve as the public transport system in Anning District, with the outreach of various BRT routes covering the entire territory of Anning District. In this sense, the physical delineation of the project boundary is Anning District of Lanzhou City.

The sources of emissions within the project boundary are diagrammatically shown in Figure 2. The geographical location of the BRT corridor is presented in Figure 3 in which the geographical coordinates of the terminal stations of the BRT corridor are highlighted.

Emission sources not considered

Emissions caused by remaining transport system (taxis, cars, conventional public transport

Emissions caused by freight, ship, rail and air transport

Emission sources considered

Direct project and baseline emissions
Emissions caused by passengers transported in the BRT project

Emissions included as leakage
Congestion change provoked by project resulting in (inter alia):

- Increased vehicle speed
- Rebound effect
- Upstream emissions of gaseous fuels in case more gaseous fuels are used by the project case compared to the baseline case

Other emissions included as leakage
Change of baseline factors monitored during project and included as leakage:

- Change of load factors of taxis provoked indirectly by project
- Change of load factor of remaining conventional buses provoked indirectly by project

Figure 3: Sources of Emissions within Project Boundary

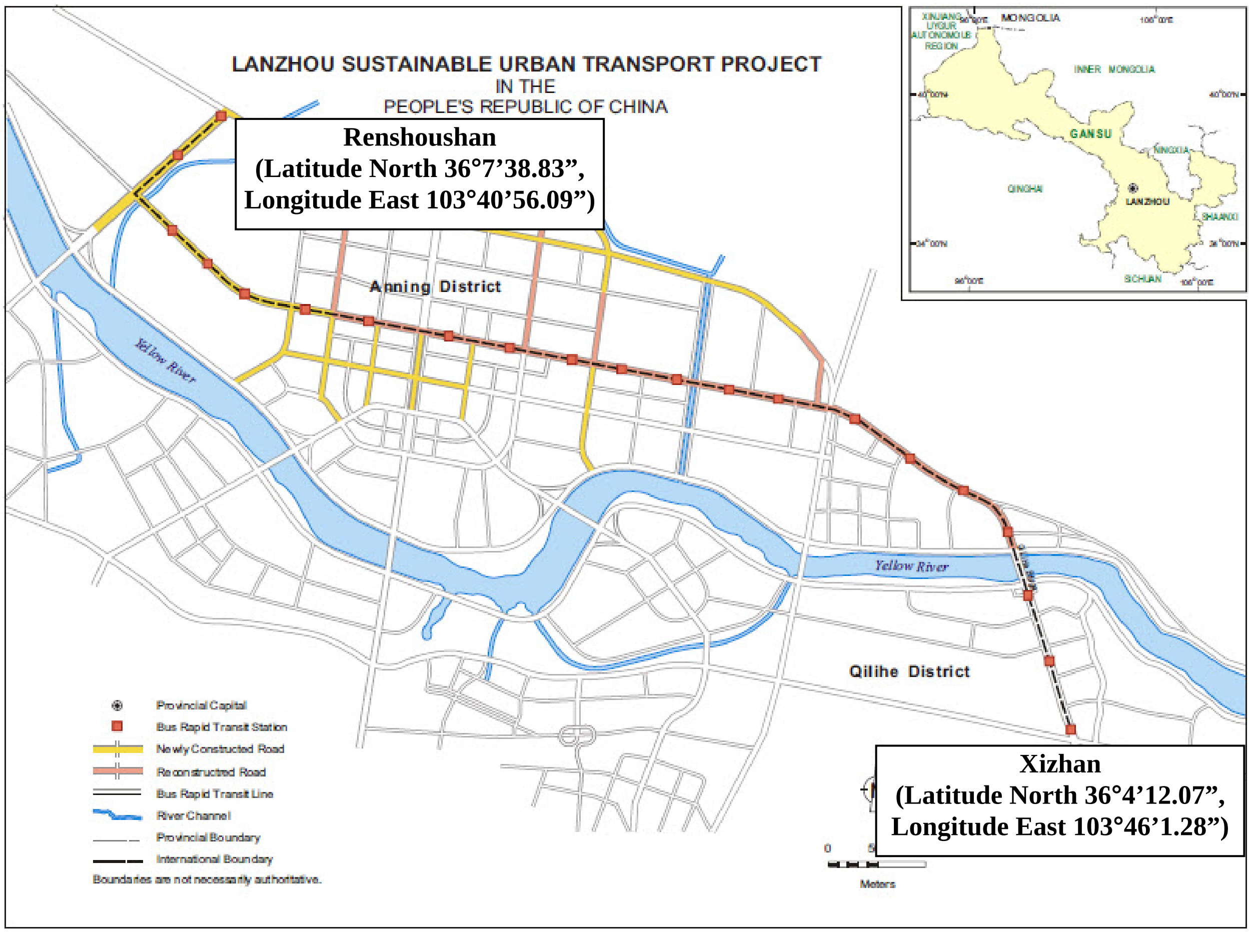

Figure 4: Geographical Location of Lanzhou BRT Corridor

In the light of the definitions by AM0031, various sources of CO_2, CH_4 and N_2O emissions are included under the baseline scenario and project activity, as summarized in the following table.

Table 1: Sources of Emissions Included in the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Mobile source emissions of different modes of road transport (e.g. buses, passenger cars, motorcycles, taxis) that would have been taken by BRT passengers in the absence of the BRT system	CO_2	Yes	Main source
		CH_4	Yes	
		N_2O	Yes	
Project Activity	Emissions from BRT system	CO_2	Yes	Main source
		CH_4	Yes	
		N_2O	Yes	

Parameters necessary for *ex-post* monitoring during crediting period are tabulated as follows, with project-specific circumstance and characteristics being duly taken account of. Details in relation to

monitoring methods and procedures as well as QA/QC requirements are elaborated hereinafter in Section 7 and Annex 4 of this PDD.

Table 2: Main Parameters for Monitoring over Crediting Period

Parameter	Definition
P_y	Total passengers transported by the project in year "y"
$S_{i,y}$	Share of passengers who in the absence of the project would have taken transport mode "i" in year "y"
$TC_{PJ,C,y}$	Total fuel (CNG) consumption by the project in year "y"
$N_{T,y}/N_{Z,y}$	Number of taxis and conventional buses still operating in year "y"
$OC_{T,y}$	Average occupancy rate of taxis in year "y"
$ROC_{Z,y}$	Average occupancy rate relative to capacity of buses in year "y"
$X_{C,y}$	Fuel type used from BRT passengers who in the absence of the BRT would have used passenger cars
$TD_{C/T/M,y}$	Average trip distance of BRT passengers who in the absence of the BRT would have used passenger cars, taxis or motorcycles
-	Policies that may affect baseline parameters

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The baseline scenario of the proposed project activity is identified by taking the step-wise approach required by AM0031.

Step 1: Identify all options available that meet the same requirement as the proposed project activity

As far as Lanzhou is concerned, the plausible alternatives to the development of the BRT system would include the following:

- Continuation of the current public transport system;
- The proposed project activity (establishment of a BRT system) not implemented as a CDM project activity;
- Development of a rail-based urban mass transit system;
- Comprehensive re-organization of the transport system.

Step 2: Analyze all options identified in Step 1 using the latest version of the "Tool for the demonstration and assessment of additionality"

Based on the characteristics of the proposed project, the following steps of the "Tool for the Demonstration and Assessment of Additionality" (Version 05.2, EB39) are taken to make further analysis on the pre-identified options in last step. In particular, the relevant guidance and methods given in Step 1 (Identification of alternatives to the project activity consistent with current laws and regulations) and Step 3 (Barrier analysis) of the Tool are referred to.

The 4 alternatives pre-identified in above Step 1 are further analyzed as follows.

Alternative 1: Continuation of the current public transport system

Evidently this alternative, as the business-as-usual scenario, is a realistic and credible alternative to the project activity as it is in compliance with all applicable legal and regulatory requirements and is able to provide service of public transport comparable with the proposed project activity. Moreover, as compared with other pre-identified alternatives, the continuation of current system would involve no new investment in infrastructure of significant amount and therefore minimum technical and financial risks.

Alternative 2: The proposed project activity (establishment of a BRT system) not implemented as a CDM project activity

Intrinsically, the principle, methods and outcome of the analysis on this alternative in this step are identical to the additionality assessment and demonstration elaborated hereinafter in Section B.5 of this PDD. For the purpose of being succinct, the details are not duplicated here but only the conclusion is referenced, viz. the proposed project not implemented as a CDM project activity is not a feasible alternative due to a series of barriers preventing its materialization.

Alternative 3: Development of a rail-based urban mass transit system

From technical perspective, the development of a rail-based urban mass transit system (i.e. MRT such as LRT, underground or elevated Metro) in Lanzhou can potentially provide service of public transport comparable with the proposed project activity of establishing a BRT system as the former have passenger capacities higher than or at least comparable with the latter, depending upon specific forms of MRT[4].

Nevertheless, this alternative is not considered being in compliance with applicable legal and regulatory requirements in the context of Lanzhou. Specifically, some key indicators in relation to social and economic development of Lanzhou are below the threshold values as stipulated by the "Notice of the General Office of the State Council on Strengthening the Management of Urban Rail-Based Mass Rapid Transit Development"[5] (Guo Ban Fa [2003] No.81). According to the Notice, cities seeking approval from the State Council on development of rail-based mass rapid transit (MRT) systems must meet mandatory requirements on a number of aspects and factors in relation to the development levels of the cites and the proposed MRTs. Amongst others, the requirements are thresholds values of a series of social and economic development indicators of the city making the proposal. Against these indicators, Lanzhou is assessed and arguably found to be ineligible for developing a MRT system, as shown in the following table.

Table 3: Assessment of Key Indicators

Indicator	Unit	"Notice of the General Office of the State Council on Strengthening the Management of Urban Rail-Based Mass Rapid Transit Development"	Lanzhou (Data of 2009)[6]

[4] GTZ, Sustainable Transport: A Sourcebook for Policy-Makers in Developing Cities, Module 3a: Mass Transit Options, 2004

[5] http://www.gov.cn/xxgk/pub/govpublic/mrlm/200803/t20080328_32328.html

[6] Data of 2009 for social and economic development indicators of Lanzhou is used as the starting date of the proposed Lanzhou BRT Project is March 2010 as explained in Section C.1.1 of this PDD.

		City Proposing Metro	City Proposing LRT	
Urban population	10,000 people	300	150	210.47[7]
GDP	100 million RMB	1000	600	925.98[8]
General budget revenue	100 million RMB	100	60	57.04[9]
Passenger flow rate at planned route of proposed MRT	Passenger per hour per direction (pphpd)	30,000	10,000	5,000 – 8,000[10]

The above comparison shows that none of the thresholds applicable to Metro development is met by Lanzhou. As far as LRT development is concerned, Lanzhou meets the requirements of urban population and GDP but stay below the thresholds of general budget revenue and passenger flow rate. Therefore, Lanzhou is not eligible to make investment in developing either Metro or LRT.

Moreover, even if the eligibility requirements are fulfilled, the significant difference in investment requirements between BRT and the Metro/LRT makes the establishment of Metro/LRT an unrealistic and infeasible alternative to the proposed BRT. In general, capital costs of rail-based MRTs may be from USD 20 to 180 million per kilometre whereas BRT systems are normally of the magnitude of USD 1 to 10 million per kilometre[11]. A report by the International Energy Agency (IEA) also points out that "…rail is expensive; even light-rail systems can cost up to 10 times as much per kilometre as bus systems…"[12].

In China, capital costs of BRT systems are approximately 10% of LRT/Metro systems, as investigated by various published literatures authored by official from the Ministry of Housing and Urban-Rural Development (formerly the Ministry of Construction)[13,14,15].

It should also be pointed out that the project proponent, Lanzhou Public Traffic Group being the sole operator of existing public transport system in Lanzhou, has no experience in managing and operating

[7] http://www.tjcn.org/tjgb/201004/10738_2.html

[8] http://www.tjcn.org/tjgb/201004/10738.html

[9] http://www.tjcn.org/tjgb/201004/10738.html

[10] Lanzhou Sustainable Urban Transport Project - Reports and Recommendations of the President (http://www.adb.org/Documents/RRPs/PRC/40625-PRC-RRP.pdf)

[11] GTZ, "*Sustainable Transport: A Sourcebook for Policy-Makers in Developing Cities, Module 3a: Mass Transit Options*", 2004, p18

[12] International Energy Agency (IEA), "*Bus Systems for The Future - Achieving Sustainable Transport Worldwide*", 2002, p22

[13] Wang Fengwu, Ministry of Construction, "BRT in China", *Public Transport International*, 4/2004, p38&p40

[14] Wang Fengwu, Ministry of Construction, "Understanding the Development of BRT in China", *Urban Transport of China*, Vol.4, No.6, Nov 2006, p28

[15] Wang Fengwu, Ministry of Construction, "Continuing Priority on Public Transportation Development, and Advancing Construction of Harmonious Transportation System", *Urban Transport of China*, Vol. 5, No.6, Nov 2007, p11

rail-based MRT systems. As of the start of the proposed project, there was no established rail-based MRT system.

Summing up, the alternative of developing rail-based MRT system cannot be considered as being a realistic and credible alternative scenario to the proposed project activity of establishing a BRT system.

Alternative 4: Comprehensive re-organization of the transport system

In a report entitled "Bus Systems for The Future - Achieving Sustainable Transport Worldwide" published by International Energy Agency (IEA) in 2002, how bus system management can be improved is elaborated, in which problems associated with public transport widely observed in many developing countries are described[16,17].

An overview of public transport in developing countries is also provided by GTZ's "Sustainable Transport: A Sourcebook for Policy-Makers in Developing Cities, Module 3b: Bus Rapid Transit, 2004". Characteristics of conventional public transit system as a mixed one comprising of both informal and formal service providers in cities in developing countries are described in detail in terms of organization, operation and management[18,19,20,21,22].

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[16] "In many developing cities, most buses are operated by independent bus companies or have been partially privatised. In some cities private companies have grown up to fill vacuums created by inadequate service of the public bus systems. Often many small, independent bus providers survive on a day-to-day basis. These companies are not able to make major investments in buses or bus systems. Some consolidation of bus service is probably needed in such cities to improve service and increase purchasing power for investment in new bus systems and technologies." (page 55)

[17] "The problem of small-scale, fly-by-night operators is endemic in many bus systems around the world, leading to poor performance and low ridership (usually in the form of low numbers of overfull buses). Much of the problem can be traced to the manner in which the bus system is regulated, licensed and managed. Deficiencies in these areas can lead to a chaotic situation where intense competition, almost literally for each passenger, relegates strategic planning, investment and co-ordinated service to the "back of the bus". (page 55)

[18] "Conventional transit systems can vary significantly in size and quality, even within the same city. Transit ranges can range from relatively modest van services to bus systems approaching the performance of a BRT system. The quality of public transit can be seen as a spectrum of possibilities ranging from customer unfriendly informal operations to full-feature mass transit systems that achieve mass transit speeds and capacities." (page 16)

[19] "Mini-buses and vans, both formal and informal, are quite evident in cities of Africa and Latin America. While these services are sometimes of relatively low quality, they often provide transit options for communities with few other choices. Standard bus services encompass the conventional 70 passenger buses (12 metres) plying the streets in most parts of the developing world." (page 16)

[20] "The state of public transit implies discomfort, long waits, risk to personal safety, and restrictions on movement. Customer satisfaction with the myriad of informal and formal vans, mini-buses, and full-sized buses that ply developing city streets is typically extremely low." (page 19)

[21] "In many instances, these firms and individuals operate informally with very little public oversight. With fierce competition between many struggling small firms and little governmental control, the frequent result has been poor quality services that do little to meet the broader needs of the customer. Private operators will tend not to provide service to smaller neighbourhoods and will operate at particular hours. Small operators also tend to be run in a relatively inefficient manner. Small vehicles are utilised in places where high-capacity vehicles could be operated at a more efficient level. This inefficiency can lead to higher fare levels than would otherwise be required." (page 139)

In general, unregulated private operators characterized by "chaotic, aggressive competition, dangerous driving, unstable services, no integration and variable fares" would have to be solved through "comprehensive regulation by government". Highly regulated private oligopoly characterized by "industry consolidated into large companies producing low levels of competition followed by fare increases and political pressures from increased fares resulting in lower-quality services or company bankruptcies" would have to be solved through "government nationalization of firms"[23].

Therefore, based on above information, it can arguably be concluded that comprehensive re-organization of public transport system can be an effective approach to developing cities where the public transport system is disorganized and inefficient due to predominance of a number of informal transit service providers. The re-organization of the sector could be done through consolidation of informal transport services into coherent structure and manageable groupings and setup of centralized management and control of the overall transit system.

However, as far as the public transport system of Lanzhou is concerned, the approach of re-organization has no relevance in that the public transit in Lanzhou is centrally organized and managed by Lanzhou Public Traffic Group as a state-owned company established in 1953. No transformation from informal to standard public transit service through sector re-organization is necessary.

In conclusion, the alternative of comprehensive re-organization of the transport system cannot be considered as being a realistic and credible alternative scenario to the proposed project activity.

Step3: If Step 2 results in more than one possible alternative baseline scenario, the most likely baseline scenario is the scenario with the lowest baseline emissions

Based on above analysis, the alternative of continuation of the current public transport system is the only one passing the screening of afore steps. Hence, step 3 is no longer necessary. Straightforwardly the conclusion can be drawn that the baseline scenario of the proposed project activity is the continuation of the current public transport system.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

In the light of the CDM glossary, the starting date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins or has begun. As far as

[22] "In some instances, each vehicle is owned separately, often by the person who does the driving. In other instances, the transit vehicle is operated by a driver who leases the vehicle from a separate owner. Since the driver pays a flat fee for access to the vehicle, he or she then has an incentive to drive the vehicle as much as possible during the day in order to maximise fare revenues. Drivers will thus work as much as 16 -hour days. The drivers will also have an incentive to drive as rapidly as possible to make as many roundtrips as they can. Further, drivers will even cut off other bus operators in order to prevent competitors from capturing customers." (page 140)

[23] GTZ, "*Sustainable Transport: A Sourcebook for Policy-Makers in Developing Cities, Module 3b: Bus Rapid Transit*", 2004, page 141

the proposed project is concerned, the date on which the People's Republic of China and Asian Development Bank (ADB) signed the Loan Agreement on Lanzhou Sustainable Urban Transport Project is taken as the starting date in CDM context, i.e. 30 March 2010.

In compliance with the "Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM" (Version 03, EB49), the project proponent, Lanzhou Public Traffic Group, has informed the Chinese DNA (National Development and Reform Commission) and the UNFCCC secretariat in writing of the commencement of the project activity and of the intention to seek CDM status. The notification was made in Sep 2010 and receipt of the same was confirmed by UNFCCC secretariat on 17 Sep 2010 and by Chinese DNA on 20 Sep 2010, respectively.

An implementation timeline recording major milestones during the development of the proposed project is tabulated as follows, in chronological order.

Table 4: Timetable of the Proposed Project

Date	Event/Progress
18 Feb 2009	Approval on Environmental Impact Assessment Report of Lanzhou Sustainable Urban Transport Project issued by Lanzhou Municipal Environmental Protection Bureau (Lan Huan Jian Fa [2009] 09)
3 Aug 2009	Approval on Feasibility Study Report of Lanzhou Sustainable Urban Transport Project issued by Gansu Provincial Development and Reform Commission (Gan Fa Gai Wai Zi [2009] 868)
Nov 2009	Completion and publication of ADB Report and Recommendations of the President to the Board of Directors (RRP) on Lanzhou Sustainable Urban Transport Project
30 Mar 2010	Loan Agreement on Lanzhou Sustainable Urban Transport Project signed between People's Republic of China and ADB
30 Mar 2010	Project Agreement of Lanzhou Sustainable Urban Transport Project signed between ADB and Gansu Provincial Government and Lanzhou Municipal Government
14 Apr 2010	Sub-Contract Agreement on Baseline Traffic Survey for CDM Development of Lanzhou BRT Project signed between TERA International Group, Inc. and Lanzhou Jiaotong University
Apr 2010	Implementation of Baseline Traffic Survey for CDM Development of Lanzhou BRT Project by Lanzhou Jiaotong University
May 2010	Implementation of Traffic Origin-Destination (O-D) Survey by Lanzhou Jiaotong University
17 Sep 2010	Form of Prior Consideration of CDM of Lanzhou BRT Project received by UNFCCC Secretariat
20 Sep 2010	Form of Prior Consideration of CDM of Lanzhou BRT Project received by Chinese DNA (National Development and Reform Commission)
20 Sep 2010	Notice of the General Office of Lanzhou Municipal Government on Establishing Leading Committee on Lanzhou BRT Planning, Construction, Operation and Management (Lan Zheng Ban Fa [2010] 289)
14 Oct 2010	CDM Stakeholder Consultation Workshop convened in Lanzhou
15 Nov 2010	Approval on Lanzhou BRT Project Feasibility Study Report by Lanzhou

	Municipal Government (Lan Jing Kai Jing Fa [2010] 48)
6 May 2011	Heads of Agreement signed between Lanzhou Public Traffic Group and ADB as Trustee of the Future Carbon Fund (FCF)
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The above table clearly shows that continuing and real actions have been and are being taken up unremittingly by the Lanzhou Municipal Government as the Executing Agency of Lanzhou Sustainable Urban Transport Project, and ADB, as the lender to the Project, in an effort to secure CDM status for the proposed project in parallel with its implementation.

According to AM0031, the additionality of the project shall be determined using the latest approved version of the "Tool for the demonstration and assessment of additionality". Specific guidance in relation to relevant steps as given by AM0031 is duly taken into consideration.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Realistic and credible alternatives to the project activity shall be defined through the following Sub-steps:

Sub-step 1a: Define alternatives to the project activity
Sub-step 1b: Consistency with mandatory laws and regulations

For the most part, the exercise in identifying alternatives to the project activity is identical to the above Section B.4 on identification of baseline scenario. For the purpose of being succinct, the details are not duplicated here but only the relevant conclusion of analysis is referenced.

Outcome of Step 1: The realistic and credible alternatives to the project activity include the continuation of the current public transport system and the proposed project activity (establishment of a BRT system) not implemented as a CDM project activity.

Step 2: Investment analysis

As specified by AM0031, depending upon the particulars of a specific project, either Step 3 (Barrier Analysis) or a combination of Step 2 (Investment Analysis) and 3 (Barrier Analysis) of the "Tool for the demonstration and assessment of additionality" shall be undertaken to demonstrate additionality.

- "Where the BRT project is fully privately financed (including roads, infrastructure etc) or where the publicly financed component is fully repaid on commercial terms through tariffs charged to system users, the project proponent should use both investment analysis and barrier analysis."
- "If the infrastructure is fully publicly financed or not being repaid on commercial terms, project proponents may use a barrier analysis only."

According to ADB Report and Recommendations of the President to the Board of Directors (RRP) on Lanzhou Sustainable Urban Transport Project, the total investment cost of the project is approximately USD 480.27 million, with the financing sources being ADB (USD 150 million, 31.3%), Bank of China (USD 240.31 million, 50%) and Lanzhou Municipal Government (USD 89.96 million, 18.7%).

The proposed Lanzhou BRT Project is an integral part to the above-mentioned Lanzhou Sustainable Urban Transport Project for which People's Republic of China and ADB signed a loan agreement valued USD 150 million. As agreed, all items directly related to BRT system will be financed 100% through ADB loan. Amongst other the items are new roads, reconstructed roads, BRT station and on-board equipment and advanced traffic control system.

Moreover, given the nature of the project being transport infrastructure as part of overall public transport system of Lanzhou, the public investment to the project will not be repaid on commercial terms through tariffs charged to the BRT passengers. According to the "Lanzhou BRT Project Feasibility Study Report", the financial IRR of the project is negative, suggesting that the project is financially unviable, let alone the payback of investment.

In conclusion, investment analysis is not necessary. Only barrier analysis is undertaken as follows to demonstrate that the proposed project activity is additional.

Step 3: Barrier analysis

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity

Based on the guidance on Step 3 as provided by AM0031 and project-specific circumstances, realistic and credible barriers that would prevent the implementation of the proposed project activity from being carried out if the project activity was not registered as a CDM activity are established, as follows:

- **Investment barrier**. The proposed project was confronted with investment barrier due to resource constraints of Lanzhou Municipal Government and ADB as public bodies having a wide spectrum of potential investment opportunities across public sectors other than urban transport for social and economic development. Registration of the proposed BRT as CDM project activity was one of the decisive factors considered by ADB and Lanzhou Municipal Government in decision-making process of project preparation and loan agreement.
- **Barrier of operational deficit**. The BRT system is subject to operational deficit as the ticket income will not cover the total operational cost.
- **Barrier due to prevailing practice ("first-of-its-kind")**. The proposed Lanzhou BRT is the first-of-its-kind[24,25] not only in Gansu Province, also in Western China[26] as a broader region. It is also one of the very few BRT systems in China established without external assistance.

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[24] The first BRT system in Western China is Chonqging BRT, which has been registered as a CDM project activity. Refer to UNFCCC website (http://cdm.unfccc.int/Projects/DB/SGS-UKL1275659668.89/view). With Chongqing BRT excluded from the analysis, Lanzhou BRT is the first in Western China.

[25] If assessed against key aspects that a BRT is featured with, Kunming shall not be termed as a "BRT" as it has no enclosed station, electronic tracking of buses, pre-board ticketing system, etc. It is more about segregated bus lanes than about BRT. It is noteworthy that, in the above-referred ITDP website (www.chinabrt.org), Kunming is the only 1 exception out of the 13 systems in China that is specifically termed as "Median bus lanes" instead of "BRT". Moreover, Kunming and Zurich of Switzerland are friendship cities and have since 1982 been cooperating on a series of initiatives and programmes in relation to public transport system in Kunming. For instance, the development of "Master Plan of Urban Development and Public Transport of Kunming", "Planning of Urban Public

1. Investment barrier

Official summary and statistics on the overall social and economic development of Lanzhou over the 11th 5-Year Plan (2006 to 2010) were delivered in the "Report on the Work of Lanzhou Municipal Government in 2011" [27] available at the official website of Lanzhou Planning Bureau. According to the Report, the total investment in fixed assets of Lanzhou amounted to RMB 225.5 billion over the period of 11th 5-Year Plan, with a number of key projects successfully implemented. Amongst others the key projects are National Petroleum Reserve Base, Oil and Gas Transmission Pipeline Infrastructure, Lanzhou-Chongqing Railway, Lanzhou Railway Terminal, Lanzhou Petrochemical 700,000-Ton Ethylene Project, Yuzhong Steel Factory, Gansu Convention Centre and Chaijiaxia Hydropower Station. Over the 5-year period, the accumulative investment urban-rural infrastructure construction was RMB 62.7 billion, facilitating the completion of a series of key infrastructure projects including westbound extension of North Binhe Road, reconstruction and expansion of Tianshui Road, retrofitting and management of Nanhe Riverbank, renovation of entry and exit points of Lanzhou, rehabilitation of historic architecture heritages at Jinchengguan and so forth. Development of urban utilities of water, electricity, gas and heating was accelerated. Infrastructure development at township and village levels was further strengthened, with focus placed upon farmland water conservancy, electricity and telecommunication, transportation and energy. In terms of social and public programs and undertakings, the government made investment totaling to RMB 28.5 billion in developing education facilities at various categories and levels and improving public health infrastructure in urban and rural areas. In year 2010, the total GDP of Lanzhou was RMB 110 billion and local fiscal revenue was RMB 12.766 billion. Total investment in fixed assets in 2010 amounted to RMB 66 billion. A total of 100 key projects were implemented, with total planned investment of RMB 79.781 billion, of which investment of RMB 25.26 billion were realized already.

The above summary and statistics clearly show the fact that Lanzhou Municipal Government, as one of the investors of the Lanzhou Sustainable Urban Transport Project, has been subject to resource constraints that put the government in a challenging position of having to make balanced and coordinated investments across a wide spectrum of public sectors that are of high priorities and key components contributing to the overall social and economic development of Lanzhou. Against this backdrop, the Lanzhou Sustainable Urban Transport Project, as one of a number of key infrastructure development programs and projects, received only limited financial support from the government through its fiscal revenue. Of the total investment cost of the project, the portion from the government was valued USD 89.96 million, accounting for only 18.7%. The remaining major part of the total investment had to be sought from other channels. Amongst the fundamental grounds on which the Lanzhou Municipal Government made the commitment of providing the mentioned fiscal revenue in support of the project were the development of a BRT system as an integral part of the project and realization of CDM registration, as evidenced in the afore-mentioned Approval on Feasibility Study Report of Lanzhou

Transport Network and Station of Kunming" and so forth. In addition, Kunming used to receive financial aid and technical assistance from the US Energy Foundation in support of study on BRT planning of Kunming. In this sense, in the course of developing public transit system Kunming has received international assistance.

[26] According to the official website of the "State Council Leading Committee on Development of Western China" (http://www.chinawest.gov.cn/web/index.asp), the boundary of Western China includes 12 Provinces/Autonomous Regions/Municipality (Sichuan, Chongqing, Guizhou, Yunnan, Guangxi, Shaanxi, Gansu, Qinghai, Ningxia, Tibet, Xinjiang, Inner Mongolia)

[27] http://www.lzgh.gov.cn/hyxw/D2011020102.jsp

Sustainable Urban Transport Project issued by Gansu Provincial Development and Reform Commission (Gan Fa Gai Wai Zi [2009] 868).

As stated in the "Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank 2008-2020"[28] approved by ADB's Board of Directors in 2008, by 2012, 80% of ADB lending will be in five core operational areas identified as comparative strengths of ADB, including infrastructure (transport and communications, energy, water supply and sanitation and urban development), environment, regional cooperation and integration, finance sector development and education. In addition, ADB will continue to operate in health, agriculture, and disaster and emergency assistance on a selective basis.

According to 2008-2010 Country Partnership Strategy (CPS)[29], ADB's 2010-2011 lending pipeline of China will focus on urban environmental protection, energy efficiency and emissions reduction, natural resource conservation, energy-efficient railways, urban transport, and road maintenance. The lending pipeline totals about $3 billion, of which 42% will support transport infrastructure and maintenance; 22% agriculture and natural resources; 22% urban development, water supply, and sanitation improvement; and 14% will be spent on the energy sector.

Hence, as far as urban transport is concerned, it is under the scope of infrastructure as one of the five core operational areas of ADB and is of the priority equivalent to many other sectors and technological fields in the lending pipeline. Whether or not a proposed loan on urban transport project could be realized would have to be subject to stringent modalities and procedures from project identification, preparation, due diligence, through to loan negotiation and board approval and in the meantime have to compete against and reconcile with other key proposed projects under core areas for limited funding resources.

As for the Lanzhou Sustainable Urban Transport Project, the approved loan from ADB is USD 150 million, accounting for merely 31.3% of the total investment cost. In ADB's Report and Recommendations of the President to the Board of Directors (RRP), through which the loan proposal was submitted to ADB's Board of Director for approval, it was stated articulately that the BRT system, as an integral part of the proposed loan project, will be developed as a CDM project to generate CERs, with the revenues used for contributed to the costs of operating and maintaining the BRT. Some excerpts in relation to CDM in the RRP are listed as follows:

- "The Project is part of ADB's initiative to support greener, more sustainable transport in the PRC and includes support for an application to use the Clean Development Mechanism of the Kyoto Protocol." (Page 6, Page 11)
- "The Project will (i) generate certified emission reductions, (ii) ...." (Page 7, Page 17)
- "The Project will … (ii) improve the energy efficiency of public transport and reduce carbon dioxide emissions; (iii) improve air quality by reducing emissions of major pollutants; (iv)…" (Page 8)
- "… During loan processing, the policy dialogue on sustainable urban transport helped LMG to refine its approach to transportation in the Lanzhou City Urban Master Plan, notably by incorporating BRT, advanced traffic management, information technology, and an application to the Clean Development Mechanism (CDM) of the Kyoto Protocol…" (Page 13)

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[28] http://cn.adb.org/about/policies_strategies.asp

[29] http://www.adb.org/PRC/strategy.asp

- "...As one important driving force of the Project, GHG emission reduction has been considered an indicator for the optimization of urban transport system planning in Lanzhou......ADB's Carbon Market Initiative will provide integrated technical support to LMG for the CDM application......Carbon credits may provide LMG with additional income to contribute to the cost of maintaining and operating BRT......The Future Carbon Fund, an integral part of ADB's Carbon Market Initiative, seeks to further stimulate investments in GHG mitigating projects by enabling project developers to gain benefits beyond 2012......The project will support finding an opportunity to utilize the Future Carbon Fund..." (Page 18, Page 19)
- "...LMG will ensure that the appointed government staff will (a) coordinate within and outside LMG for CDM related issues; (b) carry out data collection and surveys and set up and update a database for CDM application, validation, and monitoring; (c) support the PMO and ADB in the preparation of the CDM application..." (Page 28)
- Appendix 6 of the RRP details how ADB's Carbon Market Initiative will provide integrated technical support to Lanzhou Municipal Government for the CDM application of the BRT. (Page 46)

The above-mentioned RRP was approved by ADB's Board of Directors on 11 December 2009. On 30 March 2010, the Loan Agreement on Lanzhou Sustainable Urban Transport Project was countersigned by People's Republic of China and ADB and the Project Agreement on the same was countersigned by ADB and Gansu Provincial Government and Lanzhou Municipal Government.

The purpose of the Loan Agreement is articulated on Page 1 of the Loan Agreement by stating that the Borrower (People's Republic of China) has applied to ADB for a loan for the purposes of the Project described in Schedule 1 to this Loan Agreement. As described in Schedule 1, in terms of impact and outcome, the Project will "generate certified emission reduction".

According to the Project Agreement, amongst various tasks of project execution, LMG shall ensure that the appointed government staff (a) coordinate within and outside LMG for CDM related issues; (b) carry out data collection and survey, set up and update database for CDM application, validation and monitoring; (c) support the PMO and the ADB for preparation of the CDM application; and (d) serve as CDM and climate change knowledge focal point for PMO and various government and/or non-government agencies in Gansu Province and Lanzhou Municipality.

In light of Guideline 6 of "Guidelines for Objective Demonstration and Assessment of Barriers" (Version 01, EB50 Annex 13), if the PPs make the claim for investment barriers:

- <u>Guideline</u>: It should be demonstrated that the loan approval (or other significant financing decision(s)) by the lender takes explicitly the CDM registration into account."
- <u>Example</u>: For the cases where the investment is done by a company which also purchases the CERs and the loan agreement mentions that, there is an objective demonstration that the CDM facilitated the lending."
- <u>Rationale</u>: Loan agreements are an objective means to demonstrate the barrier.

Assessed against the above guideline, the RRP of ADB and the loan agreement between PRC and ADB can in an objective and convincing way be concluded to be a strong demonstration the investment barrier that the project in question was confronted with.

Summing up, the proposed project was confronted with investment barrier due to resource constraints of Lanzhou Municipal Government and ADB as public bodies having a wide spectrum of potential investment opportunities across public sectors other than urban transport for social and economic development. Registration of the proposed BRT as CDM project activity was one of the decisive factors considered by ADB and Lanzhou Municipal Government in decision-making process of project preparation and loan agreement.

2. Barrier of operational deficit

According to the projection of "Lanzhou BRT Project Feasibility Study Report", over the operational period, most likely the project will run deficit as the ticket income will be lower than total operational costs per annum. The operation of the BRT will not be able to cover all operational costs with the ticket income, let alone the coverage of capital investment made by the project proponent (Lanzhou Public Traffic Group) in purchasing buses.

As afore-mentioned, it was agreed between the parties that all items directly related to BRT system will be financed 100% through ADB loan, including new roads, reconstructed roads, BRT station and on-board equipment and advanced traffic control system. The only investment to be borne by Lanzhou Public Traffic Group as the operator of the BRT system is the procurement of BRT buses. As far as the annual operation and maintenance of the BRT system are concerned, those on the part of the Lanzhou Public Traffic Group as project proponent of this project include fuel consumption, staff salaries and social benefits, buses maintenance and repairs, station maintenance and repairs, administration and other fees, and depreciation costs of buses.

The following table presents the projections of annual average ticket income and total operational costs over the period of 2012 to 2018, corresponding to the first 7-year crediting period of the project. Depreciation costs of buses to be borne by the project proponent are not included in the analysis. Data is sourced from "Lanzhou BRT Project Feasibility Study Report".

Table 5: Projected ticket income and total operational cost (average over 2012 to 2018)

Item	Amount (RMB 10,000)
Ticket income	**6124.49**
Total operational cost	**6259.27**
Fuel consumption	*2064.35*
Salaries and social benefits	*1950.00*
Vehicle repairs and maintenance	*590.74*
Station and equipment maintenance	*843.73*
Administration and other fees	*690.76*
Business taxes and surcharges	**205.78**
Net	**-220.87**

On top of the annual average deficit amounting to over RMB 2.2 million, the project proponent will also have to bear the depreciation costs of buses that is at the magnitude of over RMB 10 million per annum.

Furthermore, it shall be noted that the project is subject to further perceived risk of having significantly less passenger ridership than originally projected which is optimal, in particular in the first few years of operation. This would be translated to significantly more deficit than above presented because the ticket

income is a function of total ridership. This was also pointed out by "Lanzhou BRT Project Feasibility Study Report" which was based on the recommended optimal operational mode of BRT modelled based on on-site traffic origin-destination (O-D) survey. The probability of such situation taking place is high as it has been widely observed that established BRT systems in China have underperformed in the first few years upon commencement of operation. For the purpose of demonstration, the example of Chongqing BRT, as the first of its kind in Western China as elaborated in next sub-section, is taken here.

According to summary and statistics on Chongqing BRT by the Institute for Transportation and Development Policy (ITDP)[30], upon its operation from Jan 2008, the highest peak hour ridership of Chongqing BRT was merely 600 passengers per hour per direction (pphpd) based on on-site measurement data in March 2011 whereas its design capacity is as much as 4,000 pphpd. This was also confirmed by the PDD of Chongqing BRT, a registered CDM project activity, in which it is stated that the projected passenger numbers given by Feasibility Report overstate actual numbers by factor 10 as evidenced by statistics on actual passenger numbers in 2009[31].

Should the proposed project be registered as a CDM project activity, the operational costs can for the most part be subsidized through revenues from CERs which are likely to be over RMB 1.1 million based on estimated unit price of Euro 10/tCO_2e and an exchange rate of Euro 1 equal to RMB 9. In this sense, arguably CDM registration of the project will to a large extent alleviate the identified barrier of operational deficit.

3. Barrier due to prevailing practice ("first-of-its-kind")

The proposed Lanzhou BRT is the first ever BRT system[32] in Gansu Province and in Northwest China[33]. As shown from official demography data published by Gansu Provincial Statistics Bureau[34], the total permanent population of Gansu Province was over 26 million, with a number of cities in the province having population of over 0.5 million and thus theoretically having the potentials for BRT development. Amongst other these cities are Lanzhou, Baiyin, Tianshui, Wuwei, Zhangye, Pingliang, Jiuquan, Qingyang, Dingxi and Longnan.

As of the starting date of the proposed Lanzhou BRT (30 March 2010), it was the first case in Gansu Province as well as in Northwest China as a broader region. As of the commencement of CDM validation, still it was the one and only BRT in the region. Across the region, neither experience gained nor lessons learned from precedents of developing and operating a BRT system is available for Lanzhou to capitalize on. By taking the initiative, Lanzhou BRT can be seen as a groundbreaking experiment and be expected to serve as a paradigm with great replicability of knowledge and experience and facilitate the planning, programming and development of urban public transport systems in other cities in Gansu Province and the region.

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[30] http://www.chinabrt.org

[31] Page 25 & page 26 of PDD. Refer to http://cdm.unfccc.int/Projects/DB/SGS-UKL1275659668.89/view,

[32] http://gs.cnr.cn/kcsd/zt2/201004/t20100422_506321523.html

[33] The boundary of Northwest China encompasses 5 Provinces/Autonomous Regions (Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang).

[34] http://www.gstj.gov.cn/doc/ShowArticle.asp?ArticleID=7671

Expanding the geographical region of investigation from Northwest China to Western China, the proposed Lanzhou BRT is thus the second-of-its-kind[35,36] in Western China, which encompasses 12 Provinces/Autonomous Regions/Municipality according to the official website of "State Council Leading Committee on Development of Western China"[37]. The total territory of Western China reaches approximately 6.72 million square km, accounting for 70% of the country. In terms of population, the region contributes to approximately 1/4 of total population of China[38].

According to statistics by the Institute for Transportation and Development Policy (ITDP)[39], as of the commencement of CDM validation of the proposed project, nationwide there are a total of merely 13 cities having BRT systems in operation, including Beijing, Changzhou, Chongqing, Dalian, Guangzhou, Hangzhou, Hefei, Jinan, Kunming, Xiamen, Yancheng, Zaozhuang and Zhengzhou. Out of the 13 cities, 1 is in Beijing as national capital, 8 are in coastal provinces in East China, 2 are in provincial capitals of provinces in Central China and the rest 2 are in West China where social and economic development are lagged behind as compared to East and Central China. The following table presents a summary on locations and time of starting operation of the 13 BRT systems.

Table 6: List of BRT in China (as of March 2011)

	City	Province/Municipality	Start of Operation	Region
1	Beijing	Beijing Municipality	2004	East China
2	Changzhou	Jiangsu Province	Jan 2008	
3	Dalian	Liaoning Province	Jan 2008	
4	Hangzhou	Zhejiang Province	2006	
5	Jinan	Shandong Province	Apr 2008	
6	Xiamen	Fujian Province	Sep 2008	
7	Guangzhou	Guangdong Province	Feb 2010	
8	Zaozhuang	Shandong Province	Aug 2010	
9	Yancheng	Jiangsu Province	May 2010	
10	Zhengzhou	Henan Province	May 2009	Central China

[35] The first BRT system in Western China is Chonqging BRT, which has been registered as a CDM project activity. Refer to UNFCCC website (http://cdm.unfccc.int/Projects/DB/SGS-UKL1275659668.89/view).

[36] If assessed against key aspects that a BRT is featured with, Kunming shall not be termed as a "BRT" as it has no enclosed station, electronic tracking of buses, pre-board ticketing system, etc. It is more about segregated bus lanes than about BRT. It is noteworthy that, in the above-referred ITDP website (www.chinabrt.org), Kunming is the only 1 exception out of the 13 systems in China that is specifically termed as "Median bus lanes" instead of "BRT". Moreover, Kunming and Zurich of Switzerland are friendship cities and have since 1982 been cooperating on a series of initiatives and programmes in relation to public transport system in Kunming. For instance, the development of "Master Plan of Urban Development and Public Transport of Kunming", "Planning of Urban Public Transport Network and Station of Kunming" and so forth. In addition, Kunming used to receive financial aid and technical assistance from the US Energy Foundation in support of study on BRT planning of Kunming. In this sense, in the course of developing public transit system Kunming has received international assistance.

[37] According to the official website of the "State Council Leading Committee on Development of Western China" (http://www.chinawest.gov.cn/web/index.asp), the boundary of Western China includes 12 Provinces/Autonomous Regions/Municipality (Sichuan, Chongqing, Guizhou, Yunnan, Guangxi, Shaanxi, Gansu, Qinghai, Ningxia, Tibet, Xinjiang, Inner Mongolia)

[38] http://zh.wikipedia.org/zh/%E4%B8%AD%E5%9B%BD%E8%A5%BF%E9%83%A8

[39] http://www.chinabrt.org

11	Hefei	Anhui Province	Jan 2010	
12	Kunming	Yunnan Province	1999	**West China**
13	Chongqing	Chongqing Municipality	Jan 2008	

(Source: ITDP website – http://www.chinabrt.org)

If the starting date of the proposed Lanzhou BRT is taken as the time point for investigation, the above list is shortened to comprise 11 cities only. BRTs in Yancheng and Zaozhuang are removed as they started operation in May 2010 and Aug 2010 respectively, later than the starting date of the proposed project (30 March 2010)

The only 2 systems in West China, Kunming and Chongqing, are further analyzed to demonstrate their essential distinctions from the proposed Lanzhou BRT.

Kunming: If assessed against key aspects that a BRT is featured with, Kunming shall not be termed as a "BRT" as it has no enclosed station, electronic tracking of buses, pre-board ticketing system, etc. It is more about segregated bus lanes than about BRT. It is noteworthy that, in the above-referred ITDP website (www.chinabrt.org), Kunming is the only 1 exception out of the 13 systems in China that is specifically termed as "Median bus lanes" instead of "BRT". Moreover, Kunming and Zurich of Switzerland are friendship cities and have since 1982 been cooperating on a series of initiatives and programmes in relation to public transport system in Kunming. For instance, the development of "Master Plan of Urban Development and Public Transport of Kunming", "Planning of Urban Public Transport Network and Station of Kunming" and so forth[40,41]. In addition, Kunming used to receive financial aid and technical assistance from the US Energy Foundation in support of study on BRT planning of Kunming[42]. In this sense, in the course of developing public transit system Kunming has received international assistance. Therefore, it can be concluded that Kunming has essential distinctions from the proposed Lanzhou BRT.

Chongqing: As above-mentioned, Chongqing BRT is the first of its kind in Western China. It is featured with 81 kilometres of dedicated bus lanes with around 350 new articulated 18m Euro 3 CNG buses, plus extensive feeder lines on all BRT routes using 8-12m Euro 2 CNG bus. The system is expected to transport more than 600 million passengers on yearly basis. Such key indicators of design and operation differ significantly from the proposed Lanzhou BRT. Moreover, Chongqing BRT is a CDM project activity. It acquired LOA from Chinese DNA in Jun 2009[43]. The validation process started from Dec 2008 and concluded in Jun 2010. In Feb 2011, the project was registered by UNFCCC EB, with its registration back-dated to Oct 2010[44]. Given such facts, the claim that essential distinctions exist between Chongqing BRT and the proposed Lanzhou BRT can be substantiated.

The above evidence-based analysis can lead convincingly to the conclusion that the proposed Lanzhou BRT Project is:

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[40]http://www.yfao.gov.cn/show.aspx?id=758

[41] http://www.chinautc.com/information/upfile/ppt/km.doc

[42] http://www.efchina.org/csepupfiles/report/2006102695218532.3748014549853.pdf/BRT_KUTPI_07042_cn.pdf

[43] http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2517.doc

[44] Refer to UNFCCC website (http://cdm.unfccc.int/Projects/DB/SGS-UKL1275659668.89/view)

- the first-of-its-kind in Gansu Province;
- the first-of-its-kind in Northwest China (5 Provinces/Autonomous Regions)
- the first-of-its-kind in Western China (12 Provinces/Autonomous Regions/Municipalities)

From the perspective of the entire country, by end of 2010 there are 236 cities in China having permanent population of over 0.5 million, as reported by United Nations Department of Economic and Social Affairs (UNDESA)[45]. The same report forecasted that 107 more cities in China will reach the threshold of 0.5 million population. In this regard, there are immense potentials of developing BRT in a number of cities across the country. Nevertheless, as afore-mentioned, as of the commencement of CDM validation of the proposed project, nationwide there are a total of merely 13 cities having BRT systems in operation, including 2 system developed or being developed as CDM project activities (Chongqing, Zhengzhou)[46]. If the starting date of the proposed Lanzhou BRT (30 March 2010) is taken as the time point for investigation, the list of operational BRT systems in China is shortened to 11 only, out of which several projects received external assistance in planning, design and implementation[47]. Comparing the 11 cities with operational BRT with the nationwide 236 cities with potentials for BRT gives the figure of 4.6%, strongly suggesting that BRT is not prevalent in the urban public transport systems in China. Development of BRT as an integral part of urban public transport system is yet to be the prevailing practice in the urban transport sector of China.

Therefore, being the first-of-its-kind in Gansu Province, Northwest China and even Western China, the proposed Lanzhou BRT is in the position of taking the initiative of experimenting BRT system with no available reference in the region and very limited experience and lessons from other regions in the country. Setting foot in this new area, both the project proponent and other parties involved in the project are inevitably exposed to significant risks across a wide range of dimensions such as planning, design, construction, installation, operation, maintenance and so forth. Underperformance of the BRT is likely to take place, e.g. fewer passengers than originally forecasted, and consequently result in lower ticket incomes making even worse the deficit of operation.

Sub-step 3 b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

The alternative of continuation of the current public transport system, as the business-as-usual scenario, is not subject to the above identified project-specific barriers. No additional investment of significant amount would be necessary for constructing new infrastructure and procuring specially-designed buses of higher costs. Existing resources available to the project proponent as a state-owned company and capabilities and experiences built up through many years of organizing and operating urban public transit are sufficient to make sure smooth continuation of the public transport system under current structure, without the perceived risks of having significant uncertainties associated with ticket income and operational costs.

In conclusion, the above identified barriers applicable to the proposed project activity will in categorical way not prevent the implementation of the alternative of continuation of current public transport system.

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[45] http://www.chinadaily.com.cn/dfpd/2010-03/26/content_9648864.htm

[46] Chongqing BRT (http://cdm.unfccc.int/Projects/DB/SGS-UKL1275659668.89/view); Zhengzhou BRT (http://cdm.unfccc.int/Projects/Validation/DB/EK5F62K0WA6GO3GBY701C67PHGUYFW/view.html)

[47] Beijing, Hangzhou and Jinan received financial support from US Energy Foundation

Step 4: Common practice analysis

According to the "Tool for the demonstration and assessment of additionality" (version 05.2, EB39), there is no need to complement the generic additionality tests with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region if the proposed project type has been demonstrated to be first-of-its-kind in Sub-step 3a.

This is applicable to the proposed project activity which is first-of-its-kind as substantiated in detail in Sub-step 3a.

Conclusion
Based on analysis detailed in above steps, it is justifiable to reach the conclusion that the proposed project activity has additionlity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

BASELINE EMISSIONS

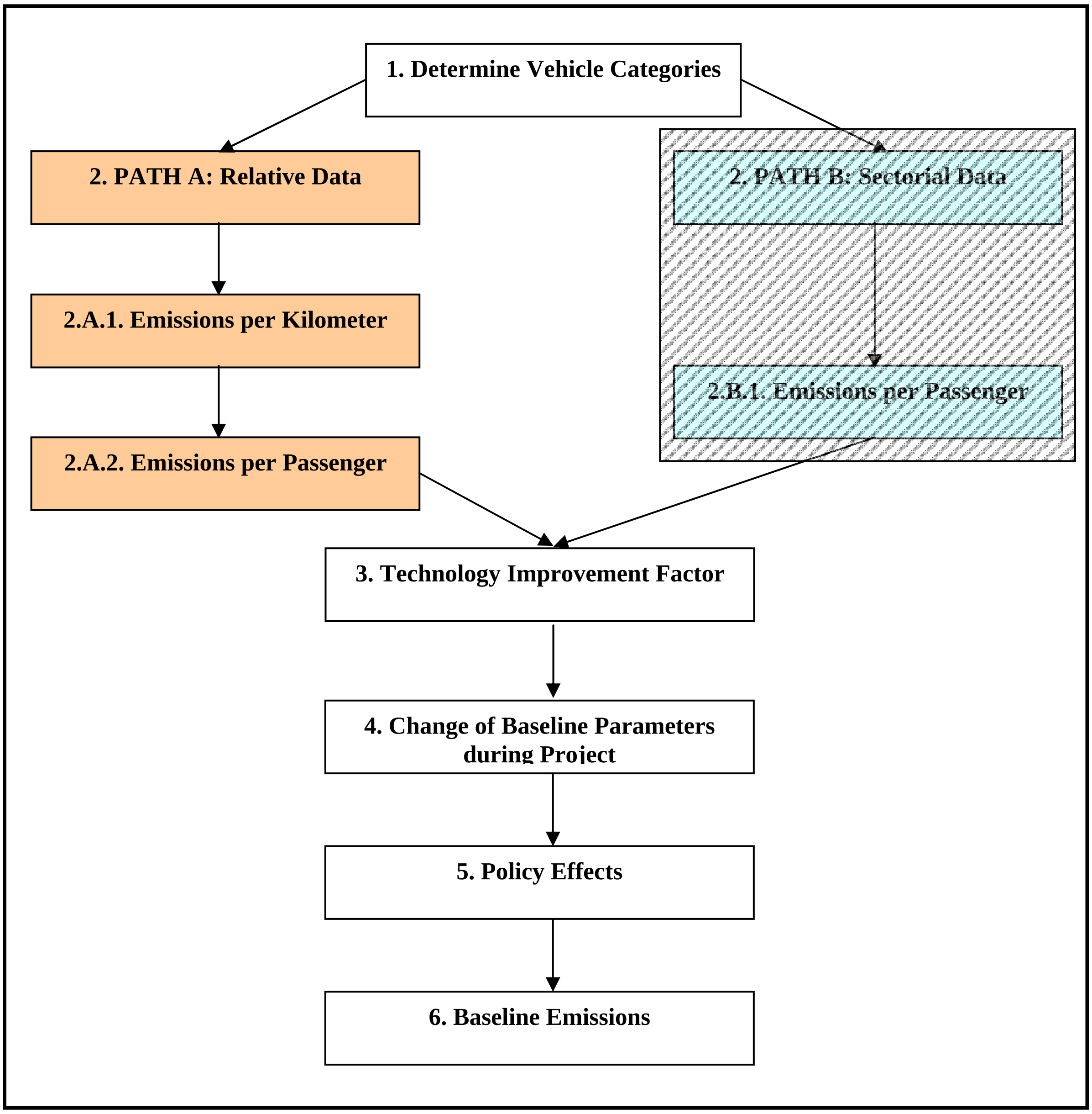
In light of AM0031, the baseline emissions shall be estimated through the following two major steps:

(1) Determination of emissions per passenger transported per vehicle category. This is calculated *ex ante*, including the usage of a fixed technology improvement factor. The baseline emission factor is adapted to potential changes in trip distance and type of fuel used by passenger cars if the *ex post* surveys to be implemented during crediting period indicate that changes in trip distance or fuel type used would lead to lower baseline emission factors;

(2) Baseline emissions are estimated *ex post* based on the passengers transported by the project and their modal split. Core baseline parameters used for calculating the baseline emission factors are reviewed through an annual survey, with changes only being applied if the baseline emission factors would be lower than the original ones determined *ex ante*. The passenger numbers shall be recorded by the BRT system operator.

Two methodological paths of determining the baseline emission per passenger transported are defined by the methodology. Taking account of data availability and data quality, the proposed project has taken Path (A) which allows the baseline emission per passenger transported per category of vehicle to be calculated as a function of emission per kilometre and passenger per kilometre.

The procedure for determining vehicle categories through to estimating baseline emissions is shown schematically as follows.



Step 1: Determine Vehicle Categories

As outlined in the methodology, the following criteria are applied to identify the relevant vehicle categories:

- At a minimum, public transport, non-motorised transport and induced traffic have to be included;
- Conditions to include categories are that there are reliable data on fuel consumption and load factors;

- Only include categories that are relevant for the BRT project. If the project will only generate credits from public transport without modal switch, then passenger cars, taxis and motorcycles need not be included;
- Differentiate relevant fuel types for each category. Diesel, gasoline and gas (CNG or LPG) are listed separately if a minimum of 10% of vehicles of the respective category use such a fuel, while the threshold for zero-emission fuels is minimum 1%. The 10% threshold is justified, as GHG emission differentials between diesel, gasoline and gaseous fuels are less than 20%;
- In case of a system extension the currently operating system is not included as a vehicle category.

Against the above criteria, the vehicle categories in Lanzhou relevant to the proposed project are identified as follows:

- Buses;
- Passenger cars;
- Taxis;
- Motorcycles;
- Non-motorized transport and induced traffic.

Step 2: Calculate Emissions per Passenger Based on Relative Data

Sub-Step 2.A.1: Determine Emissions per Kilometre for Vehicle Categories

Based on the consumption of each fuel type, the CO_2 emissions per volume or mass unit of fuel and the fraction of vehicles using the specific fuel type, the CO_2 emissions per kilometre are calculated and fixed *ex ante* for the project period.

- CO_2 emission factor is developed on the basis of the carbon content of the fuel;
- CH_4 and N_2O emission factors. CH_4 emissions are a function of the fuel and engine type, and any post-combustion controls. N_2O emissions are technology-based for each fuel type, depending upon vehicle category, installed control technologies and local data such as average driving speeds, temperatures, and altitude. The emission factors are transformed into CO_2 equivalent using GWP factors approved by the Conference of the Parties to the UNFCCC.

The following two methods can be used to determine the relevant CH_4 and N_2O emission factors:

(1) Local measured emission factors based on a reliable data source to be detailed in the PDD;

(2) Pre-determined default value per vehicle category. The default value per vehicle category is the technology with the lowest aggregate of CO_2e emissions of N_2O and CH_4. Using default values can ensure conservativeness.

Method (1) is preferred, whereas using the default value as method (2) is a conservative approach. Using fixed and average values is also justified as CH_4 as well as N_2O emissions in vehicles account on average for less than 1-2% of total CO_2e emissions. Appendix A of AM0031 presents the default parameters per vehicle category for CH_4 and N_2O in gCO_2e per litre of fuel consumed.

As far as the proposed Lanzhou BRT is concerned, the CO_2, CH_4 and N_2O emission factors of vehicle categories using liquid fuels[48] (gasoline) refer to default values presented in Appendix A of AM0031 and those of vehicle categories using gaseous fuels[49] (CNG) are determined using data from IPCC and local measurement. Neither electricity nor bio-fuel is used in the baseline and project scenarios of Lanzhou BRT. Therefore the requirements and conditions on electricity and bio-fuel have no relevance in this context.

Emissions per km for vehicles of different vehicle categories are calculated using following formula:

$$EF_{KM,i} = \sum_x \left[SEC_{x,i} \times \left(EF_{CO2,x} + EF_{CH4,x} + EF_{N2O,x} \right) \times \left(\frac{N_{x,i}}{N_i} \right) \right] \quad (1)$$

Where:

$EF_{KM,i}$	=	Transport emissions factor per distance of vehicle category *i* (gCO_2e per kilometer driven)
$SEC_{x,i}$	=	Specific energy consumption of fuel type *x* in vehicle category *i* (litre per kilometer)
$EF_{CO2,x}$	=	CO_2 emission factor for fuel type *x* (gCO_2 per litre)
$EF_{CH4,x}$	=	CH_4 emission factor for fuel type *x* (gCO_2e per litre, based on GWP)
$EF_{N2O,x}$	=	N_2O emission factor for fuel type *x* (gCO_2e per litre, based on GWP)
N_i	=	Total number of vehicles in category *i*
$N_{x,i}$	=	Number of vehicles in vehicle category *i* using fuel type *x*

If fewer than 10% of vehicles in a specific vehicle category are gasoline, diesel, CNG or LPG powered then this respective fuel can be omitted for simplicity purposes. In alternative vehicles the threshold value is less than 1%.

The following two methodological alternatives are proposed by AM0031 for determining the fuel consumption data (in order of preference):

- Alternative 1: Measurement of fuel consumption data using a representative sample for the respective category and fuel type. To ensure a conservative approach, the top 20% of the sample is not included in calculations;
- Alternative 2: Use of fixed values based on the national or international literature. The literature data can either be based on measurements of similar vehicles in comparable surroundings (e.g., from comparable cities of other countries) or may include identifying the vehicle age and technology of average vehicles circulating in the project region and then matching this with the most appropriate IPCC default values. The most important proxy to identify vehicle technologies is the average age of vehicles used in the area of influence of the project. To determine if either US or European default factors apply either local vehicle manufacturer information can be used (in the case of having a substantial domestic vehicle motor industry) or source of origin of vehicle imports.

As far as the proposed project is concerned, the specific fuel consumption of taxis and buses ($SEC_{CNG,T}$ and $SEC_{CNG,Z}$) uses data provided by Lanzhou Traffic Bureau and Lanzhou Public Traffic Group being

[48] Passenger cars and motorcycles in Lanzhou are gasoline-fuelled.

[49] Taxis and buses in Lanzhou are CNG-fuelled.

the authorized and best available sources of data at local level. For passenger cars and motorcycles, the specific fuel consumption ($SEC_{G,C}$ and $SEC_{G,M}$) is determined through *ex ante* on site baseline traffic survey and comparing survey results with international literature references on the basis of conservativeness.

Over the crediting period, the transport emissions factors per distance as determined above are not to remain constant but be subject to adjustments by introducing technology improvement factors to be applied to various vehicle categories on annual basis. Details are presented hereinafter in Step 3.

Sub-Step 2.A.2: Calculate Emissions per Passenger per Vehicle Category

Emissions per passenger per average trip for each vehicle category are determined in this sub-step.

For emissions per passenger transported by passenger cars, taxis or motorcycles, the formula (2) is applied. All data used is determined *ex ante*. A change in the occupancy rate of taxis is registered as leakage of the project, as elaborated hereinafter.

$$EF_{P,i} = \frac{EF_{KM,i} \times TD_i}{OC_i} \qquad \textbf{(2)}$$

Where:

$EF_{P,i}$	=	Transport emissions factor per passenger before project start, where $i = C$ (passenger cars), M (motorcycles) or T (taxis) (grams per passenger)
$EF_{KM,i}$	=	Transport emissions factor per distance of category i (gCO_2e per kilometer driven)
OC_i	=	Average vehicle occupancy rate of vehicle category i[50] (passengers)
TD_i	=	Average trip distance for vehicle category i (kilometers)

For emissions per passenger transported by buses, the following formula (3) is used. The time period for passengers and distance travelled must be equal (e.g., one year or one month). All data used is determined *ex ante*. A change in the occupancy rate of buses is registered as leakage of the project, as elaborated hereinafter.

$$EF_{P,Z} = \frac{EF_{KM,Z,S} \times DD_{Z,S} + EF_{KM,Z,M} \times DD_{Z,M} + EF_{KM,Z,L} \times DD_{Z,L}}{P_Z} \qquad \textbf{(3)}$$

Where:

$EF_{P,Z}$	=	Transport emissions factor in buses before project start (grams per passenger)
$EF_{KM,Z,S}$	=	Emissions from small buses (gCO_2e per kilometer)
$DD_{Z,S}$	=	Total distance driven by small buses (kilometer)
$EF_{KM,Z,M}$	=	Emissions from medium buses (gCO_2e per kilometer)
$DD_{Z,M}$	=	Total distance driven by medium buses (kilometer)

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[50] In the case of taxis the driver is not counted and only passengers are included in the occupancy rate.

$EF_{KM,Z,L}$	=	Emissions from large buses (gCO_2e per kilometer)
$DD_{Z,L}$	=	Total distance driven by large buses (kilometer)
P_Z	=	Passengers transported by buses in the baseline[51]

The above formula is adapted as follows because all buses operating in Lanzhou are categorized as large buses according to Chinese standard CJ/T 162-2002 "Technical Requirements and Equipments of Classification Grade for City Bus".

$$EF_{P,Z} = \frac{EF_{KM} \times DD_Z}{P_Z} \qquad \textbf{(4)}$$

Where:

$EF_{P,Z}$	=	Transport emissions factor in buses before project start (grams per passenger)
$EF_{KM,Z}$	=	Emissions from buses (gCO_2e per kilometer)
DD_Z	=	Total distance driven by buses (kilometer)
P_Z	=	Passengers transported by buses in the baseline[52]

Step 3: Technological Change

Under business-as-usual conditions, emission factors per vehicle category per fuel type may change due to:

- Vehicles are replaced with more efficient ones;
- Vehicles in stock tend to increase emissions based on wear and tear.

For simplicity purposes a constant average improvement rate per annum is established per vehicle category. The improvement rate is applied to each calendar year. Year 0 is the year for which specific or sector fuel consumption data was collected or determined. Emissions per vehicle category are multiplied with the corresponding technology improvement factor. The default technology improvement factors per vehicle category as given by AM0031 are tabulated as follows.

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[51] Passenger using multiple buses through transfers to realize one trip shall be counted as one passenger. For example, if a passenger takes 2 buses (namely, 1 transfer) to realize 1 trip, he/she shall be counted as 1 passenger rather than 2 passengers as recorded by the ticketing statistics of bus operator. The formula is defined for emissions per passenger-trip. The parameter "P_Z" is determined using the total registered passengers transported by buses in baseline and the average usage of buses per trip realized by bus passenger in baseline.

[52] Passenger using multiple buses through transfers to realize one trip shall be counted as one passenger. For example, if a passenger takes 2 buses (namely, 1 transfer) to realize 1 trip, he/she shall be counted as 1 passenger rather than 2 passengers as recorded by the ticketing statistics of bus operator. The formula is defined for emissions per passenger-trip. The parameter "P_Z" is determined using the total registered passengers transported by buses in baseline and the average usage of buses per trip realized by bus passenger in baseline.

Table 7: Technology Improvement Factor for fuel consumption

Vehicle category	Improvement Factor IR
Buses	0.99
Taxis	0.99
Passenger cars	0.99
Motorcycles	0.997

Step 4: Change of Baseline Parameters during Project Crediting Period

In light of AM0031, the potential changes of baseline parameters would only be necessary if the project includes a modal-switch (change from passenger cars, motorcycles or taxis to BRT). In this case, some parameters used for calculating the baseline emission factors could change over time:

- The load factor (i.e. occupancy rate) or the number of passengers per vehicle. The load factor is potentially influenced indirectly by the project. This factor is included in the monitoring of leakage of the project and thus not included in the baseline calculations;
- The distance driven by passengers using the BRT system might change or not be equivalent to the average distance driven used to calculate the baseline emission parameter. This factor is monitored through the survey conducted annually of passenger using the system;
- Type of fuel used by passenger cars. This factor is only relevant for passengers who have switched from cars to public transport. The annual passenger survey monitors the fuel used by passengers switching from passenger cars to the BRT system and adjusts the corresponding baseline emission factor for passenger cars as appropriate.

The methodology only takes changes in passenger emission factors into account if these are reduced. Details of the survey on change of trip distances as well as on change of fuel used by passenger cars are included in the survey questionnaire in Appendix 4 of this PDD.

Change of Trip Distance

The baseline emissions per passenger trip for taxis, passenger cars and motorcycles are adjusted annually with a correction factor for changing trip distances. Only downward adjustment of baseline emission factors will be made if the monitored trip distances are found to be shorter than the original ones ($TD_{i,y} < TD_i$). Longer trip distances as monitored will not be taken account of. In doing so, conservativeness of baseline emission factors is ensured[53].

$$CD_{i,y} = \frac{TD_{i,y}}{TD_i} \quad (5)$$

Where:

$CD_{i,y}$	=	Correction factor for changing trip distance in category *i* for the year *y*, where *i* = *T* (taxis), *C* (passenger cars) or *M* (motorcycles)
TD_i	=	Average trip distance in kilometers in category *i* before project start

[53] Larger distances would increase baseline emissions per passenger trip. The project emissions of larger trip distances are however fully recorded as project emissions are based on total fuel consumed.

$TD_{i,y}$ = Average trip distance in kilometers in category in year *y*

Change of Fuel Used by Passenger Cars

For passengers who, in absence of the project, would have used passenger cars, the type of fuel used by the cars shall be determined via a survey (refer to Appendix 4 of this PDD). The above formula (1) is used to re-calculate the new emission factors for passenger cars. The same threshold values for fuel types apply as described in above Step 1 regarding determination of vehicle categories.

The applicability condition for applying this change in fuel type used for passenger cars is that the new emission factor would be lower than the original emission factor ($EF_{KM,C,y} < EF_{KM,C}$). Otherwise, the baseline emission factor of passenger cars shall remain unchanged for conservativeness.

Step 5: Policy Effects

AM0031 requires that only policies with a measurable impact on GHG emissions shall be considered. Whether identified policies might have effects on various parameters needs to be assessed. To remain conservative the full impact monitored is attributed to the policy[54]. All relevant policies and their impact are included in the baseline from the date of their planned implementation[55]. However, broad development strategies and concepts are not considered if they do not have a legally binding character including as minimum an implementation date, enforcement procedures and clear activities.

The following steps are taken to analyze the policies.

(1) Identification of policies with a potential impact on GHG emissions of the current transport system;

(2) Assessment on whether an identified policy has been legally adopted with a clear implementation date. If no implementation date is given, the policy is not further considered. If the date is fixed and within the time frame of the proposed project, then the policy is included in the analysis;

(3) Assessment on the potential impact of the identified policy on any of the baseline parameters;

(4) Introduction of a correction factor, if required. The correction factor must be determined to achieve a conservative result.

Since policy is project-specific, no generally applicable formula for introducing policies and impacts can be given by the methodology. Therefore, the above-mentioned policies and their implementation dates shall be assessed *ex ante*, duly taking account of project-specific circumstances in terms of policies, rules

[54] E.g., a new policy to reduce private vehicles will potentially have an impact on the modal split. The full change of the modal split will be accounted as a result of the policy even though this could also be influenced by other factors e.g. improved supply of public transport.

[55] Policies, which potentially have an impact, include mainly fuel policies (e.g., compulsory usage of bio-fuel blends), fiscal policies (e.g., differential fuel taxes according to carbon contents), and transport policies (e.g., promotion of Non-Motorized Transport or car restriction policies).

and requirements in relation to transport. Monitoring shall be carried out on a regular basis for policies affecting parameters of the baseline, involving:

(1) Assessing new and enforced policies, which could significantly affect the modal split of passengers in the project area. This is defined here as policies which expect to change the modal split by 5% or more towards public transport. If several policies, which change the modal split, are enforced during the project's crediting period then the cumulative effect of these policies must be superior to 5%. This threshold value only applies to policies affecting the modal split. The expected modal split change is based on calculation or targets realized by the policy proponents (i.e., the ministry or governmental authority in charge of the policy). If such a policy has been enforced in year *x*, a year where no survey has been carried out, the modal split of the most recent year prior to that no survey is realized, and the modal split of the year *x-1* is applied to all passengers using the system;

(2) Assessing new and enforced policies that change the fuel usage of vehicles (either fuel type or regulations concerning maximum fuel usage). This potentially changes the emission factor per distance driven of vehicles;

(3) Assessing any other policy which results in a measurable and verifiable manner in a change of a parameter used for calculating baseline emissions such as a compulsory technology change by establishing and enforcing maximum vehicle ages.

Against the above criteria and steps, *ex ante* assessment on Lanzhou concludes that no transport policies with potentially significant impacts on parameters determining GHG emissions of the current transport system are in place. Specifically on fuel type, there is no established policy on compulsory usage of bio-fuel. All buses and taxis in Lanzhou are fuelled by CNG, a fact that has already been taken into due consideration in the course of *ex ante* determining baseline parameters.

Over the crediting period, on annual basis new and enforced policies in Lanzhou shall be monitored and assessed against whether they are likely to result, in a measureable and verifiable manner, in changes of parameters affecting the baseline.

Step 6: Determination of Baseline Emissions

The baseline emissions are *ex ante* estimated based on the *ex ante* determined baseline emission factors per passenger of various vehicle categories, total amount of BRT passengers and modal split of BRT passengers in the absence of the BRT system. The total amount of passengers transported by the BRT system shall be based on the operation statistics of the BRT operator. The modal split of BRT passengers is to be monitored through on-site questionnaire-based survey undertaken, at the minimum frequency of once every 2 months (minimum 6 times per year), over the crediting period.

$$BE_y = \sum_i \left(EF_{P,i,y} \times P_{i.y} \right) \quad \textbf{(6)}$$

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2e)
$EF_{P,i,y}$	=	Transport emissions factor per passenger in vehicle category *i* in year *y* (grams per passenger)

$P_{i.y}$	=	Passengers transported by the project (BRT) in year *y* who without the project activity would have used category *i*, where *i* = Z (buses, public transport), *T* (taxis), *C* (passenger cars), rail-based urban mass transit (*R*) or *M* (motorcycles)[56] (millions of passengers)

$$EF_{P,i,y} = EF_{P,i} \times IR_{i,t} \times CD_{i,y} \quad \textbf{(7)}$$

Where:

$EF_{P,i,y}$	=	Transport emissions factor per passenger in vehicle category *i* in year *y* (grams per passenger)
$EF_{P,i}$	=	Transport emissions factor per passenger before start of project (grams per passenger)
$CD_{i,y}$	=	Correction factor for changing trip distance in category *i* for the year *y*, where *i* = *T* (taxis), *C* (passenger cars) or *M* (motorcycles)
$IR_{i,t}$	=	Technology improvement factor at year t for vehicle category *i*
t	=	Age in years of fuel consumption data used for calculating the emission factor in year *y*[57]

For $CD_{i,y}$, it shall only be applied if $TD_{i,y} < TD_i$. For passenger cars, $EF_{KM,C,y}$ shall only be adjusted if $EF_{KM,C,y} < EF_{KM,C}$.

Emissions from passengers who in absence of the project would have used rail-based mass transit systems (*R*) are counted as $EF_{P,R,y} = 0$ grams per passenger[58].

The modal splits of BRT passengers in the absence of BRT system are calculated as follows:

$$P_{i,y} = P_y \times S_{i,y} \quad \textbf{(8)}$$

Where:

$P_{i,y}$	=	Passengers transported by the project who in absence of latter would have used transport type *i*, where *i* = *Z* (buses, public transport), *T* (taxis), *C* (passenger cars), *M* (motorcycles), *NMT* (non-motorized transport), *R* (rail-based urban mass transit) and *IT* (induced transport, i.e., would not have traveled in absence of project) (millions)
P_y	=	Total passengers transported by the project monitored in year *y* (millions)
$S_{i,y}$	=	Share of passengers transported by the project which in absence of latter would have used transport type *i*, where *i* = *Z* (buses, public transport), *T* (taxis), *C* (passenger cars), *M* (motorcycles), *NMT* (non-motorized transport), *R* (rail-based urban mass transit) and *IT* (induced transport, i.e., would not have traveled in absence of project) (%)

[56] NMT and IT are not included as emissions are “0” for this category in the baseline.

[57] This parameter refers to the difference between year “y” during the crediting period and the year in which the original fuel consumption data was obtained (baseline year prior to project). For example, if the baseline year prior to project in which original fuel consumption data was obtained is year 2010, then t=5 for year 2015.

[58] No rail-based urban mass transit system is available in Lanzhou.

Induced travel is included in leakage calculations (induced travel in passenger cars) as well as in the baseline (induced travel in public transport).

PROJECT EMISSIONS

The project emissions are from all buses of the BRT system. Considering the data availability, the proposed project opts for Alternative (A) "Use of Fuel Consumption Data" to calculate total project emissions. Specific fuel consumption data (i.e., consumption per distance driven) will be cross-checked for the purpose of QA/QC.

Alternative A: Use of Fuel Consumption Data

This alternative is based on the total fuel consumed, as follows:

$$PE_y = \sum_x \left[TC_{PJ,x,y} \times (EF_{CO2,x} + EF_{CH4,x} + EF_{N2O,x}) \right] \quad \textbf{(9)}$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2e)
$TC_{PJ,x,y}$	=	Total consumption of fuel type *x* in year *y* by the project (million litres/m^3)
$EF_{CO2,x}$	=	CO_2 emission factor for fuel type *x* (gCO_2 per litre/m^3)
$EF_{CH4,x}$	=	CH_4 emission factor for fuel type *x* (gCO_2e per litre/m^3, based on GWP)
$EF_{N2O,x}$	=	N_2O emission factor for fuel type *x* (gCO_2e per litre/m^3, based on GWP)

For BRTs using electricity, the emissions from electricity consumption are based on the latest approved version "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". This has no relevance to Lanzhou BRT as all buses of the BRT system are CNG-fuelled.

LEAKAGE EMISSIONS

According to AM0031, the following leakage sources are addressed:

(1) Change of load factor of the baseline transport system due to the project, i.e., the project potentially influences the occupancy rate of the remaining vehicles. Relevant vehicle categories are conventional buses and taxis. This is monitored on a regular basis during project crediting period;

(2) Reduced congestion in remaining roads, provoking higher average vehicle speed, plus a rebound effect. The total impact of congestion is calculated *ex ante* and not monitored in crediting period;

(3) In case of more gaseous fuel are used in the project than in the baseline case the upstream emissions of gaseous fuels should be included. No leakage emissions should be included if in the baseline more ore equal gaseous fuel are used than in the project as this would lead to negative leakage (conservative approach).

For the purpose of being conservative, leakage is only considered if the total annual effect is to reduce estimated emission reductions.

1. Change of Load Factor

The project could have a negative impact on the load factor of taxis or the remaining conventional bus fleet. Load factor changes in the baseline public transport system are thus monitored.

Leakage is only included if the load factor changes by more than 10 percentage points, as certain variations in the load factor caused by external circumstances are normal. The methodology also considers load factor changes in taxis if they are included as vehicle category by the project, thus claiming credits from a modal shift from taxi to the BRT system.

In the case of lower load factors, it is assumed that this change has occurred immediately after the last measurement, and the leakage calculation for this year includes the sum of load-factor leakage of all years since the last monitoring. This ensures a conservative approach. To avoid the risk of having to include *ex post* leakage from former years, the project proponent can monitor the load factor annually.

$$ROC_{i,y} = \frac{OC_{i,y}}{CV_{i,y}} \quad \textbf{(10)}$$

Where:

$ROC_{i,y}$	=	Average occupancy rate relative to capacity in category *i* in year *y*, where *i* = Z (buses) or *T* (taxis)
$OC_{i,y}$	=	Average occupancy of vehicle in category *i* in year *y* (passengers)
$CV_{i,y}$	=	Average capacity of vehicle *i* in year *y* (passengers)

In the case of public transport, the occupancy rate is measured in relation to the bus capacity, as bus sizes may change over time or before/after project. $ROC_{i,y}$ shall be monitored directly through visual surveys.

The leakage emissions from change of load factors in buses are determined as follows:

$$LE_{LF,Z,y} = EF_{KM,Z} \times VD_Z \times N_{Z,y} \times \left(1 - \frac{ROC_{Z,y}}{ROC_{Z,0}}\right) \quad \textbf{(11)}$$

Where:

$LE_{LF,Z,y}$	=	Leakage emissions from change of load factor in buses in year *y* (tCO_2e)
$EF_{KM,Z}$	=	Baseline transport emissions factor per distance for buses (gCO_2e per kilometer)
VD_Z	=	Annual distance driven per vehicle for buses before the project start, determined *ex ante* (kilometres)
$N_{Z,y}$	=	Number of buses in the conventional transport system operating in year *y*
$ROC_{Z,y}$	=	Average occupancy rate relative to capacity of conventional buses in year *y*, based on the most recent study of occupancy rates
$ROC_{Z,0}$	=	Average occupancy rate relative to capacity of buses before start of project

$$VD_Z = \frac{\sum_{k=S,M,L} DD_{Z,k}}{\sum_{k=S,M,L} N_{Z,k}} \quad (12)$$

Where:

VD_Z = Distance driven per bus before the project start (kilometres)

$DD_{Z,k}$ = Total distance driven by buses of size k (kilometers)

$N_{Z,k}$ = Number of buses in the conventional transport system of size k

Note: If $ROC_{Z,0}$ - $ROC_{Z,y} \leq 0.1$ then $LE_{LF,Z,y} = 0$, i.e. if the occupancy rate of buses is not reduced by more than 0.1, then the project has had no negative effect (leakage).

The leakage emissions from change of load factors in taxis are determined as follows:

$$LE_{LF,T,y} = EF_{KM,T} \times VD_T \times N_{T,y} \times \left(1 - \frac{OC_{T,y}}{OC_{T,0}}\right) \quad (13)$$

Where:

$LE_{LF,T,y}$ = Leakage emissions from change of load factor in taxis in year y (tCO_2e)

$EF_{KM,T}$ = Transport emissions factor per distance of taxi in baseline (gCO_2e per kilometer)

VD_T = Distance driven per taxi on average before project start (kilometres)

$N_{T,y}$ = Number of taxis operating in year y

$OC_{T,y}$ = Average occupancy rate of taxi for the year y (driver not counted)

$OC_{T,0}$ = Average occupancy rate of taxi before project start (driver not counted)

Note: If $OC_{T,0}$ - $OC_{T,y} \leq 0.1$ then $LE_{LF,T,y} = 0$, i.e. if the occupancy rate of taxis is not reduced by more than 0.1, then the project has had no negative effect (leakage).

During the crediting period, the monitoring of the occupancy rate is based on representative surveys, which register all taxis passing the survey points. Taxis without passengers are counted as “0” occupancy rate. Only circulating taxis are counted.

2. Impact of Reduced Congestion on Remaining Roads

A BRT project reduces buses on the road and thus potentially reduces congestion. Reduced congestion has the following impacts relevant for GHG emissions:

- “Rebound effect” leading to additional trips and thus higher emissions;
- Higher average speeds and less stop-and-go traffic leading to lower emissions.

If a project leads to increased congestion, then all formulae in relation to congestion can still be used equally, with the effects simply being reversed, namely lower average speed and increased stop-and-go traffic leading to increased emissions while rebound effect leading to less induced traffic than under BAU.

Steps to Address Congestion Impact

Two elements need to be considered:

- Trunk roads can potentially reduce the space of remaining roads. The proportion of reduced road space available to passenger cars has to be calculated;
- Conventional buses are retired thus freeing road space. The proportion of retired buses and the proportion of public transport in road space have to be determined.

The additional impact of new and longer trips shall be assessed via the direct application of "capacity elasticity", i.e. additional cars (additional/longer trips) resulting from a change in road capacity.

Step 1: Calculate additional road-space available

The additional road space available in year *y* is determined as follows:

$$ARS_y = \sum_{w=1...y} \frac{BSCR_w}{N_Z} \times SRS - \frac{RSB - RSP}{RSB} \qquad \textbf{(14)}$$

Where:

ARS_y	=	Additional road space available in year *y* (%)
$BSCR_w$	=	Bus units scrapped by project in year *w*, where *w* = 1 to *y* (NB: if buses are not scrapped the estimated amount of retired buses is taken)
N_Z	=	Number of buses in use in the baseline
SRS	=	Share of road space used by public transport in the baseline (%)
RSB	=	Total road space available in the baseline (kilometres)
RSP	=	Total available road space in the project (= RSB minus kilometre of lanes that where reduced due to dedicated bus lanes) (kilometres)

If $ARS_y < 0$, it suggests that road space is reduced in year *y*, and thus increased emissions due to reduced vehicle speed, but reduced emissions due to a negative "rebound effect".

The following formula is used to determine SRS if no recent and good quality study is available which has calculated this parameter. For all parameters related to distance, the same vintage of data, the same spatial scope and the same time-span (e.g. one month or one year) are required.

$$SRS = \frac{DD_Z}{DD_Z + DD_T + DD_C} \qquad \textbf{(15)}$$

Where:

SRS	=	Share of road space used by public transport in the baseline (in percentage)
DD_Z	=	Total distance driven by public transport buses baseline (kilometers)
DD_T	=	Total distance driven in kilometers by taxis baseline (kilometers)
DD_C	=	Total distance driven in by passenger cars baseline (kilometers)

Step 2: Assess the rebound impact of the additional road space

The leakage emissions from additional/longer trips ("rebound effect") are calculated as follows. The impact is calculated as immediately although the short-term reaction of induced traffic is significantly lower than the long-term (3 years+) reaction. Nevertheless, by bringing forward the reaction and assuming that the maximum possible effects will take place over short-term, the calculated leakage emissions from "rebound effect" are inflated and therefore conservativeness is ensured.

$$LE_{TRIPS,y} = ITR \times ARS_y \times TR_C \times TD_C \times EF_{KM,C} \times D_y \quad \textbf{(16)}$$

Where:

$LE_{TRIPS,y}$	=	Leakage emissions from additional and/or longer trips in year *y* (tCO_2e)
ITR	=	Elasticity factor for additional and/or longer trips: the factor is fixed at 0.1
ARS_y	=	Additional road space available (%)
TR_C	=	Number of daily trips realized by passenger cars baseline (number)
TD_C	=	Average trip distance for passenger cars (kilometers)
$EF_{KM,C}$	=	Transport emissions factor per distance of passenger cars before start of project (gCO_2e per kilometer)
D_y	=	Number of days buses operate in year *y*

Step 3: Assess the impact of changing vehicle speed from passenger cars

$$LE_{SP,y} = TR_C \times TD_C \times \left[EF_{KM,VP,C} - EF_{KM,VB,C}\right] \times DW_y \quad \textbf{(17)}$$

Where:

$LE_{SP,y}$	=	Leakage emissions from change in vehicle speed in year *y* (tCO_2e)
TR_C	=	Number of daily trips realized by passenger cars baseline (number)
TD_C	=	Average trip distance driven by passenger cars (kilometers)
$EF_{KM,VP,C}$	=	Transport emissions factor per distance for passenger cars at project speed (gCO_2 per km)
$EF_{KM,VB,C}$	=	Transport emissions factor per distance for passenger cars at baseline speed (gCO_2 per km)
DW_y	=	Number of days per year in year *y*

The new vehicle speed is calculated based on the number of retired vehicles or additional available road space. The project proponent can either use a speed dependency factor developed with an officially recognized methodology for the project region (with the corresponding documentation to ensure a good quality; if latter is available this would be the first preference) or use as default relation the speed dependency factor Passenger Cars (gCO_2 per km) developed by CORINAR. If the project has no data on speed changes or current speed, then it is assumed that the speed impact is equal to 0.

Formula of CORINAR speed dependency factor is as follows:

$$EF_{KM,m,C} = 135.44 - 2.314 \times V + 0.0144 \times V^2 \quad \textbf{(18)}$$

Where:

$EF_{KM,m,C}$	=	Transport emissions factor per distance for passenger cars traveling at speed *m* (gCO_2 per km)
V	=	Vehicle speed (km/h); calculated both for the project speed (V_P) and baseline speed (V_B)

Step 4: Sum of congestion impacts and determination of leakage factor

The sum of the rebound effect and the speed impact is included as leakage emissions resulting from the impact of reduced congestion. The impact of congestion is only calculated *ex ante* and not monitored.

$$LE_{CONG,y} = LE_{TRIPS,y} + LE_{SP,y} \quad \textbf{(19)}$$

Where:

$LE_{CONG,y}$	=	Leakage emissions from reduced congestion in year *y* (tCO_2e)
$LE_{TRIPS,y}$	=	Leakage emissions from additional and/or longer trips in year *y* (tCO_2e)
$LE_{SP,y}$	=	Leakage emissions from change in vehicle speed in year *y* (tCO_2e)

3. Upstream Emissions of Gaseous Fuels

Upstream leakage of gaseous fuels is only included if project vehicles consume more gaseous fuels than baseline vehicles. In this case and to simplify calculations the upstream leakage included is based only on project gaseous fuels used. The following leakage emission sources shall be considered:

- Fugitive CH_4 emissions associated with fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of natural gas used in the project plant and fossil fuels used in the grid in the absence of the project activity;
- In the case LNG is used in the project plant: CO_2 emissions from fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression into a natural gas transmission or distribution system.

As far as the proposed Lanzhou BRT project is concerned, no LNG is used and gaseous fuels (CNG) consumed by project vehicles are less than baseline vehicles (details in Annex 3). Given so, no upstream emissions of gaseous fuels are necessary to be considered in this project.

Total Leakage

The above mentioned various leakage sources contribute to the total leakage[59].

$$LE_y = LE_{LF,Z,y} + LE_{LF,T,y} + LE_{CONG,y} \quad \textbf{(20)}$$

Where:

LE_y	=	Emissions leakage in year *y* (tCO_2e)
$LE_{LF,Z,y}$	=	Leakage emissions from change of load factor in buses in year *y* (tCO_2e)
$LE_{LF,T,y}$	=	Leakage emissions from change of load factor in taxis in year *y* (tCO_2e)

[59] Upstream emissions of gaseous fuels are not included.

$LE_{CONG,y}$ = Leakage emissions from reduced congestion in year y (tCO_2e)

If $LE_y < 0$, then leakage is not included;
If $LE_y > 0$, then leakage is included.

The impact of induced traffic (additional trips) provoked through the new transport system is addressed directly in the project emissions and is therefore not part of the leakage. This is addressed by including as project emissions the emissions from the trips of passengers, who in absence of the BRT project would not have realized the trip.

LEAKAGE EMISSIONS

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(21)}$$

Where:

ER_y = Emission reductions in year y (tCO_2e)

BE_y = Baseline emissions in year y (tCO_2e)

PE_y = Project emissions in year y (tCO_2e)

LE_y = Leakage emissions in year y (tCO_{2e})

Sensitivity Analysis

A sensitivity analysis is carried out for data and parameters used to calculate baseline as well as project emissions (at minimum where uncertainty level of data is considered moderate or high). Data with this level of uncertainty shall be identified. The sensitivity analysis shall also identify potential critical parameters for further discussion.

The sensitivity analysis shall be based on calculating the change of the identified parameter that would be required to reduce ERs by 5%. This value gives an indication of the magnitude of change of the parameter required to significantly change calculated ERs. A sensitivity analysis shall be undertaken at a minimum for the load factor and for the modal distribution.

Steps to carry out the sensitivity analysis include:

(1) Identify all data with moderate or high uncertainty levels;

(2) Carry out a sensitivity analysis on these parameters by calculating the level of change of the parameter required to reduce ERs by 5% below the originally estimated ERs;

(3) Assess the result in light of possible data uncertainty:

- The parameter change required is considered as highly improbable. Arguments on why this is considered improbable shall be elaborated.
- The parameter change is considered as plausible. In this case the maximum plausible change must be incorporated in the parameter to assure for a conservative calculation of ERs.

With the view of ensuring a holistic study, the sensitivity analysis of the proposed project is applied to all parameters in relation to baseline emissions and project emissions that are listed in Section B.6.2 and Section B.7.1 of this PDD. Parameters using IPCC value or default values given by the methodology are not included in the analysis. Details of the sensitivity analysis are presented in Annex 3 of this PDD.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**$SEC_{CNG,T}$**
Data unit:	m^3/100km
Description:	Specific energy consumption of CNG by taxis
Source of data used:	Lanzhou Traffic Bureau
Value applied:	8.0 m^3/100km for new vehicles; (9.0 m^3/100km for vehicles older than 1 year.)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Statistic data based on operation, provided by local government authority. For the purpose of this study, the specific energy consumption of CNG of 8.0m^3/100km is applied to all taxis irrespective of actual ages of specific vehicles, thus ensuring conservativeness of calculation.
Any comment:	All taxis in Lanzhou are CNG-fuelled.

Data / Parameter:	**$SEC_{G,C}$**
Data unit:	litre/100 km
Description:	Specific energy consumption of gasoline by passenger cars
Source of data used:	Baseline Traffic Survey for CDM Development of Lanzhou BRT Project “China’s Fuel Economy Standards for Passenger Vehicles” published in 2009 by Harvard Kennedy School
Value applied:	7.84
Justification of the choice of data or description of measurement methods and procedures actually applied :	Method (1): $SEC_{G,C}$ =7.84 litre/100 km Based on “Baseline Traffic Survey for CDM Development of Lanzhou BRT Project”, with the top 20% of samples being excluded for the purpose of conservativeness as required by the methodology. Method (2): $SEC_{G,C}$ =8.5 litre/100 km Based on weighted vehicle sales 2002 to 2006 and SFC for 2002 and 2006 based on measurements using Chinese standards and drive cycles of all models sold (weighted according to models), with original data from China Automotive Technology & Research Centre (CATARC) and National Development and Reform Commission (NDRC). This is conservative as: - Based on overall drive cycle while urban drive cycle has significantly higher SFC - No wear and tear included - Only vehicles aged 2002 upwards included

	Drive cycle SFC is under optimal conditions while actual operations are sub-optimal (e.g. tire pressure, maintenance, stop-and-go traffic, driver behaviour) and thus actual SFC tends to be significantly higher than drive-cycle SFC
Any comment:	For conservativeness, lower value from the two methods is taken.

Data / Parameter:	**$SEC_{G,M}$**
Data unit:	litre/100 km
Description:	Specific energy consumption of gasoline by motorcycles
Source of data used:	Baseline Traffic Survey for CDM Development of Lanzhou BRT Project; Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual
Value applied:	2.2
Justification of the choice of data or description of measurement methods and procedures actually applied :	Method (1): $SEC_{G,M}$ =2.2 litre/100 km Based on "Baseline Traffic Survey for CDM Development of Lanzhou BRT Project", with the top 20% of samples being excluded for the purpose of conservativeness as required by the methodology. Method (2): $SEC_{G,M}$ =2.4 litre/100 km (at minimum) Latest data of IPCC (no new values published in the 2006 guidelines). Lowest value of all motorcycle types and all makes published by IPCC is taken to be conservative. European motorcycles (Table 1-42) <50cc: 2.4 l/100km >50cc 2-stroke: 4.0 l/100km >50cc 4-stroke: 5.1 l/100km US motorcycles (Table 1-33) Non catalytic control: 9.3 l/100km Uncontrolled: 11.2 l/100km All motorcycles are gasoline-fuelled.
Any comment:	For conservativeness, lower value from the two methods is taken.

Data / Parameter:	**$SEC_{CNG,Z}$**
Data unit:	m^3/100 km
Description:	Specific energy consumption of CNG by buses
Source of data used:	Lanzhou Public Traffic Group
Value applied:	31.41m^3/100km
Justification of the choice of data or description of measurement methods and procedures actually applied :	Statistic data based on operation provided by Lanzhou Public Traffic Group
Any comment:	All buses in Lanzhou are CNG-fuelled.

Data / Parameter:	$EF_{CO2,CNG}$
Data unit:	gCO_2/m^3
Description:	CO_2 emission factor of CNG
Source of data used:	IPCC 2006, Volume 2, Chapter 1, Table 1.4. Lanzhou Public Traffic Group
Value applied:	1,970.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	NCV of CNG = 35.13 MJ/m^3 (Lanzhou Public Traffic Group) CO_2 emission factor of CNG = 56.1 gCO_2/MJ (IPCC 2006, Volume 2, Chapter 1, Table 1.4)
Any comment:	Applicable to both CNG-fuelled buses and CNG-fuelled taxis.

Data / Parameter:	$EF_{CH4,CNG,Z}$
Data unit:	gCO_2e/m^3
Description:	CH_4 emission factor of CNG for buses
Source of data used:	IPCC 2006, Volume 2, Chapter 3, Table 3.2.4 Lanzhou Public Traffic Group
Value applied:	515.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated using the following parameters: • $SEC_{CNG,C}$ = 31.41 $m^3/100km$ • CH_4 emission factor of CNG for buses = 7.715g/km • GWP of CH_4 = 21
Any comment:	

Data / Parameter:	$EF_{N2O,CNG,Z}$
Data unit:	gCO_2e/m^3
Description:	N_2O emission factor of CNG for buses
Source of data used:	IPCC 2006, Volume 2, Chapter 3, Table 3.2.4 Lanzhou Public Traffic Group
Value applied:	99.7
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated using the following parameters: • $SEC_{CNG,C}$ = 31.41 $m^3/100km$ • N_2O emission factor of CNG for buses = 0.101g/km • GWP of N_2O = 310
Any comment:	

Data / Parameter:	$EF_{CH4,CNG,T}$
Data unit:	gCO_2e/m^3
Description:	CH_4 emission factor of CNG for taxis
Source of data used:	IPCC 2006, Volume 2, Chapter 3, Table 3.2.4

	Lanzhou Traffic Bureau
Value applied:	123.4
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated using the following parameters: • $SEC_{CNG,T}$ = 8.0 m^3/100km • CH_4 emission factor of CNG for taxis (average of lower and upper limits of 0.215g/km and 0.725g/km) • GWP of CH_4 = 21
Any comment:	

Data / Parameter:	**$EF_{N2O,CNG,T}$**
Data unit:	gCO_2e/m^3
Description:	N_2O emission factor of CNG for taxis
Source of data used:	IPCC 2006, Volume 2, Chapter 3, Table 3.2.4 Lanzhou Traffic Bureau
Value applied:	187.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated using the following parameters: • $SEC_{CNG,T}$ = 8.0 m^3/100km • N_2O emission factor of CNG for taxis (average of lower and upper limits of 0.027g/km and 0.070g/km) • GWP of N_2O = 310
Any comment:	

Data / Parameter:	**$EF_{CO2,G,C/M}$**
Data unit:	gCO_2/litre
Description:	CO_2 emission factors of gasoline for passenger cars and motorcycles
Source of data used:	Appendix A “Parameters Used in Baseline Methodology” of AM0031
Value applied:	Passenger cars = 2313 Motorcycles = 2313
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default emission factors provided by AM0031.
Any comment:	

Data / Parameter:	**$EF_{CH4,G,C/M}$**
Data unit:	gCO_2e/litre
Description:	CH_4 emission factor of gasoline for passenger cars and motorcycles
Source of data used:	Appendix A “Parameters Used in Baseline Methodology” of AM0031
Value applied:	Passenger cars = 11 Motorcycles = 29
Justification of the choice of data or	Default emission factors provided by AM0031.

description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**$EF_{N2O,G,C/M}$**
Data unit:	gCO_2e/litre
Description:	N_2O emission factor of gasoline for passenger cars and motorcycles
Source of data used:	Appendix A "Parameters Used in Baseline Methodology" of AM0031
Value applied:	Passenger cars = 14 Motorcycles = 7
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default emission factors provided by AM0031.
Any comment:	

Data / Parameter:	**OC_T**
Data unit:	Passengers
Description:	Average occupancy rate of taxis
Source of data used:	Baseline Traffic Survey for CDM Development of Lanzhou BRT Project
Value applied:	1.08
Justification of the choice of data or description of measurement methods and procedures actually applied :	The upper bound of 95% confidence interval calculated based on surveyed data is taken, for the purpose of conservativeness. The sample size of this parameter is 29,983. Calculation based on survey results suggests that the statistical requirements of 95% confidence level and maximum 5% error margin are complied with. The survey of OC_T was carried out by following the relevant guideline of methodology and duly taking into account local circumstance. Detailed survey implementation plan is presented in Annex 4 of this PDD for reference.
Any comment:	Taxi driver was not counted as required by the methodology.

Data / Parameter:	**OC_C**
Data unit:	Passengers
Description:	Average occupancy rate of passenger cars
Source of data used:	Baseline Traffic Survey for CDM Development of Lanzhou BRT Project
Value applied:	1.71
Justification of the choice of data or description of	The upper bound of 95% confidence interval calculated based on surveyed data is taken, for the purpose of conservativeness.

measurement methods and procedures actually applied :	The sample size of this parameter is 58,441. Calculation based on survey results suggests that the statistical requirements of 95% confidence level and maximum 5% error margin are complied with. The survey of OC_C was carried out by following the relevant guideline of methodology and duly taking into account local circumstance. Detailed survey implementation plan is presented in Annex 4 of this PDD for reference.
Any comment:	

Data / Parameter:	**OC_M**
Data unit:	Passengers
Description:	Average occupancy rate of motorcycles
Source of data used:	Baseline Traffic Survey for CDM Development of Lanzhou BRT Project
Value applied:	1.51
Justification of the choice of data or description of measurement methods and procedures actually applied :	The upper bound of 95% confidence interval calculated based on surveyed data is taken, for the purpose of conservativeness. The sample size of this parameter is 742. Calculation based on survey results suggests that the statistical requirements of 95% confidence level and maximum 5% error margin are complied with. The survey of OC_M was carried out by following the relevant guideline of methodology and duly taking into account local circumstance. Detailed survey implementation plan is presented in Annex 4 of this PDD for reference.
Any comment:	

Data / Parameter:	**P_Z**
Data unit:	Passenger-trips
Description:	Passenger-trips realized with buses in the baseline
Source of data used:	Lanzhou Public Traffic Group; Baseline Traffic Survey for CDM Development of Lanzhou BRT Project
Value applied:	402,319,193
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated using the following parameters: • Total registered passengers transported by buses in baseline (2010) = 615,548,365 (passengers) • Average usage of buses per trip realized by bus passenger in baseline = 1.53 (buses per trip)
Any comment:	

Data / Parameter:	**DD_Z**
Data unit:	kilometer

Description:	Total distance driven by all buses in the baseline
Source of data used:	Lanzhou Public Traffic Group;
Value applied:	143,013,462
Justification of the choice of data or description of measurement methods and procedures actually applied :	Statistic data based on operation of 2010, provided by Lanzhou Public Traffic Group
Any comment:	

Data / Parameter:	**$TD_{C,T,M}$**
Data unit:	kilometer
Description:	Average trip distance of passenger cars, taxis and motorcycles in baseline
Source of data used:	Baseline Traffic Survey for CDM Development of Lanzhou BRT Project
Value applied:	Passenger cars = 10.3km Taxis = 6.79 km Motorcycles = 5.99 km
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on results of "Baseline Traffic Survey for CDM Development of Lanzhou BRT Project" carried out by following the relevant guideline of methodology and duly taking into account local circumstance.
Any comment:	

Data / Parameter:	**N_Z**
Data unit:	Buses
Description:	Total number of buses in Lanzhou
Source of data used:	Lanzhou Public Traffic Group
Value applied:	2,135
Justification of the choice of data or description of measurement methods and procedures actually applied :	Statistic data based on operation provided by Lanzhou Public Traffic Group
Any comment:	This parameter is to be used for determining leakage emissions from change of load factors in buses.

Data / Parameter:	**N_T**
Data unit:	Taxis
Description:	Total number of taxis in Lanzhou
Source of data used:	Lanzhou Traffic Bureau
Value applied:	6,738
Justification of the	

choice of data or description of measurement methods and procedures actually applied :	Statistic data based on vehicle registration, provided by local government authority.
Any comment:	This parameter is to be used for determining leakage emissions from change of load factors in taxis.

Data / Parameter:	**N_C**
Data unit:	Passenger cars
Description:	Total number of passenger cars in baseline
Source of data used:	Traffic Division of Lanzhou Public Security Bureau
Value applied:	142,341
Justification of the choice of data or description of measurement methods and procedures actually applied :	Statistic data based on vehicle registration, provided by local government authority.
Any comment:	This parameter is to be used for determining the parameter of "TR_C" for calculating leakage emissions from additional/longer trips.

Data / Parameter:	**VD_T**
Data unit:	Kilometers
Description:	Annual distance driven per taxi on average before start of project
Source of data used:	Lanzhou Traffic Bureau
Value applied:	110,000
Justification of the choice of data or description of measurement methods and procedures actually applied :	Statistic data based on operation, provided by local government authority.
Any comment:	This parameter is to be used for determining leakage emissions from change of load factors in taxis.

Data / Parameter:	**VD_Z**
Data unit:	kilometer
Description:	Annual distance driven per bus before start of project
Source of data used:	Lanzhou Public Traffic Group
Value applied:	66,985
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated using the following parameters: • Total distance driven by all buses in the baseline = 143,013,462 (km) • Total number of buses in Lanzhou = 2,135 (buses)

Any comment:	This parameter is to be used for determining leakage emissions from change of load factors in buses.

Data / Parameter:	$ROC_{Z,0}$
Data unit:	%
Description:	Average occupancy rate relative to capacity of buses before start of project
Source of data used:	Baseline Traffic Survey for CDM Development of Lanzhou BRT Project
Value applied:	34.69%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on results of "Baseline Traffic Survey for CDM Development of Lanzhou BRT Project" carried out by following the relevant guideline of methodology and duly taking into account local circumstance.
Any comment:	This parameter is to be used for determining leakage emissions from change of load factors in buses.

Data / Parameter:	TR_C
Data unit:	trips
Description:	Number of daily trips realized by passenger cars in baseline
Source of data used:	Baseline Traffic Survey for CDM Development of Lanzhou BRT Project; Traffic Division of Lanzhou Public Security Bureau
Value applied:	382,897
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated using the following parameters: • Average number of daily trips per passenger car in baseline = 2.69 • Total number of passenger cars in Lanzhou = 142,341
Any comment:	This parameter is to be used for determining leakage emissions from additional/longer trips ("rebound effect").

Data / Parameter:	SRS
Data unit:	%
Description:	Share of road space used by public transport in the baseline
Source of data used:	Lanzhou Public Traffic Group; Lanzhou Traffic Bureau; Traffic Division of Lanzhou Public Security Bureau; Baseline Traffic Survey for CDM Development of Lanzhou BRT Project;
Value applied:	6.15%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated based on distances driven by buses, taxis and passenger cars as defined by equation 17 of AM0031 (version 03.1.0).
Any comment:	This parameter is to be used for determining leakage emissions from additional/longer trips ("rebound effect").

Data / Parameter:	**RSB / RSP**
Data unit:	km
Description:	Total road space available in the baseline / Total available road space in the project (= RSB minus road space dedicated to BRT lanes)
Source of data used:	Lanzhou Municipal Engineering Administration Department; Lanzhou BRT Project Feasibility Study Report
Value applied:	RSB = 446.62 km RSP = RSB – Road space dedicated to BRT lanes = 446.62 – 12.3 = 434.32km
Justification of the choice of data or description of measurement methods and procedures actually applied :	Statistic data provided by local government authority and design data by Feasibility Study Report.
Any comment:	This parameter is to be used for determining leakage emissions from additional/longer trips (“rebound effect”).

Data / Parameter:	**$BSCR_w$**
Data unit:	buses
Description:	Bus units scrapped by project in year w, where w = 1 to y (NB: if buses are not scrapped, the estimated amount of retired buses is taken)
Source of data used:	Lanzhou Public Traffic Group
Value applied:	Table 8: Estimated amount of retired buses per year (see below)
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the methodology definition, the estimated amount of retired buses shall be taken in the event that no buses will be scrapped by the project.
Any comment:	This parameter is to be used for determining leakage emissions from additional/longer trips (“rebound effect”).

Table 8: Estimated amount of retired buses per year

	2 12	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
BSCR	257	97	258	275	115	263	237
$BSCR_w$	257	354	612	887	1 02	1265	1502

Data / Parameter:	**V_B / V_P**
Data unit:	km/h
Description:	Vehicle speed of passenger cars in baseline / project scenario
Source of data used:	Baseline Traffic Survey for CDM Development of Lanzhou BRT Project
Value applied:	V_B = 39.45; V_P = N/A (no data is available as BRT is yet to be operational)
Justification of the	

choice of data or description of measurement methods and procedures actually applied :	The parameter of V_B was obtained through "Baseline Traffic Survey for CDM Development of Lanzhou BRT Project" carried out by following sector practice of transport and duly taking into account local circumstance. For the parameter of V_P, there is no data available because the BRT is yet to be up and operational, making practically impossible the comparison of vehicles speeds between pre and post project scenarios.
Any comment:	This parameter is to be used for determining leakage emissions from speed change of passenger cars. However, according to the methodology, as no data on V_P is available, it is therefore assumed that the speed impact is equal to "0". The impact of speed change of passenger cars is part of the total impact of congestion which is only calculated *ex ante* and not monitored.

The following default factors defined by the methodology are not tabulated in this section:

- Technology improvement factor for various categories of baseline vehicles. Refer to Appendix A "Parameters Used in Baseline Methodology" of AM0031 (Version 03.1.0) for details.

B.6.3. Ex-ante calculation of emission reductions:

This section summarizes the ex-ante estimation of the baseline, project and leakage emissions of the project. For the purpose of being succinct, only the results of calculation are tabulated as follows. Details in relation to the formulae and parameters involved in each and every step of the calculation are presented in Annex 3 of this PDD for reference.

BASELINE EMISSIONS

The baseline emissions are the summation of emissions from different categories of baseline vehicles that are determined by multiplying the ex-ante calculated emission factor per passenger per vehicle category with the number of BRT passengers who, in the absence of BRT system, would have taken that specific vehicle category.

The total passengers of BRT system and their modal split used in this calculation are based on projection and therefore subject to considerable variation from what would be observed through regularly monitoring the operation of the BRT over the crediting period.

Table 9: Estimated Baseline Emissions (tCO_2e)

Parameter	2012	2013	2014	2015	2016	2017	2018
BE_y of buses	14,633	15,318	15,987	16,642	17,282	17,908	18,520
BE_y of taxis	5,656	5,920	6,179	6,432	6,680	6,922	7,158
BE_y of passenger cars	8,661	9,066	9,462	9,850	10,229	10,599	10,961
BE_y of motorcycles	163	172	180	189	198	206	215
BE_y	29,112	30,476	31,810	33,114	34,389	35,635	36,854

PROJECT EMISSIONS

The project emissions are from the fuel consumption by trips realized by bus fleets of the new BRT system. The approach of fuel consumption data, namely Alternative A as defined by the methodology, is used in this project. The calculation presented here is based on projection of total fuel consumption by BRT buses which are subject to consideration variation from actual operation to be monitored.

Table 10: Estimated Project Emissions (tCO_2e)

Parameter	2012	2013	2014	2015	2016	2017	2018
PE_y	17,723	18,609	19,539	20,516	21,542	22,619	23,750

LEAKAGE EMISSIONS

The leakage emissions are composed of the following components:

(1) Change of load factors of the baseline transport system due to the project, i.e., the project would potentially influence the occupancy rate of the remaining vehicles (conventional buses and taxis). This component is to be monitored regularly over the crediting period.

(2) Reduced congestion in remaining roads, provoking higher average vehicle speed, plus a rebound effect. The total impact of congestion is calculated ex ante and not required to be monitored, as specified by the methodology.

(3) Upstream emissions of gaseous fuels in case that more gaseous fuels are used in the project than in the baseline scenario. Consumption of gaseous fuels is to be monitored over crediting period.

Table 11: Estimated Leakage Emissions (tCO_2e)

Parameters	2012	2013	2014	2015	2016	2017	2018
Load factor leakage of buses	0	0	0	0	0	0	0
Load factor leakage of taxis	0	0	0	0	0	0	0
Rebound effect leakage	-531	-457	-261	-52	35	236	416
Speed leakage	0	0	0	0	0	0	0
Upstream emissions of gaseous fuels	0	0	0	0	0	0	0
LE_y	**0**	**0**	**0**	**0**	**35**	**236**	**416**

According to the methodology, for the sake of a conservative approach, leakage shall only be considered if the total annual effect is to reduce estimated emission reductions, i.e. the leakage is positive. In light of this principle, the annual leakage emissions over period of 2012 to 2015 are set as "0" to ensure conservativeness.

B.6.4 Summary of the ex-ante estimation of emission reductions:

The estimated emission reductions of the proposed project in the first 7-year crediting period are tabulated as follows.

Table 12: Estimated emission reductions over the first 7-year crediting period

Crediting period Year	Estimation of baseline emissions (tCO_2e)	Estimation of project activity emissions (tCO_2e)	Estimation of leakage emissions (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
2012	29,112	17,723	0	11,389
2013	30,476	18,609	0	11,867
2014	31,810	19,539	0	12,270
2015	33,114	20,516	0	12,597
2016	34,389	21,542	35	12,811
2017	35,635	22,619	236	12,780
2018	36,854	23,750	416	12,687
Total (tCO_2e)	**231,389**	**144,300**	**687**	**86,402**

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**P_y**
Data unit:	Passengers
Description:	Total passengers transported by the project in year "y"
Source of data to be used:	BRT operation statistics from Lanzhou Public Traffic Group
Value of data applied for the purpose of calculating expected emission reductions in section B.5	According to the Lanzhou BRT Project Feasibility Study Report, annual total passegners of Lanzhou BRT are projected to be as follows: Table 13: Projected total passengers transported by the project Year: Total passengers 2012: 65,517,500 2013: 69,277,000 2014: 73,036,500 2015: 76,796,000 2015: 80,555,500 2017: 84,315,000 2018: 88,074,500
Description of measurement methods and procedures to be applied:	This parameter is to be monitored by referring to the entry statistics of transit management unit showing the number of total passengers transported by the BRT system.
QA/QC procedures to be applied:	The statistics of passengers shall be cross-checked with records of ticket sales.
Any comment:	Data presented here is based on ex-ante estimation and thus subject to variation

	during the crediting period.

Data / Parameter:	**$S_{i,y}$**
Data unit:	%
Description:	Share of passengers who in the absence of the project would have taken transport mode "i" in year "y"
Source of data to be used:	On-site questionnaire-based survey to be undertaken by independent organization with recognized qualifications
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Based on the results of "Baseline Traffic Survey for CDM Development of Lanzhou BRT Project", the share of passengers is estimated, on ex-ante basis, to be as follows: • Buses: 78.91% • Passenger cars: 12.19% • Taxis: 7.67% • Motorcycles: 1.22% • Non-Motorized Transport / Rail-Based Urban Mass Transit / Induced Traffic: 0%
Description of measurement methods and procedures to be applied:	The on-site questionnaire-based survey shall be undertaken, at the minimum frequency of once every 2 months, by independent organization with recognized qualifications by following implementation plan established on the basis of the general principles and specific guidelines given by AM0031. Details of survey implementation plan are presented in Annex 4 of this PDD, for reference.
QA/QC procedures to be applied:	Details of QA/QC procedures are included in the survey implementation plan presented in Annex 4 of this PDD, for reference.
Any comment:	Data presented here is based on ex-ante estimation and thus subject to variation during the crediting period.

Data / Parameter:	**$TC_{PJ,C,y}$**
Data unit:	m^3
Description:	Total fuel (CNG) consumption by the project in year "y"
Source of data to be used:	BRT operation statistics from Lanzhou Public Traffic Group
Value of data applied for the purpose of calculating expected emission reductions in section B.5	According to the Lanzhou BRT Project Feasibility Study Report, total CNG consumption of Lanzhou BRT in year "y" is projected to be as follows: Table 14: Projected total CNG consumption by the project (see table below)

Table 14: Projected total CNG consumption by the project

Year	CNG consumption (m^3)
2012	6,852,656
2013	7,195,289
2014	7,555,053
2015	7,932,806
2015	8,329,446
2017	8,745,919

	2018	9,183,214
Description of measurement methods and procedures to be applied:	This parameter is to be monitored on monthly basis by referring to gas filling records of BRT buses.
QA/QC procedures to be applied:	The parameters of specific energy consumption of CNG (SEC) and total distance driven by BRT buses (DD) are to be cross-checked against the total fuel consumption (TC) for the purpose of QA/QC. SEC is to be determined on the basis of records of fuel consumption data of BRT operator. Variations of monitored SEC values are likely to be observed during crediting period due to different bus models used, changes of routes and frequency, load factor variation, change of driver and so on. In the event of significant variations, cross-checking data against invoices issued by fuel suppliers will be necessary. According to AM0031, the data uncertainty level of SEC is defined as being low. DD is to be monitored on the basis of GPS records and thus with low level of data uncertainty as defined by AM0031.
Any comment:	Data presented here is based on ex-ante estimation and thus subject to variation during the crediting period.

Data / Parameter:	**$N_{T,y}$ / $N_{Z,y}$**
Data unit:	Taxis / Buses
Description:	Number of taxis and conventional buses still operating in year "y"
Source of data to be used:	Lanzhou Traffic Bureau; Lanzhou Public Traffic Group
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Taxis = 6,738 Buses = 2,135
Description of measurement methods and procedures to be applied:	The parameters shall be monitored by referring to vehicle registration statistics of local government authority (Lanzhou Traffic Bureau) and the service provider of public transport in Lanzhou (Lanzhou Public Traffic Group). The monitoring shall be realized in year 3 and 7 of the first 7-year crediting period, as recommended by AM0031.
QA/QC procedures to be applied:	Same source of data shall be referred to, so as to ensure data consistency and comparability.
Any comment:	The two parameters are to be used for determining leakage emissions from change of load factors in taxis and buses. The monitoring of the two parameters is only necessary when the average occupancy rate relative to capacity of buses ($ROC_{Z,y}$) and the average occupancy

	rate of taxis ($OC_{T,y}$) are reduced by more than 0.1 as compared to those prior to the start of the project.

Data / Parameter:	**$OC_{T,y}$**
Data unit:	Passengers
Description:	Average occupancy rate of taxis in year "y"
Source of data:	On-site traffic survey to be undertaken by independent organization with recognized qualifications
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.08 (based on data analysis of "Baseline Traffic Survey for CDM Development of Lanzhou BRT Project") No significant variation of this parameter is envisaged.
Measurement procedures (if any):	The monitoring, based on random sampling, shall be realized in year 3 and 7 of the first 7-year crediting period, as recommended by AM0031.
QA/QC procedures:	Data consistency shall be ensured by applying the same survey methodology as under baseline scenario to survey the occupancy rates under project scenario (Refer to Annex 4 of this PDD for details of the survey methodology).
Any comment:	This parameter is to be used for determining leakage emissions from change of load factors in taxis. Only if the monitored load factor is reduced by more than 0.1 as compared to that prior to the start of the project, the leakage emissions from change of load factor in taxis need to be taken into account.

Data / Parameter:	**$ROC_{Z,y}$**
Data unit:	%
Description:	Average occupancy rate relative to capacity of buses in year "y"
Source of data:	On-site traffic survey to be undertaken by independent organization with recognized qualifications
Value of data applied for the purpose of calculating expected emission reductions in section B.5	34.69% (based on data analysis of "Baseline Traffic Survey for CDM Development of Lanzhou BRT Project") No significant variation of this parameter is envisaged.
Measurement procedures (if any):	The monitoring, based on random sampling, shall be realized in year 3 and 7 of the first 7-year crediting period, as recommended by AM0031.
QA/QC procedures:	Data consistency shall be ensured by applying the same survey methodology as under baseline scenario to survey the occupancy rates under project scenario (Refer to Annex 4 of this PDD for details of the survey methodology).
Any comment:	This parameter is to be used for determining leakage emissions from change of load factors in buses. Only if the monitored load factor is reduced by more than 0.1 as compared to that prior to the start of the project, the leakage emissions from change of load factor in buses need to be taken into account.

Data / Parameter:	**X_C**
Data unit:	None
Description:	Fuel type used from BRT passengers who in the absence of the BRT would have used passenger cars

Source of data:	On-site questionnaire-based survey to be undertaken by independent organization with recognized qualifications
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100% gasoline
Measurement procedures (if any):	The on-site questionnaire-based survey shall be undertaken, at the minimum frequency of once every 2 months, by independent organization with recognized qualifications by following implementation plan established on the basis of the general principles and specific guidelines given by AM0031. Details of survey implementation plan are presented in Annex 4 of this PDD, for reference.
QA/QC procedures:	Details of QA/QC procedures are included in the survey implementation plan presented in Annex 4 of this PDD, for reference.
Any comment:	This parameter is to be used for adjusting baseline emission factor for passenger cars. Only if the new emission factor per distance is lower than the original one ($EF_{KM,C,y} < EF_{KM,C}$), the adjustment of baseline emission factor for passenger cars needs to be taken into account.

Data / Parameter:	**$TD_{C/T/M,y}$**
Data unit:	Kilometres
Description:	Average trip distance of BRT passengers who in the absence of the BRT would have used passenger cars, taxis or motorcycles
Source of data to be used:	On-site questionnaire-based survey to be undertaken by independent organization with recognized qualifications
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Based on the results of "Baseline Traffic Survey for CDM Development of Lanzhou BRT Project", the three parameters are determined ex-ante as follows: Passenger cars = 10.3 Taxis = 6.79 Motorcycles = 5.99
Description of measurement methods and procedures to be applied:	The on-site questionnaire-based survey shall be undertaken, at the minimum frequency of once every 2 months, by independent organization with recognized qualifications by following implementation plan established on the basis of the general principles and specific guidelines given by AM0031. Details of survey implementation plan are presented in Annex 4 of this PDD, for reference.
QA/QC procedures to be applied:	Details of QA/QC procedures are included in the survey implementation plan presented in Annex 4 of this PDD, for reference.
Any comment:	This parameter is to be used for adjusting baseline emission factor for passenger cars, taxis and motorcycles. Only if the monitored average trip distance is lower

	than the original one ($TD_{i,y} < TD_i$), the adjustment of baseline emission factors need to be taken into account.

Data / Parameter:	**Policies**
Data unit:	None
Description:	Policies that may affect baseline parameters
Source of data to be used:	Local government authority such as Lanzhou Traffic Bureau
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A
Description of measurement methods and procedures to be applied:	Annually the project proponent shall identify and assess transport and fuel related policies that may affect the baseline parameters. The assessment shall cover: (1) New and enforced policies that could significantly affect the modal split of passengers in the project area (5% or more towards public transport). (2) New and enforced policies that change the fuel usage of vehicles. (3) Any other policies which could, in a measurable and verifiable manner, result in a change of a parameter related to baseline emissions.
QA/QC procedures to be applied:	
Any comment:	

All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period.

B.7.2. Description of the monitoring plan:

BRT systems have as core environmental aspect that the resource efficiency of transporting passengers in the urban transport system of a city shall be improved. As compared with the scenario without project, the fuel consumption and emissions per passenger trip shall be reduced.

The monitoring plan is established by specifying the necessary methods and procedures to measure and record all the parameter concerned as required by AM0031 as described in detail in above section B.7.1. Depending upon project-specific circumstance and characteristics on the site, the detailed monitoring methods and procedures of specific parameters may be adjusted based on the original general guidance in AM031, without compromising the data quality.

Principle of Monitoring

For **Baseline Parameters**, baseline emission factors per passenger transported for all modes of transport are determined *ex ante*. These factors are not constant and shall be subject to adjustments *ex post*. For passengers taking the BRT, who in absence would have used taxis, passenger cars or motorcycles, the change in distance travelled and in the fuel-mix is monitored based on a questionnaire survey. To ensure a

conservative approach, the baseline emission factors are only adjusted if the monitoring results show that the new factors would be lower than the ones originally determined.

The total baseline emissions are derived by applying the activity level (passengers per mode transported) of the BRT system to the baseline emission factors. Data sources are either from recent statistics or measurements or are based on fixed default values taken from the international literature, primarily IPCC. Local data is preferred. Default values are last options in case of non-availability of more precise data. Use of default values results in less baseline emissions and therefore is conservative.

All data used to calculate the baseline emission factors are determined *ex ante*. For calculating the total baseline emissions the number of passengers using the BRT and the traffic mode they would have used in the absence of the BRT needs to be monitored (conventional public transport, taxis, passenger cars, motorcycles, non-motorized transport or induced traffic). Baseline emissions can thus only be calculated *ex post* during the crediting period.

For **Project Parameters**, the monitoring of the project activity is based on measuring the total fuel consumption and thus emissions of the BRT system. From a methodological perspective, data is derived from actual measurements based on actual operations. Default values for fuel consumption cannot be used for project emissions. Furthermore, in view of the fact that statistics on fuel consumption and relevant QA/QC procedures have long been part of routine works with established procedures in daily operation of Lanzhou Public Traffic Group, relevant experience and practice can be transferred to the monitoring of BRT system operation, ensuring high quality and reliability of measured data.

For **Leakage Parameters**, the monitoring of leakage emissions depends basically on elements calculated *ex ante* based on pre-established factors and to a minor degree on *ex post* measurements during project operation. In particular, congestion leakage is calculated *ex ante* for the project period and not monitored. Overall, data necessary for determining leakage emissions is obtained primarily from planning sources and fixed parameters derived from the international literature, and secondarily from periodic surveys to be carried out on site.

All parameters in relation to baseline, project and leakage emissions that are necessary for *ex-post* monitoring during crediting period are tabulated as follows, with project-specific circumstance and characteristics being duly taken account of. For parameters of $S_{PJ,i,y}$, $OC_{T,y}$ and ROC_Z, their specific monitoring methods are provided in the Annex 4 of this PDD. Monitoring methods and procedures of other parameters are detailed in above Section B.7.1.

Table 15: Main Parameters for Monitoring over Crediting Period

Parameter	Definition
P_y	Total passengers transported by the project in year "y"
$S_{i,y}$	Share of passengers who in the absence of the project would have taken transport mode "i" in year "y"
$TC_{PJ,C,y}$	Total fuel (CNG) consumption by the project in year "y"
$N_{T,y}/N_{Z,y}$	Number of taxis and conventional buses still operating in year "y"
$OC_{T,y}$	Average occupancy rate of taxis in year "y"
$ROC_{Z,y}$	Average occupancy rate relative to capacity of buses in year "y"
$X_{C,y}$	Fuel type used from BRT passengers who in the absence of the BRT would have used passenger cars
$TD_{C/T/M,y}$	Average trip distance of BRT passengers who in the absence of the BRT

	would have used passenger cars, taxis or motorcycles
-	Policies that may affect baseline parameters

Implementation of Monitoring

A CDM unit will be set up and staffed by the project proponent, namely Lanzhou Public Traffic Group, to be responsible for all works in relation to monitoring activities, reporting, verification and issuance of CERs over the crediting period. Amongst other important works are data collection through various methods, QA and QC, preparation of reports, management of data and documentation. ADB will, through its Carbon Market Program, provide assistance to the project proponent in designing and implementing the monitoring plan and undergoing verification procedure in the first few years of the crediting period.

A monitoring implementation manual will be jointly developed by the project proponent and ADB for the purpose of ensuring that the actual monitoring activities are fully aligned with the required methods and procedures and the emission reductions achieved by the project activity are measurable, reportable and verifiable. The practice of transport sector as well as the project proponent (Lanzhou Public Traffic Group) will be duly taken into consideration in the development of the manual.

The manual will outline responsibilities and general procedures of the monitoring, with specific chapters focusing on relevant parameters to be monitored. Pre-designed templates of BRT passenger survey questionnaire and monitoring report are incorporated in the manual. For each specific parameter, detailed guidance is provided with regard to data and information collection approach, frequency, unit conversion (if applicable), QA/QC, corrective measures in case of data error or non-conformity, data processing, calculation of emissions (baseline, project, leakage) based on processed data, and other remarks.

Prior to the start of crediting period, a technical workshop will be organized whereby training will be offered to familiarize the staffs of the CDM unit of Lanzhou Public Traffic Group with the manual and the specific monitoring methods and procedures.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Date of completion of current version of baseline study and monitoring methodology: 21 July 2011

The name of the responsible person is:

Wayne Zhou
Technical Support Facility (TSF), Carbon Market Program (CMP)
Regional and Sustainable Development Department
Asian Development Bank
6 ADB Avenue, Mandaluyong City,
1550 Metro Manila, Philippines
Email: wzhou.consultant@adb.org

The above individual is not a project participant.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

30 March 2010

In the light of the CDM glossary, the starting date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins or has begun. As far as the proposed project is concerned, the date on which the People's Republic of China and Asian Development Bank (ADB) signed the Loan Agreement on Lanzhou Sustainable Urban Transport Project is taken as the starting date in CDM context, i.e. 30 March 2010.

C.1.2. Expected operational lifetime of the project activity:

25 years

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

1 January 2012 or the date of CDM registration whichever is later.

C.2.1.2. Length of the first crediting period:

7 years and 0 month

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The environmental impact assessment (EIA) report of the Lanzhou Sustainable Urban Transport Project was prepared by Gansu Environmental Science and Design Research Institute and received approval from Lanzhou Environmental Protection Bureau in February 2009 (Lan-Huan-Jian-Fa [2009] 09). The anticipated environmental impacts to be incurred by the proposed project and relevant mitigation measures to be adopted by the project owner are summarised as follows.

A. Air Quality

Construction Stage: Potential air quality impacts during the construction stage are due to asphalt plants, exhaust gases generated by construction machinery, and odour nuisances. Dust will be generated during demolition, loading and unloading operations, excavation, transportation, and piling of building materials. It may have cumulative impacts. Mitigation measures will be environmentally friendly construction practices and such best available pollution control technologies as the following: machinery and equipment will be fitted with pollution control devices; trucks carrying earth, sand, or stone will be covered with tarps to avoid spilling; road surfaces, excavation, and construction sites will be sprayed to keep them moist; demolition sites will be covered; transportation of dusty materials will be arranged in such way as to avoid busy, heavy traffic, and residential areas; for environmentally sensitive road sections, night-time transportation can be arranged; and timely removal of spilled earth.

Operation Stage: Projections of impacts from transport emissions (CO and NO_2) to air quality have been conducted, as stated in "Specifications of the EIA for Highways (JTGB005-96)". Emission source intensities were calculated for the project roads for 2013, 2015, 2020, and 2025 using with-project and without-project scenarios. Daily average emission source intensities were calculated, as well. It is projected that, in general, under unfavourable weather conditions concentrations of pollutants (NO_2, CO) will be higher in the "without-project" case than the "with-project" case. CO concentrations for all road sections outside the right-of-way do not exceed the standard.

Lanzhou City's human activities, including industrial activities, transport, and households are affecting the city's air quality. Therefore, the project's air quality mitigation measures will be carried out along with other sectors' air quality improvement measures by Lanzhou municipal government (LMG). Compared with the no-action scenario, the project road network will significantly reduce the traffic congestion in the district. Also, the BRT component will reduce the total transport demand and thereby its air pollutant emission.

B. Solid Waste

Construction Stage: The Project generates a large amount of spoil and construction waste due to utility facility construction, road construction, and demolition of houses. Three alternative dump sites have been assessed: borrow pits to the north of Binhe road, the railway marshalling yard, and Dasha Sloot urban disposal site. The borrow pits of the Huangjiatanxincun section of Binhe Road were not restored during its construction and affect the visual quality of the landscape. These can be used as a dump site for the Project's spoil provided that hydrologic investigations show no risk of groundwater contamination. The railway marshalling yard has a large capacity, presents no risk of groundwater pollution, and can be used as an alternative disposal site. Dasha Sloot urban disposal site will be used for dumping demolition waste.

Operation Stage: No significant impacts are anticipated. Maintenance of the urban road should be organized, including cleaning roads and drainage systems, collecting solid waste, etc.

C. Surface and Groundwater

Construction Stage: Impacts to the hydrologic environment are anticipated mainly as water quality degradation due to exposing large amounts of soil to erosion processes (especially in the June–September rainy season), potentially contaminating surface and groundwater with fuel and chemical spills, discharging wastewater from the equipment maintenance shops, and discharging sewage from

construction camps (predicted as 11.25 m^3/day from a camp). In addition, Dasha Sloot can affect the embankment of road construction, especially in case of mudflow. For roads located in a class II water source protection zone, no construction camps, construction equipment repair sites, mixing plants, or cleaning sites for equipment should be set near such area. To avoid contaminating water sources from accidental failure of sewage and storm-water pipeline networks, these pipelines must be designed to higher standards and ground sections under these pipeline networks must be insulated. During construction of utility facilities, accumulated runoff or groundwater will be pumped off the site and discharged into a permanent drainage system through silt traps. Utility facilities near the class II drinking water protection zone of Lanzhou city should be designed with insulation. A groundwater channel should be applied where the water table is expected to rise due to potential blocks in the groundwater flow. Mitigation measures in relation to Dasha Sloot (watercourse rechanneling) will include rock rip-rapping of the banks. Civil works contracts will contain provisions to avoid adverse impacts on water quality, including development and implementation of a spill management plan. Water will be regularly monitored during construction.

Operation Stage: No significant impacts to surface or groundwater are anticipated. During the operation stage, proposed upgrading and construction of new roads with improved drainage systems will reduce erosion from the roadway and result in minor water quality improvements.

D. Noise

Construction Stage: Significant noise impacts on the urban environment are anticipated from such heavy construction machinery as excavators, bulldozers, graders, and dump trucks in the construction stage. A number of sensitive receptors located at distances of 10–280 m from construction sites were identified. Mitigation measures include:

(i) Source controls. All exhaust systems will be maintained in good working order; properly designed engine enclosures and intake silencers will be employed; and regular equipment maintenance will be undertaken.
(ii) Site controls. Stationary equipment will be placed as far from noise-sensitive receptors as practical, selected to minimize objectionable noise impacts, and provided with shielding mechanisms where possible.
(iii) Time constraints. Construction activities should be prohibited from 11 pm to 6 am. Construction activities near schools and universities will be scheduled largely outside time of studies.
(iv) Community awareness. Public notification of construction operations will incorporate noise considerations; methods to handle complaints will be specified; and construction near sensitive receptors will be coordinated with administrations of these organizations.

Operation Stage: Noise level projections have been made in accordance with the model given in the Specifications for Environment Impact Assessment on Highways (JTJ 005–1996) for 2013 and 2020. Predictions were made for the project roads and sensitive points. For the sensitive spots on the upgraded roads, as compared with the existing monitoring values, the added value of noise projection is 0.01–2.79 dB in year 2013 and 0.01–4.33 dB in 2020. For the new roads, the added value is high, about 3.21–7.03 dB in 2013 and 3.66–8.42 dB in 2020.

The major mitigation measures proposed for the new roads include roadside noise barriers and soundproof windows. A roadside barrier with noise reduction effect of 6–10 dBA is proposed for the section near the Lanzhou Power School, where the night-time noise level exceeds 7.1 dBA. Asphalt pavement with noise reduction effect of 3–5 dBA is proposed for the road sections near the residential

areas where excess noise levels are less than 3 dBA. For areas where noise exceeds by more than 3 dBA, soundproof windows with noise reduction effect of 8–15 dBA are proposed. Two alternatives were considered for the roads to be reconstructed: (i) soundproof windows, and (ii) combination of soundproof windows (in sensitive locations) and low noise asphalt pavement for major roads. Although option (ii) is more costly, it has been proposed as more preferable as replacing a substantial amount of windows will create great inconveniences and affect people's lives. Among other mitigation measures proposed are prohibition of night-time truck and heavy vehicle traffic on the six streets where substantial noise levels are projected, planting a tree and shrub belt along the road, relocating existing sensitive receptors to less noisy environments, and avoiding planning of new sensitive receptors near major roads.

E. Urban Ecosystems and Landscapes

Construction Stage: Short-term impacts on urban ecosystem and landscapes are anticipated during the construction stage. Construction works will impact on aesthetics and the city's landscapes, specifically in the areas of houses demolition and earthworks. Large amounts of construction waste can impact the hygienic environment and landscapes. Construction dust can settle and contaminate such areas adjacent to construction as parks and gardens. Mitigation measures include restricting construction works to construction sites, halting earthworks during heavy precipitation, timely cleaning of construction sites, and replanting trees where possible.

Operation Stage: The Project will have an impact on urban ecology and landscapes. Whereas before the Project the urban ecosystems are mostly represented by agricultural and urban ecological communities, it is expected that after the construction equilibrium will be shifted toward urban communities. Farmland where vegetables, fruit trees, and orchids are grown will decrease. Poor biodiversity of the ecosystem will be reduced even further. Provided that comparatively small areas planted with widespread fruit trees and vegetables will be acquired, however, no significant impacts on the urban ecosystem are expected. In addition, planting trees along the roads, landscape afforestation, grassing and bedding will be undertaken to increase biodiversity, enhance urban landscaping and aesthetic value, and reduce noise and emission pollution. No rare or endangered flora or fauna occur in the project area, and no impacts to such species are anticipated.

F. Social Issues and Urban Infrastructure

Construction Stage: Urban traffic congestion can occur due to construction activities or increased construction machinery traffic on some roads during rush hours. The traffic on the two major east-west roads is busy in rush hours, and these roads can cause traffic jams. The construction can cause temporary interruptions or increased loads for such urban systems as water supply, natural gas pipelines, sewerage, energy, communication lines, and heating. The impacts on urban traffic will be temporarily and manageable, provided close cooperation with the relevant urban infrastructure departments will be established. Temporary electric and water supply schemes should be developed in coordination with the relevant authorities to supply construction works with electricity and water. The PMO will develop a traffic management plan to prevent congestion and traffic jams by consulting with the Traffic Control Department under the Public Security Bureau.

Operation Stage: In the operation stage, the Project is anticipated to have positive impacts on the social environment and urban infrastructure. Conflicts between NMT, motor vehicles, and pedestrians will be minimized; traffic bottlenecks will be relieved, and the number of road accidents will be reduced. Promoting BRT will improve the flow of people, shorten travel times, and improve travel efficiency. Adverse health impacts associated with road traffic will be reduced by minimizing vehicular emissions

and noise. The Project will have a beneficial impact on Lanzhou's investment competitiveness and attract more investors. Improving transportation systems in Anning District will positively influence the economic value of Anning property. Aesthetic value of the district will improve.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

As summarized in above section, the overall environmental impacts of the proposed project, during either construction stage or operation stage, are not considered significant. A comprehensive set of mitigation measures against the identified impacts across a range of environmental aspects has been well designed and will be implemented by the project proponent to minimize any adverse impacts to the extent possible.

The conclusions of the EIA are sound and credible, as justified by the approval from Lanzhou Environmental Protection Bureau in February 2009 (Lan-Huan-Jian-Fa [2009] 09).

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

CDM stakeholder consultation workshop was organized by the project proponent at the Project Management Office of Lanzhou Sustainable Urban Transport Project in Oct 2010 to gather public views and concerns towards the proposed project. In organizing the workshop, a notice was published on the local daily newspaper to invite interested individuals and parties to attend the workshop. During the workshop meeting, the project proponent introduced the proposed project activity, features of its plan and design, environmental impacts, CDM development progress and so on, and replied questions raised by the attendees concerning the impacts of the project on local environment and urban public transport. Prior to the conclusion of the workshop, the attendees were requested to fill in questionnaires. Furthermore, in order to collect more views and opinions widely, more questionnaires were distributed to more potentially affected people randomly selected from the project area.

E.2. Summary of the comments received:

A total of 68 questionnaires were distributed, completed and returned, with an effective response rate of 100%. Key findings of the survey are summarized in the following table.

Table 16: Summary of Survey Results

Questions	*Answers*	*Percentage*
1. What do you think of the overall environment and traffic conditions in Anning District?	Excellent	7.5%
	Mediocre	89.5%
	Poor	1.5%
	Extremely bad	1.5%
2. What are the major environmental pollution problems locally?	Air pollution	92.6%
	Water pollution	7.4%
	Solid waste pollution	2.9%
	Noise pollution	1.5%

3. Are you aware of the fact that the exhaust gas of vehicles is one of the major emission sources of greenhouse gases such as CO_2, CH_4, N_2O and other air pollutants?	Yes	94.1%
	No	5.9%
4. In your opinion, what are the major problems associated with the current urban road network in Lanzhou, in particular in Anning District?	Low level of land use by urban road network and underdevelopment of traffic infrastructure	100.0%
	No systematically-established and well-functioning road network. Local traffic congestions with high frequency of occurrence.	19.1%
	At-grade crossings of trunk roads with suboptimal configuration and dimensions limiting traffic capacity and worsening traffic congestions	10.3%
	Interference between cross-border traffic and in-city traffic having adverse impact on overall capacity of traffic	22.1%
	Limited connection between Anning District and other parts of Lanzhou to the south bank of Yellow River	27.9%
5. In your opinion, in what aspects the existing public transport service in Anning District shall be improved?	Outreach, coverage, density and routes of public transport network	95.6%
	Service hours, bus frequency, punctuality and waiting time at stations	4.4%
	Bus model, configuration, condition and comfort	16.2%
	Traffic conditions and vehicle speeds on trunk roads during peak hours	10.3%
6. What do you think would be the overall impact of the BRT operation on traffic conditions in Anning District and, in a larger context, Lanzhou City?	Improvement of traffic conditions of road network and public transport capacity, reduction of traffic congestions and enhancement of efficiency of passenger trips	92.6%
	Reduction of available road space for conventional vehicles due to BRT corridor, resulting in more traffic congestions and lower efficiency of transportation	19.1%
	No major impacts	0.0%
7. What do you think would be the overall impacts of the BRT operation on air pollution problems in Anning District and, in a larger context, Lanzhou City?	Less exhaust gas of vehicles and improved air quality	83.8%
	More exhaust gas of vehicles and downgraded air quality	16.2%
	No major impacts	0.0%
8. What do you think would be the overall impacts of the BRT construction and operation on	Positive	91.2%
	Negative	0.0%
	Not sure	4.4%

your daily life or business operation of your company/organization?		
9. Based on your understanding and opinion, do you agree on the significance and necessity of the proposed project and support its construction and operation?	Yes	91.2%
	No	0.0%
	Not sure	7.4%

As indicated by the survey results, over 92.5% respondents defined the local environmental quality and traffic conditions as being mediocre, poor or even extremely bad. Air pollution was identified as the key pollution problem at local level. Most respondents (over 94%) were aware of the fact that the exhaust gas of vehicles is one of the major emission sources of GHG such as CO_2, CH_4, N_2O and other air pollutants.

In terms of local road network, underdevelopment of traffic infrastructure was identified by all respondents to be the major problem to be addressed. Traffic capacity, connectivity of roads and traffic congestions were also identified, amongst others. As far as the existing public transport service in Anning District is concerned, most respondents (over 95%) were of the opinion that improvements should be made in terms of the outreach, coverage, density and routes of public transport network. Bus model, configuration, condition and comfort were also of concern.

As for the proposed BRT, over 92% respondents believed that the operation of the system will improve traffic conditions of road network and public transport capacity, reduce traffic congestions and enhance efficiency of passenger trips. Moreover, the BRT will have positive impacts on local air quality by leading to less exhaust gas of vehicles, as expected by 83.8% respondents.

In general, the vast majority of respondents believed the BRT will generate positive impacts to personal lives and business operations and hence were supportive of its development. No objection against the project was received.

E.3. Report on how due account was taken of any comments received:

Summing up the above, the local stakeholders have given strong positive comments on the impacts that the project activity will potentially make across a number of aspects associated with environmental pollution and urban public transport. Given so, there is no necessity to modify the original technical plan and environmental protection measures based on the comments received. The project proponent will comply with all relevant environmental laws, rules and regulations and strictly implement all measures required by the EIA so as to achieve the envisioned environmental, social and economic benefits of the projects as envisioned. In addition, the project proponent will maintain regular communications with the stakeholders during the construction and operating periods and duly take into consideration any comments and suggestions received.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The proposed project activity does not involve any official development assistance (ODA) from Annex I countries.

Annex 3

BASELINE INFORMATION

A.1. BASELINE EMISSIONS

A.1.1. Formulae

$$EF_{KM,i} = \sum_x \left[SEC_{x,i} \times \left(EF_{CO2,x} + EF_{CH4,x} + EF_{N2O,x} \right) \times \left(\frac{N_{x,i}}{N_i} \right) \right]$$

Where:

$EF_{KM,i}$ = Transport emissions factor per distance of vehicle category *i* (gCO_2e/km)
$SEC_{x,i}$ = Specific energy consumption of fuel type *x* in vehicle category *i* (litre/km or m^3/ km)
$EF_{CO2,x}$ = CO_2 emission factor for fuel type *x* (gCO_2 / litre or m^3)
$EF_{CH4,x}$ = CH_4 emission factor for fuel type *x* (gCO_2e / litre or m^3, based on GWP)
$EF_{N2O,x}$ = N_2O emission factor for fuel type *x* (gCO_2e / litre or m^3, based on GWP)
N_i = Total number of vehicles in category *i*
$N_{x,i}$ = Number of vehicles in vehicle category *i* using fuel type *x*

$$EF_{P,i} = \frac{EF_{KM,i} \times TD_i}{OC_i}$$

Where:

$EF_{P,i}$ = Transport emission factor per passenger before project start, where i= C (passenger cars), M (motorcycles) or T (taxis) (gCO_2e/passenger)
$EF_{KM,i}$ = Transport emission factor per distance of category *i* (gCO_2e/km)
TD_i = Average trip distance for vehicle category *i* (km)
OC_i = Average vehicle occupancy rate of vehicle category *i*[60] (passengers)

[60] In the case of taxis the taxi driver is not counted and only passengers are included in the occupancy rate.

$$EF_{P,Z} = \frac{EF_{KM,Z} \times DD_Z}{P_Z}$$

Where:

$EF_{P,Z}$ = Transport emission factor per passenger transported by buses before project start (gCO_2e/passenger)
$EF_{KM,Z}$ = Transport emissions factor per distance of buses (gCO_2e/km)
DD_Z = Total distance driven by buses (km)
P_Z = Passengers transported by buses in the baseline (passengers)[61]

$$BE_y = \sum_i \left(EF_{P,i,y} \times P_{i.y}\right)$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2e)
$EF_{P,i,y}$ = Transport emissions factor per passenger in vehicle category *i* in year *y* (tCO_2e/passenger)
$P_{i,y}$ = Passengers transported by the project (BRT) in year *y* that without the project activity would have used category *i*, where *i* = Z (buses, public transport), T (taxis), C (passenger cars), R (rail-based urban mass transit) or M (motorcycles)[62] (passengers)

$$EF_{P,i,y} = EF_{P,i} \times IR_{i,t} \times CD_{i,y}$$

Where:

$EF_{P,i,y}$ = Transport emissions factor per passenger in vehicle category *i* in year *y* (tCO_2e/passenger)
$EF_{P,i}$ = Transport emissions factor per passenger before project start (tCO_2e/passenger)
$CD_{i,y}$ = Correction factor for changing trip distance in category *i* for the year *y*, where *i* = T (taxis), C (passenger cars) or M (motorcycles)
$IR_{i,t}$ = Technology improvement factor at year *t* for vehicle category *i*
t = Age in years of fuel consumption data used for calculating the emission factor in year *y*

$$P_{i,y} = P_y \times S_{i,y}$$

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[61] For passengers taking various buses to complete one trip, they are counted as one passenger.

[62] NMT and IT are not included as emissions are 0 for this category in the baseline

Where:

$P_{i,,y}$ = Passengers transported by the project which in absence of latter would have used transport type *i*, where *i*= Z (buses, public transport), T (taxis), C (passenger cars), M (motorcycles), NMT (non-motorized transport), R (rail-based urban mass transit) and IT (induced transport, i.e. would not have travelled in absence of project) (passengers).

P_y = Total passengers transported by the project monitored in year *y* (passengers)

$S_{i,,y}$ = Share of passengers transported by the project which in absence of latter would have used transport type *i*, where *i*= Z (buses, public transport), T (taxis), C (passenger cars), M (motorcycles), NMT (non-motorized transport), R (rail-based urban mass transit) and IT (induced transport, i.e. would not have travelled in absence of project) (%).

A.1.2. Parameters

Table A1. Parameters for determining baseline

Parameter	Definition	Value	Unit	Source/Note
$SEC_{G,C}$	Specific energy consumption of gasoline by passenger cars	7.84	l/100km	Baseline Traffic Survey
$SEC_{CNG,T}$	Specific energy consumption of CNG by taxis	8.0	m^3/100km	Lanzhou Traffic Bureau
$SEC_{G,M}$	Specific energy consumption of gasoline by motorcycles	2.2	l/100km	Baseline Traffic Survey
$SEC_{CNG,Z}$	Specific energy consumption of CNG by buses	31.41	m^3/100km	Lanzhou Public Traffic Group
NCV_{CNG}	Net calorific value of CNG	35.13	MJ/m^3	Lanzhou Public Traffic Group
$EF_{CO2,CNG}$	CO_2 emission factor of CNG	1970.8	gCO_2/m^3	Calculated based on NCV (35.13MJ/m^3) and CO_2 emission factor (56.1gCO_2/MJ, IPCC 2006, Volume 2, Chapter 1, Table 1.4)
$EF_{CH4,CNG,Z}$	CH_4 emission factor of CNG for buses	515.8	gCO_2/m^3	Calculated based on $SEC_{CNG,C}$ (31.41 m3/100km), CH_4 emission factor of CNG buses (7.715g/km, IPCC 2006, Volume 2, Chapter 3, Table 3.2.4) and GWP of CH4 (21)
$EF_{N2O,CNG,Z}$	N_2O emission factor of CNG for buses	99.7	gCO_2/m^3	Calculated based on $SEC_{CNG,C}$ (31.41 m3/100km), N_2O emission factor (0.101g/km, IPCC 2006, Volume 2, Chapter 3, Table 3.2.4) and GWP of N_2O (310)
$EF_{CH4,CNG,T}$	CH_4 emission factor of CNG for taxis	123.4	gCO_2/m^3	Calculated based on $SEC_{CNG,T}$ (8.0 m3/100km), CH_4 emission factor of CNG taxis (average of lower and

				upper limits of 0.215g/km and 0.725g/km, IPCC 2006, Volume 2, Chapter 3, Table 3.2.4) and GWP of CH4 (21)
$EF_{N2O,CNG,T}$	N_2O emission factor of CNG for taxis	187.9	gCO_2/m^3	Calculated based on $SEC_{CNG,T}$ (8.0 m3/100km), N_2O emission factor of CNG taxis (average of lower and upper limits of 0.027g/km and 0.070g/km, IPCC 2006, Volume 2, Chapter 3, Table 3.2.4) and GWP of N_2O (310)
$EF_{CO2,G,C/M}$	CO2 emission factors of gasoline for passenger cars and motorcycles	2313	gCO_2/litre	Appendix A of AM0031
$EF_{CH4,G,C}$	CH4 emission factor of gasoline for passenger cars	11	gCO_2/litre	Appendix A of AM0031
$EF_{N2O,G,C}$	N2O emission factor of gasoline for passenger cars	14	gCO_2/litre	Appendix A of AM0031
$EF_{CH4,G,M}$	CH4 emission factor of gasoline for motorcycles	29	gCO_2/litre	Appendix A of AM0031
$EF_{N2O,G,M}$	N2O emission factor of gasoline for motorcycles	7	gCO_2/litre	Appendix A of AM0031
$IR_{Z,T,C}$	Technology improvement factor of buses, taxis, cars	0.99	--	Appendix A of AM0031
IR_M	Technology improvement factor of motorcycles	0.997	--	Appendix A of AM0031
OC_C	Average occupancy rate of passenger cars	1.71	passengers	Baseline Traffic Survey
OC_T	Average occupancy rate of taxis	1.08	passengers	Baseline Traffic Survey
OC_M	Average occupancy rate of motorcycles	1.51	passengers	Baseline Traffic Survey
TD_C	Average trip distance of passenger cars in baseline	10.3	km	Baseline Traffic Survey
TD_T	Average trip distance of taxis in baseline	6.79	km	Baseline Traffic Survey
TD_M	Average trip distance of motorcycles in baseline	5.99	km	Baseline Traffic Survey
P_Z	Passenger-trips realized with buses in the baseline	402,319,193	passenger trips	Calculated based on total registered passengers transported by buses in baseline (615,548,365 passengers in 2010, Lanzhou Public Traffic Group) and average usage of buses per trip realized by bus passenger in baseline (1.53 buses per trip, Baseline Traffic Survey)
DD_Z	Total distance driven by all buses in the baseline	143,013,462	km	Lanzhou Public Traffic Group
S_i	Share of passengers using mode *i* for the	Table A2	%	Baseline Traffic Survey

	baseline trip			
P_y	Total passengers transported by the project (BRT)	Table A4	passengers	Project Feasibility Study Report

Table A2. Share of passengers using mode *i* for the baseline trip

Mode	Share
Passenger car	12.19%
Taxi	7.67%
Motorcycle	1.22%
Bus	78.91%
NMT and Induced Traffic	0%

Table A3. Transport emissions factor per passenger of vehicle category *i* before start of project (gCO_2/passenger)

Mode	2012	2013	2014	2015	2016	2017	2018
Bus	283	280	277	275	272	269	266
Passenger car	1084	1073	1063	1052	1041	1031	1021
Taxi	1125	1114	1103	1091	1081	1070	1059
Motorcycle	204	203	202	202	201	201	200

A.1.3. Results

Table A4. Baseline Emissions

Parameter	unit	2012	2013	2014	2015	2016	2017	2018
Passengers transported by BRT	passengers	65,517,500	69,277,000	73,036,500	76,796,000	80,555,500	84,315,000	88,074,500
Baseline emissions from buses	tCO_2	14,633	15,318	15,987	16,642	17,282	17,908	18,520
Baseline emissions from taxis	tCO_2	5,656	5,920	6,179	6,432	6,680	6,922	7,158
Baseline emissions from passenger cars	tCO_2	8,661	9,066	9,462	9,850	10,229	10,599	10,961
Baseline emissions from motorcycles	tCO_2	163	172	180	189	198	206	215
Total baseline emissions	**tCO_2**	29,112	30,476	31,810	33,114	34,389	35,635	36,854

A.2. PROJECT EMISSIONS

A.2.1. Formulae

$$PE_y = \sum_x \left[TC_{PJ,x,y} \times (EF_{CO2,x} + EF_{CH4,x} + EF_{N2O,x}) \right]$$

Where:

PE_y = Project emissions in year *y* (tCO_2e)
$TC_{PJ,x,y}$ = Total consumption of fuel type *x* in year *y* by the project (litre or m^3)
$EF_{CO2,x}$ = CO_2 emission factor for fuel type *x* (gCO_2 per litre or m^3)
$EF_{CH4,x}$ = CH_4 emission factor for fuel type *x* (gCO_2e per litre or m^3)
$EF_{N2O,x}$ = N_2O emission factor for fuel type *x* (gCO_2e per litre or m^3)

A.2.2. Parameters

Table A5. Project Parameters

Parameter	Definition	Value	Unit	Source
$TC_{PJ,x,y}$	Total consumption of CNG by project in year "y"	Table A6	m^3	Project Feasibility Study Report
NCV_{CNG}	Net calorific value of CNG	35.13	MJ/m^3	Lanzhou Public Traffic Group
$EF_{CO2,CNG}$	CO_2 emission factor of CNG	1970.8	gCO_2/m^3	Calculated based on NCV ($35.13MJ/m^3$) and CO_2 emission factor ($56.1gCO_2/MJ$, IPCC 2006, Volume 2, Chapter 1, Table 1.4)
$EF_{CH4,CNG,Z}$	CH_4 emission factor of CNG for buses	511.4	gCO_2/m^3	Calculated based on $SEC_{CNG,C}$ (31.68 m3/100km), CH_4 emission factor of CNG buses (7.715g/km, IPCC 2006, Volume 2, Chapter 3, Table 3.2.4) and GWP of CH4 (21)
$EF_{N2O,CNG,Z}$	N_2O emission factor of CNG for buses	98.8	gCO_2/m^3	Calculated based on $SEC_{CNG,C}$ (31.68 m3/100km), N_2O emission factor (0.101g/km, IPCC 2006, Volume 2, Chapter 3, Table 3.2.4) and GWP of N_2O (310)

Table A6. Total consumption of CNG by project

Parameter	2012	2013	2014	2015	2016	2017	2018

CNG consumption (m^3)	6,852,656	7,195,289	7,555,053	7,932,806	8,329,446	8,745,919	9,183,214

A.2.3. Results

Table A7. Project Emissions

Parameter	unit	2012	2013	2014	2015	2016	2017	2018
Total project emissions	**tCO_2**	17,723	18,609	19,539	20,516	21,542	22,619	23,750

A.3. LEAKAGE EMISSIONS

A.3.1. Formulae

$$ROC_{i,y} = \frac{OC_{i,y}}{CV_{i,y}}$$

Where:

$ROC_{i,y}$ = Average occupancy rate relative to capacity in category *i* in year y, where *i* = Z (buses) or T (taxis)
$OC_{i,y}$ = Average occupancy of vehicle in category *i* in year *y* (persons)
$CV_{i,y}$ = Average capacity of vehicle *i* in year *y* (persons)

$$LE_{LF,Z,y} = EF_{KM,Z} \times VD_Z \times N_{Z,y} \times \left(1 - \frac{ROC_{Z,y}}{ROC_{Z,0}}\right)$$

Where:

$LE_{LF,Z,y}$ = Leakage emissions from change of load factor in buses in year *y* (tCO_2e)
$EF_{KM,z}$ = Baseline transport emissions factor per distance for buses (gCO_2e per kilometer)
VD_Z = Annual distance driven per vehicle for buses before the project start, determined *ex ante* (kilometres)
$N_{Z,y}$ = Number of buses in the conventional transport system operating in year *y* (buses)
$ROC_{Z,y}$ = Average occupancy rate relative to capacity of conventional buses in year *y*, based on the most recent study of occupancy rates
$ROC_{Z,0}$ = Average occupancy rate relative to capacity of buses before start of project

$$VD_Z = \frac{\sum_{k=S,M,L} DD_{Z,k}}{\sum_{k=S,M,L} N_{Z,k}}$$

Where:

VD_Z = Distance driven per bus before the project start (kilometres)
$DD_{Z,k}$ = Total distance driven by buses of size *k* (kilometers)

$N_{Z,k}$ = Number of buses in the conventional transport system of size *k*

$$LE_{LF,T,y} = EF_{KM,T} \times VD_T \times N_{T,y} \times \left(1 - \frac{OC_{T,y}}{OC_{T,0}}\right)$$

Where:

$LE_{LF,T,y}$ = Leakage emissions from change of load factor in taxis in year *y* (tCO_2e)
$EF_{KM,T}$ = Transport emissions factor per distance of taxi baseline (tCO_2e per kilometer)
VD_T = Distance driven per taxi on average before the project starts (kilometres)
$N_{T,y}$ = Number of taxis operating in year *y* (taxis)
$OC_{T,y}$ = Average occupancy rate of taxi for the year *y* (passengers only: driver not counted)
$OC_{T,0}$ = Average occupancy rate of taxi before project start (passengers only: driver not counted)

$$ARS_y = \sum_{w=1...y} \frac{BSCR_w}{N_Z} \times SRS - \frac{RSB - RSP}{RSB}$$

Where:

ARS_y = Additional road space available in year *y* (in percentage)
$BSCR_w$ = Bus units scrapped by project in year *w*, where *w* = 1 to *y* (NB: if buses are not scrapped the estimated amount of retired buses is taken)
N_Z = Number of buses in use in the baseline (buses)
SRS = Share of road space used by public transport in the baseline (percentage)
RSB = Total road space available in the baseline (kilometres)
RSP = Total available road space in the project (= RSB minus kilometre of lanes that where reduced due to dedicated bus lanes) (kilometres)

$$SRS = \frac{DD_Z}{DD_Z + DD_T + DD_C}$$

Where:

SRS = Share of road space used by public transport in the baseline (in percentage)
DD_Z = Total distance driven by public transport buses baseline (kilometers)

DD_T = Total distance driven in kilometers by taxis baseline (kilometers)
DD_C = Total distance driven in kilometers by passenger cars baseline (kilometers)

(*Note: According to the methodology, the above formula is used to determine SRS in the absence of recent and good quality study which has calculated SRS.*)

$$LE_{TRIPS,y} = ITR \times ARS_y \times TR_C \times TD_C \times EF_{KM,C} \times D_y$$

Where:
$LE_{TRIPS,y}$ = Leakage emissions from additional and/or longer trips in year *y* (tCO_2e)
ITR = Elasticity factor for additional and/or longer trips: the factor is fixed at 0.1
ARS_y = Additional road space available (percentage)
TR_C = Number of daily trips realized by passenger cars baseline (trips)
TD_C = Average trip distance for passenger cars (kilometers)
$EF_{KM,C}$ = Transport emissions factor per distance of passenger cars before the project start (gCO_2e/km)
D_y = Number of days buses operate in year *y* (days)

$$LE_{SP,y} = TR_C \times TD_C \times \left[EF_{KM,VP,C} - EF_{KM,VB,C}\right] \times DW_y$$

Where:
$LE_{SP,y}$ = Leakage emissions from change in vehicle speed in year *y* (tCO_2e)
TR_C = Number of daily trips realized by passenger cars baseline (trips)
TD_C = Average trip distance driven by passenger cars (kilometers)
$EF_{KM,VP,C}$ = Transport emissions factor per distance for passenger cars at project speed (gCO_2 / km)
$EF_{KM,VB,C}$ = Transport emissions factor per distance for passenger cars at baseline speed (gCO_2 / km)
DW_y = Number of days per year in year *y*

$$EF_{KM,m,C} = 135.44 - 2.314 \times V + 0.0144 \times V^2$$

Where:
$EF_{KM,m,C}$ = Transport emissions factor per distance for passenger cars traveling at speed *m* (gCO_2 / km)

V = Vehicle speed (km/h); calculated both for the project speed (VP) and baseline speed (VB)

$$LE_{CONG,y} = LE_{TRIPS,y} + LE_{SP,y}$$

Where:

$LE_{CONG,y}$ = Leakage emissions from reduced congestion in year *y* (tCO_2e)

$LE_{TRIPS,y}$ = Leakage emissions from additional and/or longer trips in year *y* (tCO_2e)

$LE_{SP,y}$ = Leakage emissions from change in vehicle speed in year *y* (tCO_2e)

$$LE_y = LE_{LF,Z,y} + LE_{LF,T,y} + LE_{CONG,y}$$

Where:

LE_y = Emissions leakage in year *y* (tCO_2e)

$LE_{LF,Z,y}$ = Leakage emissions from change of load factor in buses in year *y* (tCO_2e)

$LE_{LF,T,y}$ = Leakage emissions from change of load factor in taxis in year *y* (tCO_2e)

$LE_{CONG,y}$ = Leakage emissions from reduced congestion in year *y* (tCO_2e)

A.3.2. Parameters

Table A8. Parameters for determining leakage emissions

Parameter	Definition	Value	Unit	Source
$N_{Z,y}$	Number of buses in the conventional transport system operating in year *y*	2,130	buses	Lanzhou Public Traffic Group. This parameter is to be monitored.
$N_{T,y}$	Number of taxis operating in year *y*	6,738	taxis	Lanzhou Traffic Bureau. This parameter is to be monitored.
VD_Z	Distance driven per bus before the project start	67,142	km	Lanzhou Public Traffic Group
VD_T	Distance driven per taxi on average before the project starts	110,000	km	Lanzhou Traffic Bureau
$ROC_{Z,0}$	Average occupancy rate relative to capacity of buses before start of project	34.69%	--	Baseline Traffic Survey
$ROC_{Z,y}$	Average occupancy rate relative to capacity of conventional	34.69%	--	To be monitored. Same data as $ROC_{Z,0}$ is taken

	buses in year *y*			as no significant variation is envisaged.
$OC_{T,0}$	Average occupancy rate of taxi before project start	1.08	passenger	Baseline Traffic Survey
$OC_{T,y}$	Average occupancy rate of taxi for the year *y*	1.08	passenger	To be monitored. Same data as $OC_{T,0}$ is taken as no significant variation is envisaged.
SRS	Share of road space used by public transport in the baseline	6.15%	--	Calculated based on DD_Z, DD_T, and DD_C.
DD_Z	Total distance driven by public transport buses baseline	143,013,462	kilometre	Lanzhou Public Traffic Group
DD_T	Total distance driven by taxis baseline	741,180,000	kilometre	Calculated based on N_T in the baseline (6,738 taxis, Lanzhou Traffic Bureau), VD_T (110,000km, Lanzhou Traffic Bureau).
DD_C	Total distance driven in kilometers by passenger cars baseline	1,439,502,362	kilometre	Calculated based on N_C in the baseline (142,341 passenger cars, Traffic Division of Lanzhou Public Security Bureau), average number of daily trips per passenger car (2.69 trips, Baseline Traffic Survey), TD_C (10.3km, Baseline Traffic Survey) and number of days per year (365 days).
RSB	Total road space available in the baseline	446.62	kilometre	Lanzhou Municipal Engineering Administration Department;
RSP	Total available road space in the project	434.32	kilometre	Lanzhou Municipal Engineering Administration Department; Lanzhou BRT Project Feasibility Study Report
$BSCR_w$	Bus units scrapped by project in year *w*, where *w* = 1 to *y* (NB: if buses are not scrapped the estimated amount of retired buses is taken)	Table A9	buses	Lanzhou Public Traffic Group
ITR	Elasticity factor for additional and/or longer trips	0.1	none	Appendix A of AM0031
TD_C	Average trip distance of passenger cars in baseline	10.3	km	Baseline Traffic Survey
N_C	Total number of passenger cars in baseline	142,341	passenger cars	Traffic Division of Lanzhou Public Security Bureau
TR_C	Number of daily trips realized by passenger cars baseline	382,897	trips	Calculated based on N_C in the baseline (142,341 passenger cars, Traffic Division of Lanzhou Public Security Bureau), average number of daily trips per passenger car (2.69 trips, Baseline Traffic Survey)
V_B	Vehicle speed under baseline scenario	39.45	km/h	Baseline Traffic Survey

V_P	Vehicle speed under project scenario	Not available	km/h	Not available. According to AM0031, if the project has no data on speed changes or current speed, then it is assumed that the speed impact is equal to 0. Therefore, LF_{SP} is taken as 0.

Table A9. Parameters related to impact of congestion

	2012	2013	2014	2015	2016	2017	2018
RSB – RSP (km)	12.3	12.3	12.3	12.3	12.3	12.3	12.3
$BSCR_W$ (buses)	257	354	612	887	1002	1265	1502
ARS (%)	-0.020	-0.017	-0.010	-0.002	0.001	0.009	0.016

Table A10. Comparison of gaseous fuel consumption under baseline scenario and project scenario

	2012	2013	2014	2015	2016	2017	2018
CNG consumption by baseline buses (m3)	5,601,274	5,863,458	6,119,837	6,370,503	6,615,543	6,855,046	7,089,097
CNG consumption by baseline taxis (m3)	2,478,308	2,594,312	2,707,748	2,818,656	2,927,075	3,033,044	3,136,601
CNG consumption by project buses (m3)	6,852,656	7,195,289	7,555,053	7,932,806	8,329,446	8,745,919	9,183,214
Baseline - Project > 0	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE

A.3.3. Results

Table A11. Total Leakage

	unit	2012	2013	2014	2015	2016	2017	2018
Change of load factor in buses ($LE_{LF,Z,y}$)	tCO_2e	0	0	0	0	0	0	0
Change of load factor in taxis ($LE_{LF,T,y}$)	tCO_2e	0	0	0	0	0	0	0
Rebound effect ($LE_{TRIPS,y}$)	tCO_2e	-531	-457	-261	-52	35	236	416
Speed effect ($LE_{SP,y}$)	tCO_2e	0	0	0	0	0	0	0
Upstream emissions of gaseous fuels ($LE_{UP,y}$)	tCO_2e	0	0	0	0	0	0	0
Total leakage emissions (LE_y)	**tCO_2e**	**0**	**0**	**0**	**0**	**35**	**236**	**416**

(Note: according to AM0031, for the sake of a conservative approach, leakage is only considered if the total annual effect is to reduce estimated emission reductions. Therefore, the negative total leakage emissions are taken as 0.)

A.4. EMISSION REDUCTIONS

A.4.1. Formulae

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y = Emission reductions in year *y* (tCO_2e)
BE_y = Baseline emissions in year *y* (tCO_2e)
PE_y = Project emissions in year *y* (tCO_2e)
LE_y = Leakage emissions in year *y* (tCO_2e)

A.4.2. Results

Table A12. Emission Reductions

Parameter	Unit	2012	2013	2014	2015	2016	2017	2018	Total
Baseline emissions	tCO_2e	29,112	30,476	31,810	33,114	34,389	35,635	36,854	231,389
Project emissions	tCO_2e	17,723	18,609	19,539	20,516	21,542	22,619	23,750	144,300
Leakage emissions	tCO_2e	0	0	0	0	35	236	416	687
Emission Reductions	**tCO_2e**	**11,389**	**11,867**	**12,270**	**12,597**	**12,811**	**12,780**	**12,687**	**86,402**

A.5. SENSITIVITY ANALYSIS

In accordance with the methodology, a sensitivity analysis is carried out for data and parameters, which are used to calculate baseline as well as project emissions (at minimum where uncertainty level of data is considered moderate or high). To ensure a holistic study, the sensitivity analysis of this project is applied to all parameters in relation to baseline emissions and project emissions that are listed in Section B.6.2 and Section B.7.1 of this PDD. Parameters using IPCC value or default values given by the methodology are not included in the analysis. The sensitivity analysis is performed by calculating the level of change of the identified data and parameters that would be required to reduce emission reduction by 5% below the original estimation.

Table A13: Sensitivity Analysis

Parameter	Definition	Original value	Change required for 5% reduction of ER	Comment
Project Emissions				
$TC_{PJ,x,y}$	Total consumption of CNG by project in year "y"	Table A6	0.71%	As defined by AM0031, the uncertainty level of data of this parameter is low. The calculation result suggests that the ER is likely to be sensitive to the change of total consumption of CNG by the project. However, the data of fuel consumption used for ex-ante estimation purpose is from the project feasibility study report (FSR), which is the best available reference prior to the operation of the BRT system. Moreover, over the crediting period, this parameter will be monitored on monthly basis by referring to gas filling records of BRT buses (100% monitoring rather than sampling) and be cross-checked against the parameters of specific energy consumption of CNG (SEC) and total distance driven by BRT buses (DD) for the purpose of QA/QC. While the actual operation of BRT system is most likely to vary considerably as compared to what is originally planned and designed because of various factors, through well-performed monitoring and QA/QC procedures, the total fuel consumption of BRT buses, along with other parameters related to BRT operation and maintenance, will fully record such variations and thus make sure no discrepancy would exist between actual and monitored operation of the BRT. In summary, the data for ex-ante estimation is of high precision and reliability and the quality of data for ex-post calculation of project emissions will be well

				controlled through QA/QC procedures of monitoring. Justifiably it can be concluded that the actual amount of total CNG consumption by BRT system in year "y" being different from the monitored amount in the same year will be highly improbable.
Baseline Emissions				
P_y	Total passengers transported by the project (BRT)	Table A4	-1.27%	As defined by AM0031, the uncertainty level of data of this parameter is low. The calculation result suggests that the ER is likely to be sensitive to the change of passengers transported by the project. However, the data of total passengers used for ex-ante estimation purpose is from the project feasibility study report (FSR), which is the best available reference prior to the operation of the BRT system. Moreover, over the crediting period, this parameter will be monitored by referring to the entry statistics of transit management unit and be cross-checked with records of ticket sales for the purpose of QA/QC. While the actual operation of BRT system is most likely to vary considerably as compared to what is originally planned and designed because of various factors, through well-performed monitoring and QA/QC procedures, the total passengers transported by BRT, along with other parameters related to BRT operation and maintenance, will fully record such variations and thus make sure no discrepancy would exist between actual and monitored operation of the BRT. In summary, the data for ex-ante estimation is of high precision and reliability and the quality of data for ex-post calculation of baseline emissions will be well controlled through QA/QC procedures of monitoring. Justifiably it can be concluded that the actual amount of passengers transported by BRT system in year "y" being different from the monitored amount in the same year will be highly improbable.
$SEC_{G,C}$	Specific energy consumption of gasoline by passenger cars	7.84 l/100km	-6.34%	As defined by AM0031, the uncertainty level of data of this parameter is medium. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, this data is based on on-site traffic survey statistics without the top 20% of samples. Moreover, it is considerably lower than that given by the afore-mentioned international literature titled "China's Fuel

				Economy Standards for Passenger Vehicles" published by Harvard Kennedy School. It shall be pointed out that Chongqing BRT, being the first registered BRT-based CDM project in China, uses the data of 8.5 l/100km as given by the "China's Fuel Economy Standards for Passenger Vehicles". Being also in western China, Chongqing can be regarded as a comparable city to Lanzhou. In this regard, Lanzhou using 7.84 l/100km as opposed to Chongqing using 8.5 l/100km is conservative. Conservativeness is further strengthened by applying the technology improvement factor on annual basis to the parameter Therefore the change of this parameter between actual and monitored values by as much as 6.34% leading to 5% reduction of ER is highly improbable.
$SEC_{CNG,T}$	Specific energy consumption of CNG by taxis	8.0 m^3/100km	-11.13%	As defined by AM0031, the uncertainty level of data of this parameter is medium. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, this data is based on statistic from actual operation of taxis as provided by local government authority (Lanzhou Traffic Bureau) and therefore is of high precision and reliability. Conservativeness is ensured by applying 8.0m^3/100km of new taxis to all taxis irrespective of actual ages of many taxis operating in Lanzhou and further strengthened by applying the technology improvement factor on annual basis to the parameter. Note that Chongqing BRT also uses 8.0m^3/100km based on records of local taxi company. Therefore the change of this parameter between actual and monitored values by as much as 11.13% leading to 5% reduction of ER is highly improbable.
$SEC_{G,M}$	Specific energy consumption of gasoline by motorcycles	2.2 l/100km	>-100%	The ER is not sensitive to the change of this parameter.
$SEC_{CNG,Z}$	Specific energy consumption of CNG by buses	31.41 m^3/100km	-3.48%	As defined by AM0031, the uncertainty level of data of this parameter is medium. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, this data is based on statistics from operation of all buses in 2010 as provided by Lanzhou Public Traffic Group and therefore is of

				high precision and reliability. Conservativeness is ensured by applying the technology improvement factor on annual basis to the parameter. Note that Chongqing BRT uses 32.7 m^3/100km, suggesting that it is conservative to use 31.41 m^3/100km for Lanzhou as a comparable city in western China. Therefore the change of this parameter between actual and monitored values by 3.48% leading to 5% reduction of ER is highly improbable.
OC_C	Average occupancy rate of passenger cars	1.71 passengers	6.69%	As defined by AM0031, the uncertainty level of data of this parameter is medium. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, based on extensive on-site traffic survey, the data is of high precision and reliability as the survey was realized by following the relevant guideline of methodology and duly taking into account local circumstance. The statistical requirements of 95% confidence level and maximum 5% error margin are complied with. Moreover, the upper bound of 95% confidence interval calculated based on surveyed data is taken, for the purpose of conservativeness. Therefore the change of this parameter between actual and ex-ante surveyed values (or between actual and ex-post monitored values) by 6.69% leading to 5% reduction of ER is highly improbable.
OC_T	Average occupancy rate of taxis	1.08 passengers	10.63%	As defined by AM0031, the uncertainty level of data of this parameter is medium. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, based on extensive on-site traffic survey, the data is of high precision and reliability as the survey was realized by following the relevant guideline of methodology and duly taking into account local circumstance. The statistical requirements of 95% confidence level and maximum 5% error margin are complied with. Moreover, the upper bound of 95% confidence interval calculated based on surveyed data is taken, for the purpose of conservativeness. This parameter is to be monitored in year 3 and 7 of the first 7-year crediting period by applying the same survey methodology as under baseline scenario.

				Therefore the change of this parameter between actual and monitored values by 10.63% leading to 5% reduction of ER is highly improbable.
OC_M	Average occupancy rate of motorcycles	1.51 passengers	>100%	The ER is not sensitive to the change of this parameter.
TD_C	Average trip distance of passenger cars	10.3 km	-6.18%	As defined by AM0031, the uncertainty level of data of this parameter is low. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, this data is based on on-site traffic survey realized by following the relevant guideline of methodology and duly taking into account local circumstance. This parameter is to be monitored through on-site questionnaire-based survey undertaken, at the minimum frequency of once every 2 months, by independent organization with recognized qualifications by following implementation plan established on the basis of the general principles and specific guidelines given by AM0031. Only if the monitored parameter is lower than the original one ($TD_{C,y} < TD_C$), the monitored data will be used to adjust the baseline emission factor of passenger cars. Therefore, reliability and conservativeness of data is ensured and the change of this parameter between actual and monitored values by 6.18% leading to 5% reduction of ER is highly improbable.
TD_T	Average trip distance of taxis	6.79 km	-9.62%	As defined by AM0031, the uncertainty level of data of this parameter is low. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, this data is based on on-site traffic survey realized by following the relevant guideline of methodology and duly taking into account local circumstance. This parameter is to be monitored through on-site questionnaire-based survey undertaken, at the minimum frequency of once every 2 months, by independent organization with recognized qualifications by following implementation plan

				established on the basis of the general principles and specific guidelines given by AM0031. Only if the monitored parameter is lower than the original one ($TD_{T,y}$ < TD_T), the monitored data will be used to adjust the baseline emission factor of taxis. Therefore, reliability and conservativeness of data is ensured and the change of this parameter between actual and monitored values by 9.62% leading to 5% reduction of ER is highly improbable.
TD_M	Average trip distance of motorcycles	5.99 km	>-100%	The ER is not sensitive to the change of this parameter.
P_Z	Passenger-trips realized with buses in the baseline	402,319,193 passenger trips	3.86%	As defined by AM0031, the uncertainty level of data of this parameter is low. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, the data is based on the statistics on actual operation of 2010 as provided by Lanzhou Public Traffic Group and average usage of buses per trip realized by bus passenger as obtained through on-site traffic survey based on large samples, both of which are the best available data sources prior to the operation of the BRT system. Justifiably it can be concluded that the actual amount of passengers-trips realized with buses in the baseline being different from the data presented here will be highly improbable. Therefore, reliability of data is ensured and the change of this parameter by 3.86% leading to 5% reduction of ER is highly improbable.
DD_Z	Total distance driven by all buses in the baseline	143,013,462 km	-3.71%	As defined by AM0031, the uncertainty level of data of this parameter is medium. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, the data is based on the statistics on actual operation of 2010 as provided by Lanzhou Public Traffic Group, which is the best available data source prior to the operation of the BRT system. Justifiably it can be concluded that the actual amount of total distance driven by all buses in the baseline being different from the data presented here will be highly improbable.

				Therefore, reliability of data is ensured and the change of this parameter by 3.71% leading to 5% reduction of ER is highly improbable.
S_Z	Share of passengers using buses for the baseline trip	Table A2	-3.71%	As defined by AM0031, the uncertainty level of data of this parameter is low. The calculation result suggests that the ER is likely to be moderately sensitive to the change of this parameter. However, the data used for ex-ante estimation purpose is from the on-site baseline traffic survey, which is the best available data source prior to the operation of the BRT system. Moreover, over the crediting period, this parameter will be monitored through monthly on-site questionnaire-based survey undertaken, at the minimum frequency of once every 2 months, by independent organization with recognized qualifications by following implementation plan established on the basis of the general principles and specific guidelines given by AM0031. In doing so, the survey results will be representative and therefore the surveyed share of passengers using buses for the baseline trip being different from the actual value will be highly improbable.
S_C	Share of passengers using cars for the baseline trip	Table A2	-6.28%	Ditto.
S_T	Share of passengers using taxis for the baseline trip	Table A2	-9.61%	Ditto
S_M	Share of passengers using motorcycles for the baseline trip	Table A2	>-100%	The ER is not sensitive to the change of this parameter.

Annex 4

MONITORING INFORMATION

A. Survey Methodology and Implementation Plan of Occupancy Rate of Taxis ($OC_{T,y}$)[63]

In accordance with the "Guideline for the establishment of load factor studies for taxis" given by AM0031, the same methodology shall be used for the load factor study performed prior to the project as during the monitoring. The methodology and implementation plan presented here, as a draft, refers primarily to that under the baseline traffic survey which was carried out by following the relevant principle and guideline of AM0031 and duly taking into account local circumstance in Lanzhou[64].

Survey frequency	Year 3 and 7 of the first 7-year crediting period.
Survey period	Monday to Friday, daily peak hours (07:30-09:00 / 17:30 - 19:00) and non-peak hours (09:30-11:00 / 15:00-16:30)
Survey locations	A total of 16 survey locations: Anning District: Intersections between Wangfu Hotel and Anning West Road, Taohai Market and Anning West Road, Wanxin Road and Anning West Road, Changxin Road and Anning East Road, Baoshihua Road and Jianning Road, Changxin Road and North Binhe Road. Chengguan District: Intersections between Zhongshan Road and Zhangye Road, Jiuquan Road and Qingyang Road; Crossing to the east of Dongfanghong Square; Intersection between Tianshui Road and Lanzhou Railway Station Qilihe District: Intersection between Dunhuang Road and Huoxing Street; Crossing near Qilihe Bridge; Intersection between Xiuchuan Road and Xijin West Road. Xigu District: Intersection between Fuli Road and Park Road, Intersection between Fuli Road and Xianfeng Road, Intersection between Xiguzhong Road and Yumen Street.
Survey methods and procedures to be applied:	At 16 locations, visual counting of occupancy rates of taxis will be carried out. This is to be done by, at a certain checkpoint of each survey location, over the 4 time periods continuously counting and recording the number and passengers of taxis crossing the checkpoint. The coverage of taxis crossing each specific checkpoint shall be 95% at minimum. 100% coverage is desired. Taxi driver is not counted. Taxis without passengers are counted as "0"

[63] This is a draft subject to changes prior to actual survey activities in crediting period.

[64] According to AM0031, locations of monitoring can change as traffic flows in cities change over time. Other parameters of the study (duration, sample size, counting method etc) however should remain constant to ensure consistency and comparability of studies.

	occupancy rate. Only circulating taxis are counted. The sampling size of the survey is expected to be more than 20,000.

B. Survey Methodology and Implementation Plan of Occupancy Rate of Buses ($ROC_{Z,y}$)[65]

In accordance with the "Guideline for the establishment of load factor studies for buses" given by AM0031, the same methodology shall be used for the load factor study performed prior to the project as during the monitoring. The methodology and implementation plan presented here, as a draft, refers primarily to that under the baseline traffic survey which was carried out by following the relevant principle and guideline of AM0031 and duly taking into account local circumstance in Lanzhou.

Survey frequency	Year 3 and 7 of the first 7-year crediting period.
Survey period	Tuesday to Thursday, daily 7:30 – 19:30, continuously over 12 hours
Survey locations	A total of 16 survey locations: Anning District: East entrance of intersection between Wangfu Hotel and Anning West Road, East entrance of intersection between Wanxin Road and Anning West Road, East entrance of intersection between Changxin Road and Anning East Road, East entrance of intersection between Baoshihua Road and Jianning Road, East entrance of intersection between Changxin Road and North Binhe Road, vicinity of the entrance of Anning District Justice Bureau. Chengguan District: South entrance of intersection between Zhongshan Road and Zhangye Road, East entrance of intersection between Jiuquan Road and Qingyang Road; East entrance of the crossing to the east of Dongfanghong Square; North entrance of intersection between Tianshui Road and Lanzhou Railway Station Qilihe District: South entrance of intersection between Dunhuang Road and Huoxing Street; East entrace of the crossing near Qilihe Bridge; East entrance of intersection between Xiuchuan Road and Xijin West Road. Xigu District: South entrance of intersection between Fuli Road and Park Road, East entrance of intersection between Fuli Road and Xianfeng Road, East entrance of intersection between Xiguzhong Road and Yumen Street.
Survey methods and procedures to be applied:	Visual counting of occupancy rates of buses will be carried out. This is to be done by, at a certain checkpoint of each location, over 12 hours continuously counting and recording the number and passengers of key bus fleets crossing the checkpoint. The counting and recording of numbers of buses and passengers in the buses shall be done separately by 2 surveyors at each checkpoint.

[65] This is a draft subject to changes prior to actual survey activities in crediting period.

	Data and information to be obtained shall include: (1) Counting of buses (2) Counting of occupancy rate (quantity of passengers) of each target bus. (3) Route numbers of bus fleets

C. Survey Methodology and Implementation Plan of Mode of Transport ($S_{i,y}$)[66]

The on-site questionnaire-based survey shall be conducted, at the minimum frequency of once every 2 months in a year during crediting period, based on a representative survey of all passengers of the BRT system. The categories of transport modes include public transport (conventional buses), taxis, passenger cars, motorcycles, non-motorized transport (e.g. bicycles and pedestrian) and induced traffic (i.e. passengers would not have made the trip in the absence of the BRT). The relative distribution is measured and the absolute numbers are calculated based on total passengers transported by the BRT. Additionally, per specific transport mode (taxis, passenger cars, motorcycles) the passengers are asked for their trip origins and destinations to calculate distance travelled for the purpose of tracking potential changes. For passengers who would have used passenger cars in absence of the BRT system, they will be further inquired about the fuel types of their passenger cars.

Basic principles and requirements

- The survey must be realized with maximum 5% error margin and a 95% confidence interval. The sampling size is determined by the 95% confidence interval and the 5% maximum error margin;
- Sampling must be statistically robust and relevant i.e. the survey has a random distribution and is representative of the persons using the BRT system;
- The methodology to select persons for interviews is based on a systematic random sampling based on the flow of passengers per station per day per hour (i.e., the number of persons to be interviewed randomly per bus station and per hour per day is based on the total flow of passengers per station-day-hour to have a representative sample);
- Only persons over age 12 are interviewed;
- Minimum bi-monthly and preferably monthly surveys are to be realized to avoid any problems due to varying usage dependent on month of use (e.g. vacations);

QA/QC of data collection, processing and reporting

- The survey shall be implemented by an external organization (preferably academic/research institution) specialized in transport and with proven track record in implementing traffic survey activities;
- Training on surveyors conducting the questionnaire-based survey is to be provided by the above-mentioned survey implementation agency. The training must be based on standard questionnaire techniques and QA/QC procedures;

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[66] This is a draft subject to changes prior to actual survey activities in crediting period.

- Prior to formal monitoring, a test-run survey using the same questionnaire and following the same principles, requirements and QA/QC procedures shall be carried out for the purpose of ensuring questionnaire's design and understandability and surveyor's ability to apply it;
- Control questions shall be incorporated into the questionnaire to ensure validity and conservativeness of the survey results;
- Target population of survey shall be passengers waiting for boarding at BRT stations. Surveying passengers alighting buses shall be avoided in order to minimize potentially biased answers to questions due to unwillingness in investing time.
- All original questionnaires used for survey shall be well stored and backup shall be made in the forms of photocopies and scanned copies.
- For conservativeness and quality of data, questionnaires in which surveyed passengers tick "No" to the control questions (2a, 3a, 4a) shall be regarded as being non-consistent and thus be removed from final counting.
- A report is issued for each survey indicating all collected data.
- A survey report shall be prepared using same template following each survey. Survey results, data analysis conclusions and implications to parameters related to baseline emissions shall be presented and elaborated in an articulate manner in the report.

The questionnaire to be used for survey of mode of transport ($S_{i,y}$) of Lanzhou BRT is presented as follows[67].

Interviewer:……………………………
Date:..………………………………….
Time:…………………………………….
Bus identification (BRT line, bus station):………………………………

"Assuming that the bus system you are currently using would not exist: What mode of transport would you have used for this specific trip you are doing currently".

For the interviewer:

- *The question is related to this specific trip and not to the trips realized by the person during the year in general;*
- *To clarify, mention that you are comparing the BRT system with the conventional public transport system;*
- *Persons which cannot relate it to any mode of transport are taken as induced traffic (conservative default parameter).*

Multiple-choice **answers**

[67] This is a draft developed based on the default questionnaire of the methodology and thus subject to changes prior to actual survey activities in crediting period.

(Only tick one; if the passenger would have used more than one transport mode for the trip he/she is realizing currently then tick the mode which involves the longest distance):

1. Conventional bus based public transport (rather than BRT) → the survey is finished;
2. Passenger car → please go to 2A;
3. Taxi → please go to 3A;
4. Motorcycle → please go to 4A;
5. NMT (per foot or bicycle);
6. I would not have made the trip (induced traffic) → please go to 5

If the passenger responds with the answer 2 then ask:

2A. Do you or your family own a car or do you have access to a car (e.g. car-sharing)?

☐ NO ☐ YES

If the passenger responds with NO this specific questionnaire is deemed as non-consistent and removed from the final counting

2B. What fuel type does the car use to which you have access?

☐ gasoline ☐ diesel ☐ gas (CNG or LPG) ☐ electric ☐ I don't know ☐ other: which:………………………………………….

2C. What is the starting point of your trip (origin) and which is the final (destination) point? Please name the station or location where you first boarded a bus and where you will make the final stop?

For the interviewer: Please advise the passenger that the original departing and final point is required. This may include bus trans-boarding. It is thus the origin and final destination of the passenger trip and not of the ride on this specific bus-line.

Origin (departing point): ……………………………………………………
Destination (final point): ……………………………………………………

→ the survey is finished.

If the passenger responds with the answer 3 then ask:

3A. Have you used in the last 12 months a taxi?

☐ NO ☐ YES

If the passenger responds with NO this specific questionnaire is deemed as non-consistent and removed from the final counting

3B. What is the starting point of your trip (origin) and which is the final (destination) point? Please name the station or location where you first boarded a bus and where you will make the final stop?

For the interviewer: Please advise the passenger that the original departing and final point is required. This may include bus trans-boarding. It is thus the origin and final destination of the passenger trip and not of the ride on this specific bus-line.

Origin (departing point): ……………………………………………………
Destination (final point): ……………………………………………………

→ the survey is finished.

If the passenger responds with the answer 4 then ask:

4A. Do you or your family own a motorcycle or do you have access to a motorcycle?

☐ NO ☐ YES

If the passenger responds with NO this specific questionnaire is deemed as non-consistent and removed from the final counting

4B. What is the starting point of your trip (origin) and which is the final (destination) point? Please name the station or location where you first boarded a bus and where you will make the final stop?

For the interviewer: Please advise the passenger that the original departing and final point is required. This may include bus trans-boarding. It is thus the origin and final destination of the passenger trip and not of the ride on this specific bus-line.

Origin (departing point): ……………………………………………………
Destination (final point): ……………………………………………………

→ the survey is finished.

5. If the passenger responds with induced traffic (he/she would not have made the trip in absence of the BRT), control questions are necessary to be asked in order to ascertain that the passenger can be counted as induced traffic:
5A. Without the BRT, would you have stayed at home? *If the answer is NO, it is NOT induced traffic*
5B. Do you make this trip due only to the BRT? *If the answer is NO, it is NOT induced traffic*
5C. Will you immediately return back after this trip with the BRT or will you do something at the destination such as work or school? *If the answer is NO, it is NOT induced traffic*

→ the survey is finished.

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